Information Systems

A Manager's Guide to Harnessing Technology
Version 7.0

John Gallaugher

Created exclusively for Brooke Baer <baerb@rpi.edu>

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Information Systems: A Manager's Guide to Harnessing Technology
Version 7.0

John Gallaugher

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About the Author



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Professor John Gallaugher has led student learning experiences on five continents. Part of the founding faculty for Boston College's TechTrek programs, and former co-lead of the school's graduate field studies in Europe and Asia, Professor Gallaugher has had remarkable access to effectively study technology growth and its impact worldwide. Professor Gallaugher and his students spend several weeks each year visiting technology executives, entrepreneurs, and venture capitalists in San Francisco, Silicon Valley, Seattle, Boston, New York, and Ghana, and are regularly hosted in master-class sessions at firms from Amazon to Zynga. This unique opportunity helps give his teaching and writing a broad, deep, and continually refreshed perspective on key industry trends and developments. He is the author of the award-winning, annually updated textbook *Information Systems: A Manager's Guide to Harnessing Technology*, as well as *Learn to Program Using Swift for iOS Development*, an online book featuring over 100 video lessons that progressively teaches coding and app-building skills to new-to-programming students. Professor Gallaugher's research has appeared in the *Harvard Business Review*, *MIS Quarterly*, and other leading journals.

Named "Guru to Grads" by *Entrepreneur* magazine, Gallaugher has also received the Boston College Trzaska Faculty Leadership Award, the all-university Teaching Award, and the student newspaper's Momentum Award for campus impact. During his time on the leadership team of the Boston College Venture Competition (BCVC), entrepreneurs affiliated with the program gained admittance to elite startup accelerators (Y-combinator, TechStars, MassChallenge, Summer@Highland), launched multiple products, and raised over $100 million in capital. Professor Gallaugher has been a featured speaker at Apple Inc.'s AcademiX educator conference, and was the international keynote speaker at AIBUMA (the African International Business and Management Conference) in Nairobi, Kenya. He has consulted for and taught executive seminars for several organizations, including Accenture, Alcoa, Duke Corporate Education, ING, Partners Healthcare, Staples, State Street, the University of Ulster, and the U.S. Information Agency. His comments on business and technology have appeared in the *New York Times*, National Public Radio, *BusinessWeek*, the *Boston Globe*, *Wired*, the Associated Press, *Chronicle* (WCVB-TV), *The Daily Yomiuri* (Japan), and the *Nation* (Thailand), among others.

A member of the Information Systems Department at BC's Carroll School of Management, Professor Gallaugher earned his Ph.D. in Information Systems from the Syracuse University School of Management, and he holds an MBA and an undergraduate degree in computer science, both from Boston College. He shares additional content related to his teaching and research at http://gallaugher.com, and is also active on Twitter at @gallaugher.

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- Sascha Vitzthum, Illinois Wesleyan University

I'll continue to share what I hope are useful insights via my blog, The Week In Geek (http://www.gallaugher.com), Twitter (**@gallaugher**), and Google+ (https://plus.google.com/+JohnGallaugher). Do feel free to offer comments, encouragement, ideas, and examples for future versions. I am hugely appreciative of all who continue to share the word about this project with others. Your continued advocacy helps make this model work! Want to learn to program and build apps? Check out the online learning resource at http://gallaugher.com/swift. Professors, it's a great way to offer a high-impact, light-lifting technical course in a flipped-class model, and it also works well for online learning, independent study, as well as for a traditional lecture-driven programming course.

Boston College students Courtney Scrib and Nate Dyer also pointed me to examples I've used in this edition, as did ACU student Aaron Andrew. Thanks for thinking of me and for sharing your very useful ideas!

And finally, a thanks to my family, to whom I've dedicated this book. That really doesn't do a shred of justice to my great fortune in being Kim's husband and father to Ian, Maya, and Lily. You've been especially tolerant of the time commitment associated with my publishing projects. You are my world.

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Dedication

For Ian, Maya, Lily, and Kim—yottabytes of love!

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Preface

WHAT'S NEW IN VERSION 7.0

While the text is updated each year, the goal is to strike a balance that keeps concepts current, fresh, and exciting while minimizing re-prep by limiting larger changes only to important concepts, chapters, and cases. Every chapter received at least some refresh of examples and stats. Below is a list of some of the more notable changes.

Chapter 1—Setting the Stage: Technology and the Modern Enterprise

- New Video—"13 of the smartest Artificial Intelligence companies according to MIT"
- New Video—"Drones Deliver Medical Supplies in Rwanda"
- Two new videos in exercises useful for class discussions:
    - New Video—"AI on Track to Achieve Superintelligence?" (World Economic Forum). Mentions several issues including potential bias in data/models.
    - New Video—"3D Printing Spurring Revolutionary Advances in Manufacturing and Design" (PBS NewsHour). Useful to set the stage for possible industry disruption, opportunity, and changing nature of work.

Chapter 4—Netflix in Two Acts: Sustaining Leadership in an Epic Shift from Atoms to Bits

- Updated info on topics including the Netflix model, pricing, and stats on DVD profitability (Why don't they close DVD? Hint: it's still a cash cow.)
- New info on cable subscribers (all decreasing) vs. Netflix continued growth
- Disney as threat to Netflix (comparable content spend, NFLX briefly worth more than DIS)
- Updated "Exclusives and Original Content" subsection: updated stats/examples, firm's suggestion that data influences show success rate at NFLX (80%) vs. traditional shows (30-40%). Mention breadth of talent bench has helped the firm endure scandals: Spacy, Ansari, C.K.
- New Chart—"Streaming in US Households"
- New Chart—"Netflix Domestic/International Subscriber Mix"
- New Chart—"Non-Sports Original Content Spending in $Billion"
- Added information on French laws and Netflix Canne backout, expansion and growth
- Added "ProTip for the Technical" in "So What's It Take to Run This Thing?" Provides links to technical blogs at various firms studied: Airbnb, Amazon, Facebook, Google, Uber, Rent the Runway

Chapter 5—Moore's Law and More: Fast, Cheap Computing, and What This Means for the Manager

- Added teachable moment via photo and callout of the Bravo Reflux Capsule—a sensor and communication device implanted above my stomach last Spring to test for damaging heartburn
- Updated "e-Waste: The Dark Side of Moore's Law" section: China's shift in recycling laws, and the infamous world's largest recycling facility in Ghana

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- New Video—"Conditions in the e-Waste Capital of the World: Has Guiyu Finally Shaken Off the Title of World's e-waste Capital?" (SCMP)
- New Video—"Apple's Daisy: The Robot That Recycles iPhones" (replaces Liam)

Chapter 6—Disruptive Technologies: Understanding Giant Killers and Tactics to Avoid Extinction

- Relate prior chapter discussion on machine learning tech (GPUs, FPGAs) as firms with scale invest in custom (mostly AI/machine learning-focused) chips
- Significant update for sub-section "From Bitcoin to Blockchain and Beyond: A Disruptive Innovation for Money and More?"
    - New Video—Introduction to Blockchain Technology
    - New Subsection—"Examples of Blockchain in Action": covers financial to supply chain to IP verification (Nasdaq, IBM, Overstock, Spotify, Kodak among them)
    - New Callout—"Tastes Like Blockchain": discusses blockchain for food supply tracking w/example of chicken tracking used by French retail giant, Carrefour. Stats on the impact of this effort are offered, along with similar efforts in an IBM consortia that includes Tyson and Walmart, and a WWF effort coupled with RFID that focuses on tuna tracking.
    - New chart—"Bitcoin Price Fluctuation from January 1, 2016 through May 25, 2018" (Bitcoin price volatility)
    - New Video—"A Look Inside an Initial Coin Offering: What Happens at a Crypto ICO" (Bloomberg)
    - Info on Bitcoin forking—Bitcoin Cash

Chapter 7—Amazon: An Empire Stretching from Cardboard Box to Kindle to Cloud

- Updated info on Amazon's now consistent profitability, relating this to investments for scale advantages and platform businesses. Brief mention of JPMorgan, Berkshire Hathaway healthcare partnership.
- New Video—"Amazon-Owned Businesses" (CNN Money); also shows images of the Bezos 10,000 year clock
- Updated Chart—"Cash Conversion Cycle (in Days) among Select Major Retailers" (Amazon's negative cash conversion cycle vs. rivals)
- Added newly released info on Prime customer base (100 million)
- Added info on new billion-dollar: B2B (vs. Staples, Grainger) > 1 million US B2B customers
- New Video—"Amazon Business" (discusses B2B biz and competition with impact on Grainger & other industrial distributors)
- Updated info on Amazon's ad biz: $1.7 billion in 2017 sales, up 60 percent y2y
- New Section—"The Lord of Logistics"
    - Builds on increased content detailing Amazon's logistics biz and their use of data to optimize routing choice, selling delivery to third-parties. Info on the Ring acquisition (smart doorbell, locks). Info on current value of shipping loss.
    - New Video—"Amazon Key In-Car Service" (GM/Volvo partnership, rollout in 37 US cities)
- Updated section "Beyond Clicks: More Bricks"
    - Updated info on rollout of Amazon Books physical stores
    - New Video link—"Amazon Books Chief: Why We Opened Brick-and-mortar Bookstores"

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- More information on Whole Foods integration, synergies with other businesses, results since acquisition. Updated info on Amazon Go rollout in subsection "Hello Machine Learning, Goodbye Checkout Line."
- New Video—"Amazon Go: How does Amazon Go work?"

- Updated section "Amazon's Disruptive Consumer Hardware Businesses: Kindle, Fire, Alexa, and More"
  - Updated stats on various Amazon devices, new partnerships (Kindle, Fire, FireTV)
  - New section—"Echo, Alexa, and the Breakout Success of Amazon's Voice Interface and AI-powered Assistant" (status of platform, partnerships, Auto, Alexa for Business, extent of competition in US and Int'l)
  - Updated information on Amazon imprints, publishing business (growth vs. eBooks in general), original content (comparison with Netflix)
  - Added more Twitch info: League of Legends Championship audience was bigger than the finales of Breaking Bad, 24, and The Sopranos combined; NFL Streaming
- Updated section "Amazon and the Cloud: From Personal Storage to AWS"
  - Updated stats on size, growth (would be Fortune 167 on its own, contributes the majority of Amazon profit)
  - Warren Buffett: "I have never seen any person develop two really important industries at the same time and really be the operational guy in both... You do not want to give Jeff Bezos a 7-year head start."

Chapter 8—Platforms, Network Effects, and Competing in a Winner-Take-All World

- Refreshed stats and examples in chapter
- New Video—"Overview of Apple's HomeKit: 20 New HomeKit Features in iOS 11" (features + partners, emphasizing platform)

Chapter 9—Social Media, Peer Production, and Leveraging the Crowd

- Updated latest stats and added new examples: most-downloaded apps/newcomers Tik Tok, Musically, Fortnite
- New Table—"Top 11 Social Platforms" (Worldwide 2018)
- Discussion of paid, earned, owned media
- Replaced previous virality in advertising video example (Old Spice Man) with New Video—"Dollar Shave Club Viral Video"
- New Video—"Wiki use at Kiva.org"
- New Video—"The Future of Work": hear Slack co-founder Stewart Butterfield discuss "The Future of Work" and how his firm improves on e-mail for organizational coordination
- Significant update of "Twitter and the Rise of Microblogging" section:
  - New subsection—"Tackling Trolls, Battling Bots"
  - Decreased coverage of Twitter as developer platform—sold Fabric/Crashlytics to Google. Jack Dorsey's appeal for customer input re: troll/civility problems on Twitter.
  - Updating of financial position/profits. Info and images of "Bespoke Emoji" advertising.
- New subsection—"Blockchain for Better and Unrestricted Prediction Markets"
- New Video—"Introduction to the Augur Platform" (prediction market using blockchain technology)
- "Crowdsourcing" section now mentions Google's purchase of Kaggle
- New Callout—"Walmart Finds Big Data Experts from Crowdsourced Contests": hired a senior data scientist in charge of "Data Cafe" effort from a Kaggle contest

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- SMART: United Breaks Guitars still mentioned, but video is replaced
    - New Video—"American Airlines Flight Attendant Suspended After Altercation With Passenger": highlights American & United problems, customer service/behavior expectations in the age of social media, and firm response
- New Example: Uber CEO caught on dash-cam
- Book-wide change of "dark web" to "deep web"

Chapter 10—The Sharing Economy, Collaborative Consumption, and Efficient Markets through Tech

- Updated stats and new examples (Marriott home sharing), mergers and consolidation, valuations
- New subsection—"Share Everything? The Myth of the Market for Your Neighbor's Power Drill": Allows for discussion of liquidity, difference between positively received elevator pitch and proof of product-market fit and actual market traction
- Refreshed "Airbnb—Hey Stranger, Why Don't You Stay at My Place?"
- Major updates to "Uber's Wild Ride: Sharing Economy Success, and Lessons From a Fallen Founder"
    - New Callout—"From Rebel to Revulsion: When Uber Behavior Became Hostile and Required Big Change": Not only on toxic culture and fall of Kalanick, also delay in exposing hack (issue for current CEO Khosrowshahi's). Impact on Lyft vs. Uber.
    - Mention of APIs and integration in UberHealth initiative: Uber Health, offers APIs for healthcare scheduling products. Appointment skipping about 30%, with the reason "no available ride" often cited as reason for missing care.
    - New Video—"Softbank Acquires Stake in Uber at Discounted Valuation": panel discussion of Softbank's Uber stake purchased at a discount due to behavior/culture
    - New Video—"First Look at Uber Air" (first look at Uber Air flying taxi prototype)
    - New Video—"Who Is Competing with Uber?" (CNBC)
    - New link—Uber Engineering Blogpost: Link to a fascinating blog post showing data visualizations from Uber, animated GIFs and videos.

Chapter 11—Facebook: Platforms, Privacy, and Big Business from the Social Graph

- Updated stats, deemphasize earlier concerns about profitability, emphasize strength of mobile business (90% of revenue vs. $0 at IPO)
- New Chart—"Largest Firms by Market Cap"
- Less coverage of desktop dominance, more on mobile. Added info on Facebook Dating.
- New Video—"Facebook Dating: Facebook Launches Dating Feature"
- New Subsection—"Snapping Snapchat's Lead with Stories": Leading with Stories as a platform (integration of Spotify, Musical.ly, GoPro & others)
- Discussed Palmer Luckey's departure (trolling behavior)
- Updated Section—"So What's It Take to Run This Thing?"
- New Video—"Swedish Facebook Data Center: This Is Where All of Your Facebook Photos Go" (tour of Swedish Data Center, CNBC)
- Less emphasis on early desktop platform problems and cut bit on errant app partners
- New Subsection—"Learning from the Cambridge Analytica Scandal: Errant Apps, Privacy Protection and the Challenges of Running a Platform"
- New Video—"The Cambridge Analytica Scandal Explained"
- New Video—"Zuckerberg's Congressional Hearing on April 10, 2018"
- Updated WeChat/Weixin example: MAU growth chart, platform success, payments in China

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- Corrects David Marcus running Messenger; he's now heading Facebook's Blockchain business (former President of PayPal)
- Removed aging info on TOS struggles, smaller problems with app partners
- New Video—"The Hidden Ways Facebook Ads Target You: Everything You Need to Know About How Facebook Targets You" (Vice)
- Deemphasize hunt vs. hike and emphasized new ads and mobile ad success in "Advertising and Social Networks: A Challenging Landscape but a Big Payoff" section
- New Section—"Move Fast and Breaks Things: Fumbles, Fake News, and Global Growth Challenges" (humans, machine learning, third party partners, crowdsourcing)
- New Video—"Fake News: How a Hard-Partying Macedonian Teen Earns Thousands Publishing Lies" (CNBC)
- New Video—"Facebook's Fight Against Misinformation: Facing Facts, An Inside Look at Facebook's Fight Against Misinformation"
- Updated and reworked content on Internet.org now: "The Admirable Goals and Unintended Consequences of Internet.org"

Chapter 12—Rent the Runway: Entrepreneurs Expanding an Industry by Blending Tech with Fashion

- Updated stats on firm, customer size, new Texas distribution facility, 9 million customers, Jenn Hyman now on board of Estee Lauder
- Added a stat that 90% of the new customers that the firm acquired last year were through word of mouth
- Neiman Marcus Partnership; Ann Taylor competition
- More information on the subscription business (now biggest contributor to revenue): Why it has been successful; How it is distinctly different from, but complements, the dress rental business
- New Video—"Rent the Runway Co-Founder and CEO Jennifer Hyman at the Code Commerce Conference"
- New Video—"Inside a Rent the Runway 'Dream Fulfillment Center'"

Chapter 13—Understanding Software: A Primer for Managers

- Updated stats, changed several examples to keep them current (e.g. Nintendo Switch, Philips Hue lighting)
- Refreshed information on writing software: state of Java, frameworks, IDEs, languages mentions Google's Kotlin
- New Callout—"Want to Learn More?": directing students to build an iOS app in the free first three chapters of the video-centric Swift/iOS book
- New Section—"Software Development Methodologies: From Waning Waterfall to Ascending Agile, plus a Sprint through Scrum"
- New Video—"Scrum in Two Minutes"

Chapter 14—Software in Flux: Open Source, Cloud, Virtualized, and App-Driven Shifts

- Updated stats, streamlined content
- Refreshed open source examples: TensorFlow, Docker, MongoDB
- Newer firms leveraging OSS: Hortonworks, Cloudera, MapR, and ascendant (MongoDB, Docker)
- New Callout—"Clouds in Action: A Snapshot of Diverse Efforts": includes Cloudera/Thomson Reuters fighting fake news and Google/Airbus improving the interpretation of satellite images

Chapter 15—Data and Competitive Advantage: Databases, Analytics, AI and Machine Learning

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- Stats refreshed throughout: size of data acceleration, data captured and used by leading firms
- Exercises added—encourage students to identify and share sites where they can acquire skills such as SQL and analytics; encourage students to find out what firms such as Facebook and Google have collected on them, how they are classified, to prep for a class discussion on merit vs. risk of data aggregation
- Updated Callout—"Who's Collecting Data about You?": especially in light of the Equifax breach (covered in Chapter 17) and Cambridge Analytica (covered in Chapter 11)
- Updated Callout—"Airbnb: Better Pricing Through Data"
- Updated Callout—"Spotify: Your DJ in the Cloud": included machine learning for "Discover Weekly," acquisition of a blockchain firm for rights management
- New Section—"Artificial Intelligence, Big Data and Machine Learning: It's Now Everywhere!"
    - Mentions AI, machine learning, deep learning, supervised/unsupervised
    - New Video—"How Smart Is Today's AI: How Machines Learn" (CGP Grey)
    - New Callout—"Own an Apple product? You're Already Using a Whole Lot of AI"
    - New Video—"How Smart is Today's Artificial Intellgence?" (Vox): interesting illustrations, current examples, discusses limitations, raises privacy and other concerns
    - Prior content on expert systems, neural networks, genetic algorithms is included
    - New Subsection—"Examples of AI in Action"
    - New Subsection—"It's Not as Easy as the Press Might State: Technical, Organizational, Legal, and Societal Challenges of AI and Machine Learning"
    - New Callout—"Catching the Golden State Killer: The Promise & Peril of Big Data's Reach"
- Updated "Data Asset in Action: Technology and the Rise of Walmart"
    - Updated information on Walmart's Data Cafe, current infrastructure stats, and emphasis on e-commerce work (acquisitions: Jet.com, Bonobos, and ShoeBuy, Flipkart for Indian market)
    - New Video—"Walmart Flipkart Deal"

Chapter 16—A Manager's Guide to the Internet and Telecommunications

- Mentions importance of https and how firms like Google offer a search results rankings boost; Apple filters non "s" http calls from its apps
- Removed link to inactive gTLD map
- Updated info on current state of sTLDs and gTLD
- Replaced Yahoo service examples with Google
- Updated current information in high frequency trading discussion and added exercise question
- Refreshed information on speed of Internet infrastructure and bandwidth requirements for HD and 4k streaming
- Refreshed info on O3b (satellite), CSquared (formerly Google ProjectLink in Africa) and added info on satellite efforts from OneWeb and SpaceX
- Updated section—"Net neutrality: What's Fair?" (added information about changes under the Trump Administration, uncertainty moving forward)
- Removed much of the discussion of 3G technologies; added a new discussion of 5G technologies

Chapter 17—Information Security: Barbarians at the Gateway (and Just About Everywhere Else)

- Equifax case starts the chapter

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- Refreshed stats on cybercrime and impact, crime marketplaces, replaced some of the older descriptive examples with more current ones
- New hack examples: improved buffer overflow explanation, recent Ransomware examples
- New Callout—"City of Atlanta Ransomware Hack Related to Bitcoin Miners"
- Link to information on Defcon conference for those curious about learning more
- Added info on Russian election interference to cyber warfare discussion
- Updated diagrams to keep them current
- New Video—"How Bots and Trolls Targeted US Elections"
- New Video—"60 Minutes Shows How Easily Your Phone Can Be Hacked"
- New Video—"Could Your Smart Home Be Hacked?"

Chapter 18—Google in Three Parts: Search, Online Advertising, and an Alphabet of Opportunity

- Updated stats and charts and added information on one-trick-pony Alphabet's "other billion-dollar tricks"
- New focus on "AI First"
- New Video—"CEO Sundair Pichai Discusses Google as an "AI First" Company" (with examples)
- New stats on search, indexing, capital spending
- Refresh of information in "What's It Take to Run This Thing?"
- New Video—"How Google Search Works"
- Refreshed subsection "Search: Google Rules, but It Ain't Over": removed Wolfram Alpha and decreased semantic web discussion, increased example of search by camera lens and voice search (comparing w/rivals)
- New Video—"Google Lens: Google Lens New Features Hands-On" (Several neat examples: identifying clothing someone is wearing and linking this to purchase opportunities; instant translation of menus, street signs, or other text)
- Refreshed "How Big Is Too big" to include latest on EU's fines against Alphabet
- Project Loon used to provide service in hurricane-ravaged Puerto Rico
- Refreshed info on Android, Chromebooks, Google Pay (formerly AndroidPay)
- Google Glass/AR section framed with pivot in 2017's launch of "Glass Enterprise Edition"
- Refreshed information in YouTube: cut old pieces, since departed YouTubers; added new info on content spending for YouTube Red
- Included discussion on firms struggles from hate speech to fake news, to $12 million-a-year; Logan Paul's flippant post of a dead suicide victim
- Example of warning accompanying video source (e.g. Russia Today—government affiliated)
- New Video—"Highlights from Google CEO Sundar Pichai's Keynote at the 2018 Google I/O Developer Conference": nice overview of AI/ML-rich Google (mostly consumer) products, also includes a more gender-balanced group of tech leaders

New Definitions

Several terms were updated or introduced and linked as keywords in the text, including: agile development, bandwidth, blockchain, ccTLDs, cryptocurrencies, dark web, deep learning, deep Web, elevator pitch, feature creep, First-Sale Doctrine, geographic TLDs, goodwill, liquidity, OTT (Over The Top), scrum, social media, software development methodologies, sTLDs, unicorn, voice-print, waterfall, and windowing.

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LETTER FROM THE AUTHOR

Thanks for using this book. I very much hope that you enjoy it!

I find the space where business and technology meet to be tremendously exciting. The information systems (IS) course should be the most exciting class within any university. No discipline is having a greater impact on restructuring work, disrupting industries, and creating opportunity. And none more prominently features young people as leaders and visionaries. But far too often, students resist rather than embrace the study of tech.

My university has had great success restructuring the way we teach our IS core courses, and much of the material used in this approach has made it into this book. The results we've seen include a four-fold increase in IS enrollments in four years, stellar student ratings for the IS core course, a jump in student placement, an increase in the number of employers recruiting on campus for tech-focused jobs, and the launch of several student-initiated startups.

Material in this book is used at both the graduate and undergraduate levels. I think it's a mistake to classify books as focused on just grad or undergrad students. After all, we'd expect our students at all levels to be able to leverage articles in the *Wall Street Journal* or *BusinessWeek*. Why can't our textbooks be equally useful?

You'll also find this work to be written in an unconventional style for a textbook, but hey, why be boring? Let's face it, *Fortune* and *Wired* wouldn't survive if forced to write with the dry, encyclopedic prose used by most textbooks. Many students and faculty have written kind words about the tone and writing style used in this book, and it's been incredibly rewarding to hear from students who claim they have actually looked forward to assigned readings and have even read ahead or explored unassigned chapters. I hope that you find this book to be engaging, as well.

The mix of chapter and cases is also meant to provide a holistic view of how technology and business interrelate. Don't look for an "international" chapter, an "ethics" chapter, a "mobile" chapter, or a "systems development and deployment" chapter. Instead, you'll see these topics woven throughout many of our cases and within chapter examples. This is how professionals encounter these topics "in the wild," so we ought to study them not in isolation but as integrated parts of real-world examples. Examples are consumer-focused and Internet-heavy for approachability, but the topics themselves are applicable far beyond the context presented.

Also note that many chapters are meant to be covered across multiple classes. For example, the chapter about Google is in three parts, the one about Netflix is in two, and the one on strategy and technology likely covers more than one lecture as well. Faculty should feel free to pick and choose topics most relevant to their classes, but many will also benefit from the breadth of coverage provided throughout the book. I'd prefer our students to be armed with a comprehensive understanding of topics rather than merely a cursory overview of one siloed area.

There's a lot that's different about this approach, but a lot that's worked exceptionally well, too. I hope that you find the material to be as useful as we have. I also look forward to continually improving this work, and I encourage you to share your ideas with me via Twitter (@gallaugher), Google+ (https://plus.google.com/+JohnGallaugher), or the Web (http://www.gallaugher.com). And if you find the material useful, do let others know, as well. I remain extremely grateful for your interest and support!

Best wishes!

Professor John Gallaugher

Carroll School of Management

Boston College

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CHAPTER 1

Setting the Stage: Technology and the Modern Enterprise

1.1 Tech's Tectonic Shift: Radically Changing Business Landscapes

Learning Objective

1. Appreciate how, in recent years, technology has helped bring about radical changes across industries and throughout societies.

This book is written for a world that has changed radically in the most recent years of your lifetime. Consider just a few examples: Uber, the world's largest "taxi service," owns no vehicles for hire. Airbnb, the world's largest accommodations provider, doesn't own a single hotel or rental property. Facebook, the world's most visited media destination, creates no content. And the world's most valuable retailer, China's Alibaba, owns no product inventory of its own.[1] Change is clearly afoot, and it's wearing silicon sneakers, carrying a smartphone, and is being blown forward by cloud-fueled, AI-smart hurricane tailwinds.

Here are some more examples: At the start of the prior decade, Google barely existed and well-known strategists dismissed Internet advertising models.[2] By decade's end, Google brought in more advertising revenue than any firm, online or off, and had risen to become the most profitable media company on the planet. Today, billions in advertising dollars flee old media and are pouring into digital efforts, and this shift is reshaping industries and redefining skills needed to reach today's consumers. The firm's ambitions have grown so large that Google has rechristened itself Alphabet (http://abc.xyz), a holding company with divisions focused on markets as diverse as driverless cars and life extension.

At roughly the same time Google was being hatched, Apple was widely considered a tech industry has-been, but within ten years and powered by a succession of handheld consumer electronics hits (iPod, iPhone, iPad), Apple had grown to be the most valuable firm in the United States. The firm has since posted several of the most profitable quarters of any firm in any industry, ever.[3] If app sales through iTunes, alone, were considered a separate business, they would constitute a firm larger than *more than half* of the companies ranked in the Fortune 500.[4]

The smartphone and app store are the modern accelerant of business growth. It took telephones seventy-five years to get to 50 million users, but it took Angry Birds just thirty-five days to do the same. WhatsApp gained 700 million adherents in its six years of existence, a figure Christianity took nineteen centuries to achieve.[5]

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Social media barely warranted a mention a decade ago. Today, Facebook's user base is larger than any nation in the world. Mobile is its lynchpin. Facebook made no money on mobile when it first sold stock to the public, but today Mobile represents over 90 percent of Facebook's revenue.[6] Firms are harnessing social media for new product ideas, for millions in sales, and to vet and build trust. But with promise comes peril. When mobile phones are cameras just a short hop from YouTube, Facebook, Instagram, and Twitter, every ethical lapse can be captured, every customer service flaw graffiti-tagged on the permanent record that is the Internet. The service and ethics bar for today's manager has never been higher. Social media has also emerged as a catalyst for global change, with Facebook and Twitter playing key organizing roles in uprisings worldwide. While a status update alone won't depose a dictator or expunge racism, technology can capture injustice, broadcast it to the world, disseminate ideas, and rally the far-reaching. Yet technology itself has no morality. We've seen leading social media firms struggle as their platforms are used to spread hate, pornography, and fake news in ways that enrich organized crime and enable the influence of hostile foreign governments.

Moore's Law and other factors that make technology faster and cheaper have thrust computing and telecommunications into the hands of billions in ways that are both empowering the poor and poisoning the planet.

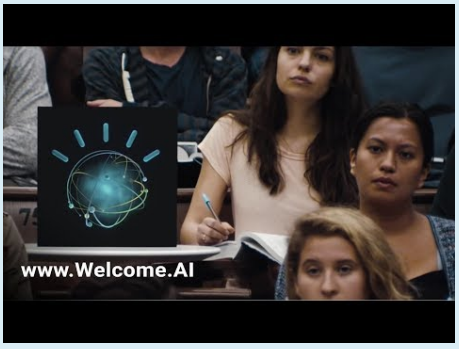
IPO

Initial public stock offering, the first time a firm makes shares available via a public stock exchange, also known as "going public."

China started the century as a nation largely unplugged and offline. But today, China has more Internet users than any other country, and China has emerged as a clear leader in smartphone payments. As of this writing, four of the ten most downloaded apps were Chinese.[7] In the first ten months of 2017, Chinese consumers spent $12.8 trillion through mobile payments (that's trillion with a "t") vs. an only $50 billion full-year total in the US.[8] China has spectacularly launched several publicly traded Internet firms that now have market caps and profits to match their US rivals, including Baidu, Tencent, and Alibaba—the largest **IPO** of all time.[9]

13 of the Smartest Artificial Intelligence Companies According to MIT

Video listing some of the global leaders in AI, and the projects they are working on. Note the diversity of industry, as well as where these firms are located. For another take on AI, see the video in the Exercises section, and prepare for additional learning in the chapter The Data Asset and Competitive Advantage: Databases, Analytics, AI, and Machine Learning.



View the video online at: http://www.youtube.com/embed/I4qM33A2OH8?rel=0

The world's second most populous nation, India, has ridden technology to become a global IT powerhouse. In two decades, India's tech sector has grown from almost nothing to a $120 billion industry, expanding even during the recent global recession.[10] Technology has enabled the once almost exclusively agrarian nation to become a go-to destination for R&D and engineering across sectors as far-flung as aircraft engine design, medical devices, telecom equipment, and microproces-

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sors.[11] India's TCS (Tata Consulting Services) is the world's number two technology solutions firm, second in size only to IBM.[12] India has half a billion mobile Internet users.[13] And India's consumer e-commerce sector is growing so quickly that Walmart recently won a high-stakes bidding war against Amazon, paying $16 billion for a 77 percent stake in India's FlipKart, a leader in S. Asian online shopping and payments.[14]

Think the United States holds the top ranking in Internet access speeds? Not so much. The United States didn't even make the top 25 nations in mobile download performance (but Bulgaria, Malta, Lithuania, and Macedonia are among the countries that did). The US did better in fixed broadband (landline connections like cable), but the nations ahead of the US included Hungary and Romania.[15]

Today, smartphones are used by 2 billion people worldwide. By the end of this decade that number will be 4 billion, with 80 percent of adults being smartphone equipped. The most popular brand in India, Micromax, sells entry-level smartphones priced below $40.[16]

Even in the far reaches of nations in sub-Saharan Africa, fast/cheap tech is becoming an economic lubricant. Seventy percent of the region's population lives within range of mobile phone coverage, a percentage of the population greater than those who have access to reliable and safe water or electricity. Forty percent of sub-Saharan Africans already have mobile phones.[17] Tech giants including Google, IBM, and Microsoft now run R&D centers and significant operations in several African nations, tapping into world-class tech talent that's finally gaining infrastructure for growth.[18] Many nations in sub-Saharan Africa now rank among the world's fastest-growing economies.[19] And entrepreneurs with local expertise are increasingly serving local needs and building impactful businesses. Ghanaian firm Esoko leverages mobile phones to empower the agrarian poor with farming info and commodity pricing, raising incomes and lowering the chance of exploitation by unscrupulous middlemen. The firm Sproxil uses text message verification to save lives by fighting drug counterfeiting in developing nations around the world. Kenya's M-PESA and Somaliland's Zaad use text messages to replace cash, bringing the safety and speed of electronic payment and funds transfer to the unbanked and leveraging mobile money at rates that far outstrip any nation in the West.[20] Adoption rates are astonishing: 84 percent of adults in Tanzania use mobile phones for money transactions.[21] Mobile money can cut corruption, too, an effort with broad implications as this tech spreads worldwide. When Afghan police officers adopted M-PESA and began receiving pay using mobile money, many reportedly thought they had received a big raise because the officers handing out their pay were no longer able to cheat workers by skimming cash for themselves.[22]

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FIGURE 1.1
Many nations in sub-Saharan Africa are seeing significant tech-fueled growth. Throughout the continent, technologies substitute for cash, deliver insights to farmers, and help uncover counterfeit pharmaceuticals. This plant in Accra, owned by Ghanaian firm Rlg, is the first sub-Saharan PC, tablet, and cell phone assembly facility.



Source: Photograph taken by Prof. John Gallaugher with permission of the Rlg plant.

Internet of Things

A vision where low-cost sensors, processors, and communication are embedded into a wide array of products and our environment, allowing a vast network to collect data, analyze input, and automatically coordinate collective action.

Fast/cheap computing is also helping create the multibillion dollar **Internet of Things** (IoT), putting smarts in all sorts of products: lamps, watches, thermostats, and door locks. Disney has embedded smarts in a wristband it uses to replace ticketing at Disney World. GE thinks sensors and computing will save the planet trillions of dollars through a hyper-efficient, data-driven, collectively orchestrated set of devices,[23] and has embedded smarts in everything from home air conditioners to high-end aircraft parts.[24] Think the smartphone market is big? There are already more so-called Internet of Things (IoT)–connected devices than the entire world population of humans, and that number is only growing.[25]

Cheap processors and software smarts are also powering the drone revolution with far-reaching impact. Today's farmers use drones to regularly survey crops at closer distances and with greater regularity than satellite or plane flight could ever match. A combination of conventional and infrared imagery can show irrigation variation, crop success, plant damage, fungal and insect infestations, and offer other insights to improve crop yields, stave off crises, improve farmer profits, and cut consumer costs. Today's agricultural drones can be purchased for less than $1,000, as compared with agricultural plane flights that cost more than $1,000 an hour.[26] And while Amazon and rivals race to replace UPS with drone-to-doorstep delivery, Silicon Valley's Zipline is leading the charge for the humanitarian community, delivering medical supplies and blood to remote regions of the world (rural Rwanda is up first), offering lifesaving packages at pizza-delivery speed.[27]

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Drones Deliver Medical Supplies in Rwanda

Tech for good: The startup Zipline is one of many organizations working to leverage cheap, accurate drones to quickly and cost-effectively deliver medical supplies to remote, underserved communities.



View the video online at: http://www.youtube.com/embed/nnKnMgWy_tM?rel=0

The way we conceive of software and the software industry is also changing radically. Apple, Facebook, Google, IBM, Netflix, and Oracle are among the firms that collectively pay thousands of programmers to write code that is then given away for free. Today, open source software powers most of the websites that you visit. And the rise of open source has rewritten the revenue models for the computing industry and lowered computing costs for startups to blue chips worldwide.

Cloud computing and software as a service are turning sophisticated, high-powered computing into a utility available to even the smallest businesses and nonprofits. Amazon Web Services, by far the world's biggest provider of cloud computing services, has been adding about as much server capacity each day as its entire e-commerce parent required ten years earlier.[28]

Three-dimensional printers, which allow designs for fabrication to be shared as easily as an e-mail, are poised to reshape manufacturing and transportation. Crafts marketplace Etsy is full of artist-created and custom-printed products, from jewelry to cookie cutters,[29] and this technology has also been used to print tools on-demand for the international space station.[30]

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FIGURE 1.2
An astronaut shows a tool produced on-demand using a 3D printer on the International Space Station.



Source: NASA

Many organizations today collect and seek insights from massive datasets, which are often referred to as "Big Data." Data analytics, business intelligence, and so-called machine-learning are driving discovery and innovation, redefining modern marketing, and creating a shifting knife-edge of privacy concerns that can shred corporate reputations if mishandled.

And the pervasiveness of computing has created a set of security and espionage threats unimaginable to the prior generation.

As recent years have shown, tech creates both treasure and tumult. While tech creates new Giants, also know that half of the Fortune 500 companies on the list in 2000 have fallen off since then as a result of mergers, acquisitions, and bankruptcies.[31] These disruptions aren't going away and will almost certainly accelerate, impacting organizations, careers, and job functions throughout your lifetime. It's time to place tech at the center of the managerial playbook.

Key Takeaways

- In the previous decade, tech firms have created profound shifts in the way firms advertise and individuals and organizations communicate.
- New technologies have fueled globalization, redefined our concepts of software and computing, crushed costs, fueled data-driven decision-making, and raised privacy and security concerns.

Questions and Exercises

1. Search online and compare profits from Google, Apple, and other leading tech firms with those of major media firms and other nontech industry leaders. How have profits at firms such as Google and Apple changed over the past few years? What do you think is behind such trends? How do these compare with changes in the nontech firms that you chose?
2. How do recent changes in computing impact consumers? Are these changes good or bad? Explain. How do they impact businesses?

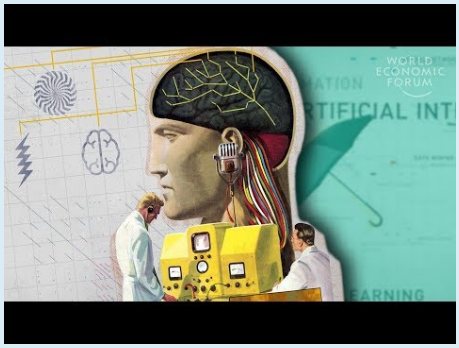
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3. Serial entrepreneur and venture capitalist Marc Andreessen has written that "software is eating the world," suggesting that software and computing are transforming entire industries and creating disruptive new upstarts. Come to class with examples of firms and industries that have been completely transformed through the use of software.
4. Venture capitalist Ben Evans, who works with Andreessen, has said "mobile is eating the world." Give examples of how mobile has built billion dollar industries that wouldn't exist without handheld computing power. How should today's managers be thinking about mobile as an opportunity and threat?
5. How is social media impacting firms, individuals, and society?
6. What kinds of skills do today's managers need that weren't required a decade ago?
7. Investigate the role of technology in emerging markets. Come to class with examples to share on how technology is helping fuel economic growth and provide economic opportunity and public good to consumers outside of North America, Europe, and Asia's wealthier nations.
8. Work with your instructor to identify and implement ways in which your class can leverage social media. For example, you might create a Facebook group where you can share ideas with your classmates, join Twitter and create a hashtag for your class, leverage Google Hangouts, create a course wiki, or start a Slack channel. (See Chapter 9 for more on these and other services.)
9. Watch the video below, produced by the World Economic Forum. Is Artificial Intelligence (AI) really intelligence? What makes AI "smarter"? Which nations lead in AI and why? What advantages does each have? What sort of balance can be struck between fearing AI, regulating AI, and harnessing AI? Give examples of how AI can be used in business.

AI on Track to Achieving Super Intelligence?

This video from the World Economic Forum highlights the global AI race, what powers AI, concerns and benefits of AI, and short examples of how AI is being used today.



View the video online at: http://www.youtube.com/embed/Ls1_tqlpMww?rel=0

10. Watch this video on how 3D printing is spurring advances in manufacturing. How are technologies like this poised to influence the economy, society, and the jobs of the future? Work with classmates to brainstorm on ways in which 3D printing can benefit society.

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3D Printing Spurring Revolutionary Advances in Manufacturing and Design

This video from PBS News Hour discusses how 3D printing is spurring revolutionary advances in manufacturing and design. Watch massive metal printers build rocket engines and fuel tanks.



View the video online at: http://www.youtube.com/embed/Adl1Sn86ojs?rel=0

1.2 It's Your Revolution

Learning Objective

1. Name firms across hardware, software, and Internet businesses that were founded by people in their twenties (or younger).

The intersection where technology and business meet is both terrifying and exhilarating. But if you're under the age of thirty, realize that this is *your* space. While the fortunes of any individual or firm rise and fall over time, it's abundantly clear that many of the world's most successful technology firms—organizations that have had tremendous impact on consumers and businesses across industries—were created by young people. Consider just a few:

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Bill Gates was an undergraduate when he left college to found Microsoft—a firm that would eventually become the world's largest software firm and catapult Gates to the top of the *Forbes* list of world's wealthiest people (enabling him to also become the most generous philanthropist of our time).

Michael Dell was just a sophomore when he began building computers in his dorm room at the University of Texas. His firm would one day claim the top spot among PC manufacturers worldwide.

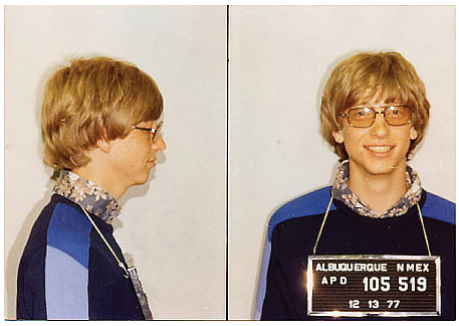
Mark Zuckerberg founded Facebook as a nineteen-year-old college sophomore.

Steve Jobs was just twenty-one when he founded Apple.

Sergey Brin and Larry Page were both twenty-something doctoral students at Stanford University when they founded Google. So were Jerry Yang and David Filo of Yahoo! All would become billionaires.

Kevin Systrom was twenty-six when he founded the photo-sharing service Instagram. In just eighteen months, his thirteen-person startup garnered 35 million users worldwide, including 5 million Android users in just a single week, and was sold to Facebook for a cool $1 billion. Systrom's take was $400 million.[32] Snapchat founder Evan Spiegel dropped out of college to focus on his new firm. By age twenty-four he was running a firm valued at over $15 billion[33] with a personal net worth of over $1.5 billion.[34] Tony Hsieh proved his entrepreneurial chops when, at twenty-four, he sold LinkExchange to Microsoft for over a quarter of a billion dollars.[35] He'd later serve as CEO of Zappos, eventually selling that firm to Amazon for $900 million.[36]

FIGURE 1.3
Wealth accumulation wasn't the only fast-paced activity for young Bill Gates. The Microsoft founder appears in a mug shot for a New Mexico traffic violation. Microsoft, now headquartered in Washington state, had its roots in New Mexico when Gates and partner Paul Allen moved there to be near early PC maker Altair.



Source: Wikimedia Commons.

Steve Chen and Chad Hurley of YouTube were in their late twenties when they launched their firms. Jeff Bezos hadn't yet reached thirty when he began working on what would eventually become Amazon. The founders of Dropbox, Box, and Spotify were all under thirty when they founded businesses that would go on to be worth billions.[37] The founders of Rent the Runway, Jenn Hyman and Jenny Fleiss, were in their twenties and still in grad school when they launched the firm that is recasting how millions of consumers engage with high-end designer apparel and accessories. And just a few years out of undergrad, dancer and fitness enthusiast Payal Kadakia launched ClassPass, a service allowing customers to take fitness classes from multiple providers. Today the firm is valued at over $400 million, more than the firm behind the New York, Boston, Washington DC, and Philadelphia Sports Clubs.[38]

David Karp was another early bloomer. Karp wasn't just another college dropout; he actually quit high school for self-paced, tech-focused home schooling. It was a good move: He was taking meetings with venture capitalists at twenty, went on to found what would become one of the world's most visited websites, and sold that website, Tumblr, to Yahoo! for $1.1 billion at an age when he was younger than most MBA students.[39] Another young home-schooler, Palmer Luckey, started "modding" video game controllers at age fifteen, founded Oculus as a teenager, and sold it to Facebook for $2 billion (that's two Instagrams) by age twenty-one, and all before his company had even shipped its first consumer product.[40] In another brilliant sign of the times, Luckey jump-started his effort not by gaining investment from angel investors or venture capitalists, who would demand an ownership stake in his business, but from a Kickstarter campaign. Hoping to raise $250,000, Luckey's Oculus Rift campaign actually raised over $2.4 million without giving up a single share of equity.[41]

FIGURE 1.4
Payal Kadakia, founder of ClassPass



Source: Image courtesy of ClassPass.

This trend will almost certainly accelerate. We're in a golden age of tech entrepreneurship where ideas can be vetted and tested online, and funding crowdsourced, Kickstarter-style; "the cloud" means a startup can rent the computing resources one previously had to buy at great expense; app stores give code jockeys immediate, nearly zero-cost distribution to a potential market of hundreds of millions of people worldwide; and social media done right can virally spread aware-

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ness of a firm with nary a dime of conventional ad spending. Crafting a breakout hit is tough, but the jackpot can be immense.

But you don't have to build a successful firm to have an impact as a tech revolutionary. Shawn Fanning's Napster, widely criticized as a piracy playground, was written when he was just nineteen. Fanning's code was the first significant salvo in the tech-fueled revolution that brought about an upending of the entire music industry. Finland's Linus Torvalds wrote the first version of the Linux operating system when he was just twenty-one. Today Linux has grown to be the most influential component of the open source arsenal, powering everything from cell phones to supercomputers.

TechCrunch crows that Internet entrepreneurs are like pro athletes—"they peak around [age] 25."[42] *BusinessWeek* regularly runs a list of America's Best Young Entrepreneurs—the top twenty-five aged twenty-five and under. *Inc.* magazine's list of the Coolest Young Entrepreneurs is subtitled the "30 under 30." While not exclusively filled with the ranks of tech startups, both of these lists are nonetheless dominated with technology entrepreneurs. Whenever you see young people on the cover of a business magazine, it's almost certainly because they've done something groundbreaking with technology. The generals and foot soldiers of the technology revolution are filled with the ranks of the young, some not even old enough to legally have a beer. For the old-timers reading this, all is not lost, but you'd best get cracking with technology, quick. Junior might be on the way to either eat your lunch or be your next boss.

Key Takeaways

- Recognize that anyone reading this book has the potential to build an impactful business. Entrepreneurship has no minimum age requirement.
- The ranks of technology revolutionaries are filled with young people, with several leading firms and innovations launched by entrepreneurs who started while roughly the age of the average university student.
- Several forces are accelerating and lowering the cost of entrepreneurship. These include crowdfunding, cloud computing, app stores, 3D printing, and social media, among others.

Questions and Exercises

1. Look online for lists of young entrepreneurs. How many of these firms are tech firms or heavily rely on technology? Are there any sectors more heavily represented than tech?
2. Have you ever thought of starting your own tech-enabled business? Brainstorm with some friends. What kinds of ideas do you think might make a good business?
3. How have the costs of entrepreneurship changed over the past decade? What forces are behind these changes? What does this mean for the future of entrepreneurship?
4. Many universities and regions have competitions for entrepreneurs (e.g., business plan competitions, elevator pitch competitions). Does your school have such a program? What are the criteria for participation? If your school doesn't have one, consider forming such a program.
5. Research business accelerator programs such as Y-Combinator, TechStars, and DreamIt. Do you have a program like this in your area? What do entrepreneurs get from participating in these programs? What do they give up? Do you think these programs are worth it? Why or why not? Have you ever used a product or service from a firm that has participated in one of these programs?
6. Explore online for lists of resources for entrepreneurship. Use social media to share these resources with your class.
7. Why are we in the "golden age" of technology entrepreneurship? What factors are helping entrepreneurs more rapidly achieve their vision, and with a lower cost?
8. Have any alumni from your institution founded technology firms or risen to positions of prominence in tech-focused careers? If so, work with your professor to invite them to come speak

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to your class or to student groups on campus. Your career services, university advancement (alumni giving and fundraising), alumni association, and LinkedIn searches may be able to help uncover potential speakers.

1.3 Geek Up—Tech Is Everywhere and You'll Need It to Thrive

Learning Objectives

1. Appreciate the degree to which technology has permeated every management discipline.
2. See that tech careers are varied, richly rewarding, and poised for continued growth.

Shortly after the start of the prior decade, there was a lot of concern that tech jobs would be outsourced, leading many to conclude that tech skills carried less value and that workers with tech backgrounds had little to offer. Turns out this thinking was stunningly wrong. Tech jobs boomed, and as technology pervades all other management disciplines, tech skills are becoming more important, not less. Today, tech knowledge can be a key differentiator for the job seeker. It's the worker without tech skills who needs to be concerned.

As we'll present in depth in a future chapter, there's a principle called Moore's Law that's behind fast, cheap computing. And as computing gets both faster and cheaper, it gets "baked into" all sorts of products and shows up everywhere: in your pocket, in your vacuum, and on the radio frequency identification (RFID) tags that track your luggage at the airport.

Well, there's also a sort of Moore's Law corollary that's taking place with people, too. As technology becomes faster and cheaper, and developments like open source software, cloud computing, software as a service (SaaS), and outsourcing push technology costs even lower, tech skills are being embedded inside more and more job functions. And ubiquitous tech fuels our current era of "Big Data," where bits-based insights move decision making from hunch to science. What this means is that, even if you're not expecting to become the next Tech Titan, your career will doubtless be shaped by the forces of technology. Make no mistake about it—there isn't a single modern managerial discipline that isn't being deeply and profoundly impacted by tech.

Finance

Many business school students who study finance aspire to careers in investment banking. Many i-bankers will work on IPOs (initial public stock offerings), in effect helping value companies the first time these firms wish to sell their stock on the public markets. IPO markets need new firms, and the tech industry is a fertile ground that continually sprouts new businesses like no other. Other i-bankers will be involved in valuing merger and acquisition (M&A) deals, and tech firms are active in this space, too. The technology sector has become a major driver of global M&A activity,[43] and there were 3,389 deals in the TMT (Technology, Media, Telecommunications) sector in 2017, totaling US$498.2 billion overall.[44] Leading tech firms are flush with cash and constantly on the hunt for new firms to acquire. In just five years, Google has bought a whopping 103 firms, IBM has bought sixty-four, Microsoft has bought sixty-three, Cisco has bought fifty-seven, and Intel has bought

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forty-eight![45] Yahoo! bought thirty-seven companies in a year and a half.[46] Apple bought twenty-seven firms in roughly the same period, spending over $14 billion, including $3 billion just for Beats (note to rappers: Want to be a billionaire? Then form a tech firm like Beats co-founder Andre Young, a.k.a. Dr. Dre).[47] And even in nontech industries, technology impacts nearly every endeavor as an opportunity catalyst or a disruptive wealth destroyer. The aspiring investment banker who doesn't understand the role of technology in firms and industries can't possibly provide an accurate guess at how much a company is worth.

TABLE 1.1 Tech Outpaces All Other Announced US M&A Deals

Sector	Deals	Value (billions)
High Tech	2,287	$240.2
Energy and Power	743	$228.6
Healthcare	1,337	$211.4
Media and Entertainment	989	$141.7
Real Estate	1,277	$139.1

Source: Mergers & Acquisitions Review, Thomson Reuters, Full Year 2017 Report.

Those in other finance careers will be lending to tech firms and evaluating the role of technology in firms in an investment portfolio. Most of you will want to consider tech's role as part of your personal investments. And modern finance simply wouldn't exist without tech. When someone arranges for a bridge to be built in Shanghai, those funds aren't carried over in a suitcase—they're digitally transferred from bank to bank. And forces of technology blasted open the 200-year-old floor trading mechanism of the New York Stock Exchange, in effect forcing the NYSE to sell shares in itself to finance the acquisition of technology-based trading platforms that were threatening to replace it. Computer-automated trading, where a human doesn't touch the deal at all, is responsible for some 60 percent of US equity trading volume.[48] As another example of the importance of tech in finance, consider that Boston-based Fidelity Investments, one of the nation's largest mutual fund firms, spends roughly $2.8 billion a year on technology. Tech isn't a commodity for finance—it's the discipline's lifeblood.

Accounting

Sarbanes-Oxley Act

Also known as Sarbox or SOX; US legislation enacted in the wake of the accounting scandals of the early 2000s. The act raises executive and board responsibility and ties criminal penalties to certain accounting and financial violations. Although often criticized, SOX is also seen as raising stakes for mismanagement and misdeeds related to a firm's accounting practices.

If you're an accountant, your career is built on a foundation of technology. The numbers used by accountants are all recorded, stored, and reported by information systems, and the reliability of any audit is inherently tied to the reliability of the underlying technology. Increased regulation, such as the heavy executive penalties tied to the **Sarbanes-Oxley Act** in the United States, have ratcheted up the importance of making sure accountants (and executives) get their numbers right. Negligence could mean jail time. This means the link between accounting and tech has never been tighter, and the stakes for ensuring systems accuracy have never been higher.

Business students might also consider that while accounting firms regularly rank near the top of *BusinessWeek*'s "Best Places to Start Your Career" list, many of the careers at these firms are highly tech-centric. Every major accounting firm has spawned a tech-focused consulting practice, and in many cases, these firms have grown to be larger than the accounting services functions from which they sprang. Today, Deloitte's tech-centric consulting division is larger than the firm's audit, tax, and risk practices. At the time of its spin-off, Accenture was larger than the accounting practice at former parent Arthur Andersen (Accenture executives are also grateful they split before Andersen's collapse in the wake of the prior decade's accounting scandals). Now, many accounting firms

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that had previously spun off technology practices are once again building up these functions, finding strong similarities between the skills of an auditor and skills needed in emerging disciplines such as information security and privacy.

Marketing

Technology has thrown a grenade onto the marketing landscape, and as a result, the skill set needed by today's marketers is radically different from what was leveraged by the prior generation. Online channels have provided a way to track and monitor consumer activities, and firms are leveraging this insight to understand how to get the right product to the right customer, through the right channel, with the right message, at the right price, at the right time. The success or failure of a campaign can often be immediately assessed based on online activity such as website visit patterns and whether a campaign results in an online purchase.

The ability to track customers, analyze campaign results, and modify tactics has amped up the return on investment of marketing dollars, with firms increasingly shifting spending from tough-to-track media such as print, radio, and television to the Web.[49] And new channels continue to emerge: smartphone, tablet, smart TV, smart watch and other wearables, smart auto, and more. Look to Apple to show how fast things grow: in roughly four years, iOS devices were in the hands, backpacks, purses, and pockets of over two hundred million people worldwide, delivering location-based messages and services and even allowing for cashless payment.[50] Roughly one-third of mobile phones used worldwide are smartphones, with the number expected to exceed 50 percent in four years. Billions will have a computer in their pockets, and this will become the primary channel for all sorts of customer engagement.[51]

The rise of social media is also part of this blown-apart marketing landscape. Now all customers can leverage an enduring and permanent voice, capable of broadcasting word-of-mouth influence in ways that can benefit and harm a firm. Savvy firms are using social media to generate sales, improve their reputations, better serve customers, and innovate. Those who don't understand this landscape risk being embarrassed, blindsided, and out of touch with their customers.

Search engine marketing (SEM), search engine optimization (SEO), customer relationship management (CRM), personalization systems, and a sensitivity to managing the delicate balance between gathering and leveraging data and respecting consumer privacy are all central components of the new marketing toolkit. And there's no looking back—tech's role in marketing will only grow in prominence. Analyst firm Gartner predicts that chief marketing officers are on a path to spend more on technology than any other function within the firm.[52]

Operations

A firm's operations management function is focused on producing goods and services, and operations students usually get the point that tech is the key to their future. Quality programs, process redesign, supply chain management, factory automation, and service operations are all tech-centric. These points are underscored in this book as we introduce several examples of how firms have designed fundamentally different ways of conducting business (and even entirely different industries), where value and competitive advantage are created through technology-enabled operations.

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Human Resources

Technology helps firms harness the untapped power of employees. Knowledge management systems are morphing into social media technologies—social networks, wikis, and Twitter-style messaging systems that can accelerate the ability of a firm to quickly organize and leverage teams of experts. And crowdsourcing tools and question-and-answer sites like Quora and Stack Overflow allow firms to reach out for expertise beyond their organizations. Human resources (HR) directors are using technology for employee training, screening, and evaluation. The accessibility of end-user technology means that every employee can reach the public, creating an imperative for firms to set policy on issues such as firm representation and disclosure and to continually monitor and enforce policies as well as capture and push out best practices. The successful HR manager recognizes that technology continually changes an organization's required skill sets as well as employee expectations.

The hiring and retention practices of the prior generation are also in flux. Recruiting hasn't just moved online; it's now grounded in information systems that scour databases for specific skill sets, allowing recruiters to cast a wider talent net than ever before. Job seekers are writing résumés with keywords in mind, aware that the first cut is likely made by a database search program, not a human being. The rise of professional social networks also puts added pressure on employee satisfaction and retention. Prior HR managers fiercely guarded employee directories for fear that a headhunter or competitive firm might raid top talent. Now the equivalent of a corporate directory can be easily pulled up via LinkedIn, a service complete with discrete messaging capabilities that can allow competitors to rifle-scope target your firm's best and brightest. Thanks to technology, the firm that can't keep employees happy, engaged, and feeling valued has never been more vulnerable.

And while many students have been wisely warned that inappropriate social posts can ruin their job candidacy, also know that the inverse is also true. In many ways social media is "the new résumé."[53] Thoughtful blog posts, a compelling LinkedIn presence, Twitter activity reflecting an enthusiastic and engaged mind, and, for tech students, participation in collaborative coding communities like GitHub all work to set apart a candidate from the herd. If you can't be found online, some employers may wonder if you have current skills, or if you have something to hide.

The Law

And for those looking for careers in corporate law, many of the hottest areas involve technology. Intellectual property, patents, piracy, and privacy are all areas where activity has escalated dramatically in recent years. The number of US patent applications waiting approval has tripled in the past decade, while China saw a threefold increase in patent applications in just five years.[54] Firms planning to leverage new inventions and business methods need legal teams with the skills to sleuth out whether a firm can legally do what it plans to. Others will need legal expertise to help them protect proprietary methods and content, as well as to help enforce claims in the home country and abroad.

Information Systems Careers

While the job market goes through ebbs and flows, recent surveys have shown there to be no end in sight for the demand for technical skills. *Money* magazine ranked tech jobs as three of the top ten "Best Jobs in America."[55] Around 1 in every 20 open job postings in the United States relates to information systems or computer science, and tech specializations are among the top three

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most-demanded college majors.[56] By some estimates, there will be three times the number of new US programming jobs created than newly minted programmers graduating from US colleges.[57] In some regions demand is even more pressing. In Massachusetts, for example, there is only one qualified graduate for every seventeen tech firm job openings requiring a bachelor's degree.[58] Tech jobs make up two of the top three "Best Jobs" on the *US News* list.[59] *BusinessWeek* ranks consulting (which heavily hires tech grads) and technology as the second and third highest paying industries for recent college graduates.[60] Technology careers have actually ranked among the safest careers to have during the most recent downturn.[61] The *Harvard Business Review* has declared "Data Scientist" the "Sexiest Job of the 21st Century."[62] And *Fortune's* ranks of the "Best Companies to Work For" is full of technology firms and has been topped by a tech business for eight years straight.[63] Want to work for a particular company? Chances are they're looking for tech talent. The demand for technology skills stretches across industries. Employers with the greatest number of recent technical job openings included JP Morgan Chase (finance), UnitedHealth (health care/insurance), Northrup Grumman (defense), and General Motors (automotive). And everyone wants to hire more coders from underrepresented groups. Apple,[64] Etsy,[65] Square,[66] Facebook,[67] and Google[68] are among the firms with programs to prep and encourage more women and minorities to pursue tech careers (details in endnotes).[69]

Students studying technology can leverage skills in ways that range from the highly technical to those that emphasize a tech-centric use of other skills. And why be restricted to just the classes taught on campus? Resources like Coursera, iTunes U., Codeacademy, Udemy, edX, YouTube, and others provide a smorgasbord of learning where the smart and motivated can geek up. Carve out some time to give programming a shot—remember, the founders of Tumblr and Instagram were largely self-taught. The high demand for scarce technical talent has also led many tech firms to offer six-figure starting salaries to graduating seniors from top universities.[70] Take some advice from the *Harvard Business Review*: "Leading a digital transformation? Learn to code."[71] Opportunities for programmers abound, particularly for those versed in new technologies. But there are also nonprogramming roles for experts in areas such as user-interface design (who work to make sure systems are easy to use), process design (who leverage technology to make firms more efficient), and strategy (who specialize in technology for competitive advantage). Nearly every large organization has its own information systems department. That group not only ensures that systems get built and keep running but also increasingly takes on strategic roles targeted at proposing solutions for how technology can give the firm a competitive edge. Career paths allow for developing expertise in a particular technology (e.g., business intelligence analyst, database administrator, social media manager), while project management careers leverage skills in taking projects from idea through deployment.

Even in consulting firms, careers range from hard-core programmers who "build stuff" to analysts who do no programming but might work identifying problems and developing a solutions blueprint that is then turned over to another team to code. Careers at tech giants like Apple, Google, and Microsoft don't all involve coding end-user programs either. Each of these firms has its own client-facing staff that works with customers and partners to implement solutions. Field engineers at these firms may work as part of (often very lucratively compensated) sales teams to show how a given company's software and services can be used. These engineers often put together prototypes that are then turned over to a client's in-house staff for further development. An Apple field engineer might show how a firm can leverage iPads in its organization, while a Google field engineer can help a firm incorporate search, banner, and video ads into its online efforts. Careers that involve consulting and field engineering are often particularly attractive for those who are effective communicators who enjoy working with an ever-changing list of clients and problems across various industries and in many different geographies.

Upper-level career opportunities are also increasingly diverse. Consultants can become partners who work with the most senior executives of client firms, helping identify opportunities for those organizations to become more effective. Within a firm, technology specialists can rise to be chief information officer or chief technology officer—positions focused on overseeing a firm's information systems development and deployment. And many firms are developing so-called *C-level*

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specialties in emerging areas with a technology focus, such as chief information security officer (CISO), and chief privacy officer (CPO). Senior technology positions may also be a ticket to the chief executive's suite. A recent *Fortune* article pointed out how the prominence of technology provides a training ground for executives to learn the breadth and depth of a firm's operations and an understanding of the ways in which a firm is vulnerable to attack and where it can leverage opportunities for growth.[72]

Your Future

With tech at the center of so much change, realize that you may very well be preparing for careers that don't yet exist. But by studying the intersection of business and technology today, you develop a base to build upon and critical thinking skills that will help you evaluate new, emerging technologies. Think you can afford to wait on tech study, and then quickly get up to speed at a later date? Whom do you expect to have an easier time adapting and leveraging a technology like social media—today's college students who are immersed in technology or their parents who are embarrassingly dipping their toes into the waters of Facebook? Those who put off an understanding of technology risk being left in the dust.

Consider the nontechnologists who have tried to enter the technology space these past few years. News Corp. head Rupert Murdoch piloted his firm to the purchase of MySpace only to see this one-time leader lose share to rivals.[73] Former Warner executive Terry Semel presided over Yahoo!'s[74] malaise as Google blasted past it. Barry Diller, the man widely credited with creating the Fox Network, led InterActive Corp. (IAC) in the acquisition of a slew of tech firms ranging from Expedia to Ask.com, only to break the empire up as it foundered.[75] And Time Warner head Jerry Levin presided over the acquisition of AOL, executing what many consider to be one of the most disastrous mergers in US business history.[76] Contrast these guys against the technology-centric successes of Mark Zuckerberg (Facebook), Steve Jobs (Apple), and Sergey Brin and Larry Page (Google).

While we'll make it abundantly clear that a focus solely on technology is a recipe for disaster, a business perspective that lacks an appreciation for tech's role is also likely to be doomed. At this point in history, technology and business are inexorably linked, and those not trained to evaluate and make decisions in this ever-shifting space risk irrelevance, marginalization, and failure.

Key Takeaways

- As technology becomes cheaper and more powerful, it pervades more industries and is becoming increasingly baked into what were once nontech functional areas.
- Technology is impacting every major business discipline, including finance, accounting, marketing, operations, human resources, and the law.
- Tech jobs rank among the best and highest-growth positions, and tech firms rank among the best and highest-paying firms to work for.
- Information systems (IS) jobs are profoundly diverse, ranging from those that require heavy programming skills to those that are focused on design, process, project management, privacy, and strategy.

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Questions and Exercises

1. Look at *Fortune*'s "Best Companies to Work For" list. How many of these firms are technology firms? Which firm would you like to work for? Are they represented on this list?
2. Look at *BusinessWeek*'s "Best Places to Start Your Career" list. Is the firm you mentioned above also on this list?
3. What are you considering studying? What are your short-term and long-term job goals? What role will technology play in that career path? What should you be doing to ensure that you have the skills needed to compete?
4. Which jobs that exist today likely won't exist at the start of the next decade? Based on your best guess on how technology will develop, can you think of jobs and skill sets that will likely emerge as critical five and ten years from now?
5. Explore online resources to learn technology on your own and search for programs that encourage college students. If you are from an underrepresented group in technology (i.e., a woman or minority), search for programs that provide learning and opportunity for those seeking tech careers. Share your resources with your professor via a class wiki or other mechanism to create a common resource everyone can use to #geekup. Then tweet what you create using that hashtag!

1.4 The Pages Ahead

Learning Objective

1. Understand the structure of this text, the issues and examples that will be introduced, and why they are important.

Hopefully this first chapter has helped get you excited for what's to come. The text is written in a style similar to business magazines and newspapers (i.e., the stuff you'll be reading and learning from for the rest of your career). The introduction of concepts in this text are also example rich, and every concept introduced or technology discussed is grounded in a real-world scenario to show why it's important. But also know that while we celebrate successes and expose failures in that space where business and technology come together, we also recognize that firms and circumstances change. Today's winners have no guarantee of sustained dominance. What you should acquire in the pages that follow are a fourfold set of benefits that (1) provide a description of what's happening in industry today, (2) offer an introduction to key business and technology concepts, (3) offer a durable set of concepts and frameworks that can be applied even as technologies and industries change, and (4) develop critical thinking that will serve you well throughout your career as a manager.

Chapters don't have to be read in order, so feel free to bounce around, if you'd like; and your professor may ask you to skip or skim over certain sections. But many students write that they've enjoyed reading even those areas not assigned (the ultimate compliment for a textbook author). I hope you find the text as enjoyable, as well. Here's what you can expect:

Chapter 2 focuses on building big-picture skills to think about how to leverage technology for competitive advantage. Technology alone is rarely the answer, but through a rich set of examples, we'll show how firms can weave technology into their operations in ways that create and reinforce resources that can garner profits while repelling competitors. A mini-case examines tech's role at FreshDirect, a firm that has defied the many failures in the online grocery space and devastated tra-

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ditional rivals. Amazon, Blue Nile, Cisco, Dell, Google, OpenTable, Uber, TiVo, and Yahoo! are among the many firms providing a set of examples illustrating both successes and failures in leveraging technology. The chapter will show how firms use technology to create and leverage brand, scale economies, switching costs, data assets, network effects, and distribution channels. We'll introduce how technology relates to two popular management frameworks—the value chain and the five forces model. And we'll provide a solid decision framework for considering the controversial and often misunderstood role that technology plays among firms that seek an early-mover advantage.

In Chapter 3 we see how a tech-fed value chain helped Spanish clothing giant Zara craft a counterintuitive model that seems to defy all conventional wisdom in the fashion industry. We'll show how Zara's model differs radically from that of the firm it displaced to become the world's top clothing retailer: Gap. We'll show how technology ranging from handheld mobile devices to communications and scheduling systems to RFID tags work together to impact product design, product development, marketing, cycle time, inventory management, and customer loyalty; and how technology decisions influence broad profitability that goes way beyond the cost-of-goods thinking common among many retailers. We'll also offer a mini-case on Fair Factories Clearinghouse, an effort highlighting the positive role of technology in improving ethical business practices. Another mini-case shows the difference between thinking about technology versus broad thinking about systems, all through an examination of how high-end fashion house Prada failed in its rollout of technology that on the surface seemed very similar to Zara's.

Chapter 4 studies Netflix in two parts. The first half of the chapter tramples the notion that dot-com startup firms can't compete against large, established rivals. We'll show how information systems at Netflix created a set of assets that grew in strength and remains difficult for rivals to match. The economics of pure-play versus brick-and-mortar firms is examined, and we'll introduce managerial thinking on various concepts such as the data asset, personalization systems (recommendation engines and collaborative filtering), the long tail and the implications of technology on selection and inventory, crowdsourcing, using technology for novel revenue models (subscription and revenue-sharing with suppliers), forecasting, and inventory management. The second part of the chapter covers Netflix's challenges as it tries what many firms have failed at—maintaining leadership even as industry-related shifts fundamentally alter a firm's business. We present how the shift from atoms (physical discs) to bits (streaming and downloads) creates additional challenges and opportunities. Issues of digital products, licensing and partnerships, bargaining power of unique-good suppliers, content creation, revenue models, brand building and customer satisfaction, disparate competitors, global expansion challenges, and delivery platforms are all discussed. The section also covers how the streaming business has additional advantages in data collection and leverage, distinctly different but still significant scale assets, compelling benefits for consumers and content providers, and more. The chapter also provides an overview of the cloud-based Netflix technical infrastructure, the firm's open source contributions and use of crowdsourcing, and the uniqueness and influence of the firm's culture.

Chapter 5 focuses on understanding the rate of technology change from a computing power and cost perspective, and the implications for firms, markets, and society. The chapter offers accessible definitions for technologies impacted by Moore's Law but goes beyond semiconductors and silicon to show how the rate of magnetic storage (e.g., hard drives) and networking price and performance improvement create markets filled with uncertainty and opportunity. The chapter will show how tech has enabled the rise of Apple and Amazon, created mobile phone markets that empower the poor worldwide, and created six waves of disruptive innovation over six decades. We'll also show how Moore's Law, perhaps the greatest economic gravy train in history, will inevitably run out of steam as the three demons of heat, energy demands, and limits on shrinking transistors halt the advancement of current technology. Studying technologies that "extend" Moore's Law, such as multicore semiconductors, helps illustrate both the benefit and limitation of technology options, and in doing so, helps develop skills around recognizing the pros and cons of a given innovation. Supercomputing, grid, and cloud computing are introduced through examples that show how these advances are changing the economics of computing and creating new opportunities. Extended examples of IBM's Watson technology are offered, including the firm's efforts to turn Wat-

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son into a platform to serve other firms and to be baked into new products and services, such as the Cognitoy dinosaur—a children's learning helper. A mini-case on the development of Disney's Magic Band shows how fast/cheap technology is being used to replace paper ticketing in Disney World in ways that improve the customer experience, streamline operations, and cut costs. The case also raises issues on the challenges of developing complex new technology initiatives that impact many areas of the firm and its customers. Issues of e-waste are explored in a way that shows that firms need to consider not only the ethics of product sourcing but also the ethics of disposal.

In Chapter 6 we'll also introduce the concept of disruptive innovation to help managers understand why so many large incumbents are beat by new entrants, and we'll offer methods for becoming the disruptor rather than the disrupted. Concepts of disruptive technologies and disruptive innovation are introduced in a way that will help managers recognize potentially firm-destroying and career-crushing tech-driven challenges and get new possibilities on a firm's early radar. Mini-cases show disruption in action—for example, competition between Intel and ARM and Intuit's migration from packaged software to cloud. The chapter also includes a section examining the potentially disruptive innovation of bitcoin. The section describes how bitcoin works, its appeal and advantages, its disruptive opportunity, and the challenges and limitations it needs to overcome to hit the mainstream.

Chapter 7 explores one of the most disruptive firms of the post-Internet era. The chapter is broken into three parts. The first discusses the firm's physical goods e-commerce business and provides an opportunity to examine how it seeks tech-driven efficiencies in warehouse operations, fuels strategic goals, creates advantages through the accounting and finance concept of the cash conversion cycle, reinforces brand strength, enables scale and network effects, creates a powerful data asset, and is fundamentally redefining shopping habits. New device experimentation, such as Amazon Dash, the Dash Button, and Amazon Echo, are also introduced. The second section looks at the rise of Amazon's Kindle business and its evolution, which has moved from e-book reader to include tablet, TV, and smartphone. The chapter also covers the importance of platform creation, challenges in "going mobile," issues of channel conflict, and how the firm is disrupting the entire publishing and media creation value chain. The final chapter examines Amazon's personal and corporate cloud computing initiatives, the infrastructure that underpins these efforts, and the business opportunities that these efforts create.

In Chapter 8 we'll see how technologies, services, and platforms can create nearly insurmountable advantages. Tech firms from Facebook to Intel to Microsoft are dominant because of network effects—the idea that some products and services get more valuable as more people use them. Studying network effects creates better decision makers. The concept is at the heart of technology standards and platform competition, and understanding network effects can help managers choose technologies that are likely to win, hopefully avoiding getting caught with a failed, poorly supported system. Students learn how network effects work and why they're difficult to unseat. The chapter ends with an example-rich discussion of various techniques that one can use to compete in markets where network effects are present.

Peer production and social media have created some of the Internet's most popular destinations and most rapidly growing firms, and they are empowering the voice of the customer as never before. In Chapter 9 students learn about various technologies used in social media and peer production, including blogs, wikis, social networking, Twitter, and more. Prediction markets and crowdsourcing are introduced, along with examples of how firms are leveraging these concepts for insight and innovation. Finally, students are offered guidance on how firms can think SMART by creating a social media awareness and response team. Issues of training, policy, and response are introduced, and technologies for monitoring and managing online reputations are discussed.

Chapter 10 expands on peer production concepts introduced in the earlier chapter to explore the so-called "Sharing Economy" and "Collaborative Consumption." Examples are offered of citizens coming together to create or share resources across markets, and of the creation of electronic markets to facilitate these services. Drivers that help bring about the sharing economy, the advantages enjoyed by sharing economy firms, and the challenges these firms face are also introduced. The chapter also discusses how mainstream firms are leveraging Sharing Economy concepts, and the

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future outlook for these firms is explored. Extended mini-cases on Airbnb and Uber discuss the impact, success, competitive advantage, platform creation, the use of APIs, and major issues facing two of the sector's most successful firms. Success strategies and challenges for firms involved in the sector are illustrated, and the future outlook for the space is explored.

Chapter 11 will allow us to study success and failure in IS design and deployment by examining one of the Internet's hottest firms. Facebook is one of the most accessible and relevant Internet firms to so many, but it's also a wonderful laboratory to discuss critical managerial concepts. The founding story of Facebook introduces concepts of venture capital, the board of directors, and the role of network effects in entrepreneurial control. Feeds show how information, content, and applications can spread virally but also introduce privacy concerns. Facebook's strength in switching costs demonstrates how it has been able to envelop additional markets from photos to chat to video and more. The challenges Facebook has faced as it transitions from a primarily desktop service to one where most users access it via mobile phone are also addressed, exposing how resources do and don't transfer from desktop to mobile and why mobile is "different" for many firms. Also included is managerial insight on how mobile is, in some ways, a richer platform with a high potential for innovation. Facebook's struggles in mobile are illustrated alongside its major acquisitions, including Instagram, WhatsApp, and Oculus VR. Lessons from Facebook as an apps platform are also discussed in a way that provides insight to managers thinking beyond services, and toward successful platform creation. The discussion includes information on the desktop platform's early success, stagnancy, the firm's mobile platform struggles, attempts to build Messenger into a platform (and contrast with WeChat and other international efforts), and continued challenges. The failure of the Beacon system shows how even bright technologists can fail if they ignore the broader procedural and user implications of an information systems rollout. Social networking advertising is contrasted with search, and the perils of advertising alongside social media content are introduced. Issues of privacy, global growth, and the firm's Internet.org effort to bring more data services to the developing world are also discussed.

Chapter 12 provides a fascinating look at how two young women entrepreneurs have crafted a business that has attracted millions of customers and recast how women relate to designer fashion. A discussion of the firm's early stage allows for the introduction of key concepts in entrepreneurship, such as product-market fit and minimum viable product. The case illustrates how a new firm developed strong network effects through crafting a win-win for customers and fashion brands. Social and mobile are detailed as being key enablers for the firm's unique sharing economy model. A section on how the firm leverages analytics to inform everything from pricing to product sourcing to customer service shows the advantages of the tech-centric firm over conventional retailers. Technology, as well as human capital, are described in a firm that is at its heart a highly complex reverse logistics business where everything that goes out must come in and often heads right out again after cleaning and treatment. The firm's expansion into traditional storefronts provides an opportunity to discuss when physical retail may make sense for a tech firm.

Chapter 13 offers a primer to help managers better understand what software is all about. The chapter offers a brief introduction to software technologies. Students learn about operating systems, application software, and how these relate to each other. Enterprise applications are introduced, and the alphabet soup of these systems (e.g., ERP, CRM, and SCM) is accessibly explained. Various forms of distributed systems (client-server, Web services, APIs, messaging) are also covered. The chapter provides a managerial overview of how software is developed, offers insight into the importance of Java and scripting languages, and explains the differences between compiled and interpreted systems. System failures (including an analysis of the failure and resurrection of systems associated with the US Affordable Care Act), total cost of ownership, and project risk mitigation are also introduced. The array of concepts covered helps a manager understand the bigger picture and should provide an underlying appreciation for how systems work that will serve even as technologies change and new technologies are introduced.

The software industry is changing radically, and that's the focus of Chapter 14. The issues covered in this chapter are front and center for any firm making technology decisions. We'll cover open source software, software as a service, hardware clouds, app software, and virtualization. Each topic

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is introduced by discussing advantages, risks, business models, and examples of their effective use. The chapter ends by introducing issues that a manager must consider when making decisions as to whether to purchase technology, contract or outsource an effort, or develop an effort in-house.

In Chapter 15 we'll study data, which is often an organization's most critical asset. Data lies at the heart of every major discipline, including marketing, accounting, finance, operations, forecasting, and planning. We'll help managers understand how data is created, organized, and effectively used. We'll cover limitations in data sourcing, issues in privacy and regulation, and tools for access, including various business intelligence and so-called "Big Data" technologies. A mini-case on Walmart shows data's use in empowering a firm's entire value chain, while examples from Spotify to L.L. Bean underscore Big Data's impact on the modern enterprise.

Chapter 16 unmasks the mystery of the Internet—it shows how the Internet works and why a manager should care about IP addresses, IP networking, the DNS, peering, and packet versus circuit switching. We'll also cover last-mile technologies and the various strengths and weaknesses of getting a faster Internet to a larger population. The revolution in mobile technologies and the impact on business will also be presented.

Chapter 17 helps managers understand attacks and vulnerabilities and how to keep end users and organizations more secure. The ever-increasing number of megabreaches at firms that now include Target, TJX, Heartland, Epsilon, Sony, and even security firm RSA, plus the increasing vulnerability of end-user systems, have highlighted how information security is now the concern of the entire organization, from senior executives to frontline staff. This chapter explains what's happening with respect to information security—what kinds of attacks are occurring, who is doing them, and what their motivation is. We'll uncover the source of vulnerabilities in systems: human, procedural, and technical. Hacking concepts such as botnets, malware, phishing, and SQL injection are explained using plain, accessible language. Also presented are techniques to improve information security both as an end user and within an organization. The combination of current issues and their relation to a broader framework for security should help you think about vulnerabilities even as technologies and exploits change over time.

Chapter 18 discusses one of the most influential and far-reaching firms in today's business environment. As pointed out earlier, a decade ago Google barely existed, but it now earns more ad revenue and is a more profitable media company than any other media firm, online or off. Google is a major force in modern marketing, research, and entertainment. In this chapter you'll learn how Google (and Web search in general) works. Issues of search engine ranking, optimization, and search infrastructure are introduced. Students gain an understanding of search advertising and other advertising techniques, ad revenue models such as CPM and CPC, online advertising networks, various methods of customer profiling (e.g., IP addresses, geotargeting, cookies), click fraud, fraud prevention, and issues related to privacy and regulation. The chapter concludes with a broad discussion of how Google is evolving (e.g., Android, Chrome, Apps, YouTube) and how this evolution is bringing it into conflict with several well-funded rivals, including Amazon, Apple, and Microsoft.

Nearly every industry and every functional area is increasing its investment in and reliance on information technology. With opportunity comes trade-offs: research has shown that a high level of IT investment is associated with a more frenzied competitive environment.[77] But while the future is uncertain, we don't have the luxury to put on the brakes or dial back the clock—tech's impact is here to stay. Those firms that emerge as winners will treat IT efforts "as opportunities to define and deploy new ways of working, rather than just projects to install, configure, or integrate."[78] The examples, concepts, and frameworks in the pages that follow will help you build the tools and decision-making prowess needed for victory.

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Key Takeaways

- This text contains a series of chapters and cases that expose durable concepts, technologies, and frameworks, and does so using cutting-edge examples of what's happening in industry today.
- While firms and technologies will change, and success at any given point in time is no guarantee of future victory, the issues illustrated and concepts acquired should help shape a manager's decision-making in a way that will endure.

Questions and Exercises

1. Which firms do you most admire today? How do these firms use technology? Do you think technology gives them an advantage over rivals? Why or why not?
2. What areas covered in this book are most exciting? Most intimidating? Which do you think will be most useful?

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CHAPTER 2

Strategy and Technology: Concepts and Frameworks for Achieving Success

2.1 Introduction

Learning Objectives

1. Define operational effectiveness and understand the limitations of technology-based competition leveraging this principle.
2. Define strategic positioning and the importance of grounding competitive advantage in this concept.
3. Understand the resource-based view of competitive advantage.
4. List the four characteristics of a resource that might possibly yield sustainable competitive advantage.

Managers are confused, and for good reason. Management theorists, consultants, and practitioners often vehemently disagree on how firms should craft tech-enabled strategy, and many widely read articles contradict one another. Headlines such as "Move First or Die" compete with "The First-Mover Disadvantage." A leading former CEO advises, "destroy your business," while others suggest firms focus on their "core competency" and "return to basics." The pages of the *Harvard Business Review* have declared, "IT Doesn't Matter," while a *New York Times* bestseller hails technology as the "steroids" of modern business.

Theorists claiming to have mastered the secrets of strategic management are contentious and confusing. But as a manager, the ability to size up a firm's strategic position and understand its likelihood of sustainability is one of the most valuable and yet most difficult skills to master. Layer on thinking about technology—a key enabler to nearly every modern business strategy, but also a function often thought of as easily "outsourced"—and it's no wonder that so many firms struggle at the intersection where strategy and technology meet. The business landscape is littered with the corpses of firms killed by managers who guessed wrong.

Developing strong strategic thinking skills is a career-long pursuit—a subject that can occupy tomes of text, a roster of courses, and a lifetime of seminars. While this chapter can't address the breadth of strategic thought, it is meant as a primer on developing the skills for strategic thinking about technology. A manager who understands issues presented in this chapter should be able to see through seemingly conflicting assertions about best practices more clearly; be better prepared to recognize opportunities and risks; and be more adept at successfully brainstorming new, tech-centric approaches to markets.

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The Danger of Relying on Technology

sustainable competitive advantage
Financial performance that consistently outperforms industry averages.

Firms strive for **sustainable competitive advantage**, financial performance that consistently outperforms their industry peers. The goal is easy to state, but hard to achieve. The world is so dynamic, with new products and new competitors rising seemingly overnight, that truly sustainable advantage might seem like an impossibility. New competitors and copycat products create a race to cut costs, cut prices, and increase features that may benefit consumers but erode profits industry-wide. Nowhere is this balance more difficult than when competition involves technology. The fundamental strategic question in the Internet era is, "*How can I possibly compete when everyone can copy my technology and the competition is just a click away?*" Put that way, the pursuit of sustainable competitive advantage seems like a lost cause.

But there are winners—big, consistent winners—empowered through their use of technology. How do they do it? In order to think about how to achieve sustainable advantage, it's useful to start with two concepts defined by Michael Porter. A professor at the Harvard Business School and father of the *value chain* and the *five forces* concepts (see the sections later in this chapter), Porter is justifiably considered one of the leading strategic thinkers of our time.

operational effectiveness
Performing the same tasks better than rivals perform them.

commodity
A basic good that can be interchanged with nearly identical offerings by others--think milk, coal, orange juice, or to a lesser extent, Windows PCs and Android phones. The more commoditized an offering, the greater the likelihood that competition will be based on price.

fast follower problem
Exists when savvy rivals watch a pioneer's efforts, learn from their successes and missteps, then enter the market quickly with a comparable or superior product at a lower cost before the first mover can dominate.

augmented-reality
A technology that superimposes content, such as images and animation, on top of real-world images.

According to Porter, the reason so many firms suffer aggressive, margin-eroding competition is because they've defined themselves according to operational effectiveness rather than strategic positioning. **Operational effectiveness** refers to performing the same tasks better than rivals perform them. Everyone wants to be better, but the danger in operational effectiveness is "sameness." When offerings are roughly the same, they are more **commodity** than differentiated. That often means that competition will focus on offering the lowest price, and this can pull down profits for all players that consumers see as basically equivalent in features. This risk is particularly acute in firms that rely on technology for competitiveness. After all, technology can be easily acquired. Buy the same stuff as your rivals, hire students from the same schools, copy the look and feel of competitor websites, reverse engineer their products, and you can match them. The **fast follower problem** exists when savvy rivals watch a pioneer's efforts, learn from their successes and missteps, then enter the market quickly with a comparable or superior product at a lower cost.

Since tech can be copied so quickly, followers can be fast, indeed. Groupon founder Andrew Mason claimed the daily deal service had spawned 500 imitators within two years of launch,[1] and venture capitalist Ben Evans notes that at the time of Facebook's WhatsApp purchase, there were over fifty social apps in the Google Play store with over 1 million downloads each.[2] When technology can be matched so quickly, it is rarely a source of competitive advantage. And this phenomenon isn't limited to the Web.

For the dangers of the fast follower problem, look at the competition between Snapchat and Facebook. Snapchat is considered the pioneer of many photo and video sharing features, such as "Stories," location stickers, and **augmented-reality** "selfie filters," but Facebook properties including Instagram, WhatsApp, Messenger, and the flagship Facebook app routinely mimic Snap features, implementing some in as little as four months after their appearance in Snapchat, leading TechCrunch to quip Facebook's development mantra, formerly "Move Fast and Break Things" should now be "Move Last and Take Things."[3] Even worse, all these Facebook properties are larger than Snapchat, making Facebook the first stop for advertisers seeking to access the largest-possible audience. Snapchat's growth tumbled 82 percent after Instagram Stories launched,[4] and the firm posted a $2.2 billion loss in its first quarter as a public company.[5]

The Flip video camera is another example of technology alone offering little durable advantage. The pocket-sized video recorders used flash memory instead of magnetic storage. Flip cameras grew so popular that Cisco bought Flip parent Pure Digital for $590 million. The problem was that digital video features were easy to copy, and constantly falling technology costs (see Chapter 5) allowed rivals to embed video into their products. Later that same year, Apple (and other firms) began including video capture as a feature in their music players and phones. Why carry a Flip

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when one pocket device can do everything? The Flip business barely lasted two years. Cisco killed the division, taking a more than half-billion-dollar spanking in the process.[6]

Operational effectiveness is critical. Firms must invest in techniques to improve quality, lower cost, and design efficient customer experiences. But for the most part, these efforts can be matched. Because of this, operational effectiveness is usually not sufficient to yield sustainable dominance over the competition. In contrast to operational effectiveness, **strategic positioning** refers to performing different activities from those of rivals, or the same activities in a different way. Technology itself is often very easy to replicate, and those assuming advantage lies in technology alone may find themselves in a profit-eroding arms race with rivals able to match their moves step by step. But while technology can be copied, technology can also play a critical role in creating and strengthening strategic *differences*—advantages that rivals will struggle to match.

strategic positioning
Performing different tasks than rivals, or the same tasks in a different way.

Different Is Good: FreshDirect Redefines the Grocery Landscape in New York City and Beyond

For an example of the relationship between technology and strategic positioning, consider FreshDirect. The New York City–based grocery firm focused on the two most pressing problems for Big Apple shoppers: selection is limited and prices are high. Both of these problems are a function of the high cost of real estate in New York. The solution? Use technology to craft an ultra-efficient model that provides farm-to-table freshness, massive product choice, and supply chain savings that neither traditional grocery stores, nor delivery firms, can match.

The firm's "storefront" is a website offering a product mix heavy on fresh produce, as well as one-click menus and semiprepared specials like "meals in four minutes." The ability to pull up prior grocery orders fuels fast reorders, and a mobile app eliminates the need for a grocery list. Enter order items as you think of them, then click a button to schedule next-day delivery. All these features appeal to the time-strapped Manhattanites who were the firm's first customers. Area shoppers—many of whom don't have cars or are keen to avoid the traffic-snarled streets of the city—were quick to embrace the model. The service is now so popular that apartment buildings in New York have begun to redesign common areas to include secure freezers that can accept FreshDirect deliveries, even when customers aren't there.[7]

Deliveries started from a vast warehouse the size of five football fields located in a lower-rent industrial area of Queens, and a new facility planned for the Bronx will double the firm's capacity. This kind of size allows FreshDirect to offer a fresh goods selection that's over five times larger than local supermarkets. And a bigger facility allows FreshDirect to service more customers, too. The firm has expanded service to ninety zip codes in New York, New Jersey, and Pennsylvania,[8] and it has recently opened a warehouse in Prince George's County, Maryland, for serving customers in metro-Washington DC.[9]

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FIGURE 2.1 The FreshDirect Website and the Firm's Tech-Enabled Warehouse Operation



Source: Used with permission from FreshDirect. See the photographic tour at the FreshDirect website, http://www.freshdirect.com/about/index.jsp?siteAccessPage=c_aboutus.

inventory turns

Sometimes referred to as inventory turnover, stock turns, or stock turnover. It is the number of times inventory is sold or used during a given period. A higher figure means that a firm is selling products quickly.

The FreshDirect model crushes costs that plague traditional grocers. Worker shifts are highly efficient, avoiding the downtime lulls and busy rush hour spikes of storefronts. The result? Labor costs that are 60 percent lower than at traditional grocers. FreshDirect buys and prepares what it sells, leading to less waste. Waste is otherwise a big risk among grocers, which often throw out one in seven truckloads of food delivered to stores.[10] At FreshDirect, food waste is only about 1 percent, an advantage that the firm claims is "worth 5 percentage points of total revenue in terms of savings."[11] Overall perishable inventory at FreshDirect turns 197 times a year versus 40 times a year at traditional grocers.[12] Higher **inventory turns** mean the firm is selling product faster, so it collects money quicker than its rivals do. And those goods are fresher since they've been in stock for less time, too. Consider that while the average grocer may have seven to nine days of seafood inventory, FreshDirect's seafood stock turns each day. Stock is typically purchased direct from the docks in order to fulfill orders placed less than twenty-four hours earlier.[13] Cofounder David McInerney maintains that FreshDirect's super-fast "farm-to-fork" supply chain also allows food to be harvested for optimal freshness, yielding taste that far outpaces the competition.[14] The firm goes a step beyond conventional grocery stores by regularly evaluating product taste and sharing these results with customers. Every day, teams inspect and sample between 400 and 500 items. The ratings (from one to five) that accompany produce on the website help consumers make more informed shopping decisions than they would by a trip to the local market.[15]

Artificial intelligence software, coupled with some seven miles of fiber-optic cables linking systems and sensors, supports everything from baking the perfect baguette to verifying orders with 99.9 percent accuracy.[16] Since it doesn't need the money-sucking open-air refrigerators of the retail store competition, the firm even saves big on energy (instead, staff bundle up for shifts in climate-controlled cold rooms tailored to the specific needs of dairy, deli, and produce). The firm also uses recycled biodiesel fuel to cut down on delivery costs. Customers who would otherwise drive to the grocery store can also feel green about their decision to order online. One study suggests delivery trucks produce 20 to 70 percent less emissions than trips made in personal vehicles.[17]

FreshDirect buys directly from suppliers, eliminating middlemen wherever possible. The firm also offers suppliers several benefits beyond traditional grocers, all in exchange for more favorable terms. These include offering to carry a greater selection of supplier products while eliminating the "slotting fees" (payments by suppliers for prime shelf space) common in traditional retail, cobranding products to help establish and strengthen supplier brand, paying partners in days rather than weeks, and sharing data to help improve supplier sales and operations. Add all these advantages together and the firm's big, fresh selection is offered at prices that can undercut the competition by as much as 35 percent.[18] And FreshDirect does it all with margins in the range of 20 percent (to as high as 45 percent on many semiprepared meals), easily dwarfing the razor-thin 1 percent margins earned by traditional grocers.[19]

FreshDirect's customer base has ballooned to over 600,000 paying customers. That's a population roughly the size of metro-Boston, serviced by a single grocer with no physical store. The privately held firm has been consistently profitable since 2010. Annual revenue exceeds $600 mil-

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lion, and in 2017 the firm raised an additional $189 million investment from JP Morgan to fund further geographic expansion.[20]

Technology is critical to the FreshDirect model, but it's the collective impact of the firm's differences when compared to rivals, this tech-enabled strategic positioning, that delivers success. Over time, the firm has also built up a set of strategic assets that not only address specific needs of a market but are now extremely difficult for any upstart to compete against. Traditional grocers can't fully copy the firm's delivery business because this would leave them **straddling** two markets (low-margin storefront and high-margin delivery), unable to gain optimal benefits from either. Entry costs for would-be competitors are also high (the firm spent over $75 million building infrastructure before it could serve a single customer), and the firm's complex and highly customized software, which handles everything from delivery scheduling to orchestrating the preparation of thousands of recipes, continues to be refined and improved each year.[21] On top of all this comes years of relationship building with suppliers, as well as customer data used to further refine processes, speed reorders, and make helpful recommendations. Competing against a firm with such a strong and tough-to-match strategic position can be brutal. Just five years after launch there were one-third fewer supermarkets in New York City than when FreshDirect first opened for business.[22]

straddling

Attempts to occupy more than one position, while failing to match the benefits of a more efficient, singularly focused rival.

Better than Grocers, but Other Rivals?

The FreshDirect model is superior to conventional grocery stores in just about every way, and the firm has devastated the competition while delivering on quality, selection, and value. However, one threat successful firms face is the potential entry of even better-funded, growth-seeking rivals to try to squeeze them out of the current market. For years, the king of e-commerce, Amazon, has had its eye on tapping the $700 billion market for grocery retail. The firm has been refining its AmazonFresh service in its hometown in Seattle, and has been slowly expanding it to other cities. Amazon has recently shown up in FreshDirect's back yard, buying a massive Northern New Jersey distribution center formerly owned by grocer PathMark. Estimates suggest the facility may be able to move ten times the dollar volume of FreshDirect's new Bronx distribution center.[23] Amazon also offers same-day delivery free to AmazonPrime subscribers. Even more troubling: many delivery items are cheaper from AmazonFresh than from FreshDirect (a firm once known for its low prices, but now seen as a premium price for premium quality supplier). And AmazonFresh can also deliver many of the non-grocery items you can order on Amazon's main website.[24] There are other players in the market, too, including Instacart, which leverages a network of Uber-style contract delivery workers to pick groceries from popular retailers that include Whole Foods and Costco. Google offers a similar service, known as Google Express. And the rise of meal-kit delivery firms, such as Blue Apron, provide a different alternative to conventional grocery shopping (FreshDirect has co-invested with Campbell Soup in rival meal kit firm, Chef'd).[25]

Early reviews of AmazonFresh in New York City have criticized the firm for a poor online shopping experience and an uneven selection.[26] These are problems a well-funded and patient giant may be able to iron out over time. It's unclear if FreshDirect's initial advantages will hold up over time, but executives seem confident. Says FreshDirect's CEO: "In a $700 billion industry, there's plenty of space for a lot of different people to play. [The firm] is doing spectacularly, and we continue to see strong growth in this environment."[27]

But What Kinds of Differences?

The principles of operational effectiveness and strategic positioning are deceptively simple. But while Porter claims strategy is "fundamentally about being different,"[28] how can you recognize whether your firm's differences are special enough to yield sustainable competitive advantage?

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resource-based view of competitive advantage

The strategic thinking approach suggesting that if a firm is to maintain sustainable competitive advantage, it must control an exploitable resource, or set of resources, that have four critical characteristics. These resources must be (1) valuable, (2) rare, (3) imperfectly imitable, and (4) nonsubstitutable.

dense wave division multiplexing (DWDM)

A technology that increases the transmission capacity (and hence speed) of fiber-optic cable. Transmissions using fiber are accomplished by transmitting light inside "glass" cables. In DWDM, the light inside fiber is split into different wavelengths in a way similar to how a prism splits light into different colors.

An approach known as the **resource-based view of competitive advantage** can help. The idea here is that if a firm is to maintain sustainable competitive advantage, it must control a set of exploitable resources that have four critical characteristics. These resources must be (1) *valuable*, (2) *rare*, (3) *imperfectly imitable* (tough to imitate), and (4) *nonsubstitutable*. Having all four characteristics is key. Miss value and no one cares what you've got. Without rareness, you don't have something unique. If others can copy what you have, or others can replace it with a substitute, then any seemingly advantageous differences will be undercut.

Strategy isn't just about recognizing opportunity and meeting demand. Resource-based thinking can help you avoid the trap of carelessly entering markets simply because growth is spotted. The telecommunications industry learned this lesson in a very hard and painful way. With the explosion of the Internet it was easy to see that demand to transport Web pages, e-mails, MP3s, video, and everything else you can turn into ones and zeros, was skyrocketing.

Most of what travels over the Internet is transferred over long-haul fiber-optic cables, so telecom firms began digging up the ground and laying webs of fiberglass to meet the growing demand. Problems resulted because firms laying long-haul fiber didn't fully appreciate that their rivals and new upstart firms were doing the exact same thing. By one estimate there was enough fiber laid to stretch from the Earth to the moon some 280 times![29] On top of that, a technology called **dense wave division multiplexing (DWDM)** enabled existing fiber to carry more transmissions than ever before. The end result: these new assets weren't rare and each day they seemed to be less valuable.

For some firms, the transmission prices they charged on newly laid cable collapsed by over 90 percent. Established firms struggled, upstarts went under, and WorldCom became the biggest bankruptcy in US history. The impact was also felt throughout all industries that supplied the telecom industry. Firms like Sun, Lucent, and Nortel, whose sales growth relied on big sales to telecom carriers, saw their value tumble as orders dried up. Estimates suggest that the telecommunications industry lost nearly $4 trillion in value in just three years,[30] much of it due to executives that placed big bets on resources that weren't strategic.

Key Takeaways

- Technology can be easy to copy, and technology alone rarely offers sustainable advantage.
- Firms that leverage technology for strategic positioning use technology to create competitive assets or ways of doing business that are difficult for others to copy.
- True sustainable advantage comes from assets and business models that are simultaneously valuable, rare, difficult to imitate, and for which there are no substitutes.

Questions and Exercises

1. What is operational effectiveness?
2. What is strategic positioning?
3. Is a firm that competes based on the features of technology engaged in operational effectiveness or strategic positioning? Give an example to back up your claim.
4. What are the dangers of competing on operational effectiveness? Are firms more likely to be considered commodities or differentiated offerings? How would you describe the basis for consumer decision-making when evaluating products that are highly similar?
5. What is the "resource-based" view of competitive advantage? What are the characteristics of resources that may yield sustainable competitive advantage?
6. Examine the FreshDirect business model and list reasons for its competitive advantage. Would a similar business work in your neighborhood? Why or why not?
7. What effect did FreshDirect have on traditional grocers operating in New York City? Why?

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8. Choose a technology-based company. Discuss its competitive advantage based on the resources it controls.
9. Use the resource-based view of competitive advantage to explain the collapse of many telecommunications firms in the period following the burst of the dot-com bubble.
10. Consider the examples of Barnes & Noble competing with Amazon, and Apple offering iTunes. Are either (or both) of these efforts straddling? Why or why not?

2.2 Powerful Resources

Learning Objectives

1. Understand that technology is often critical to enabling competitive advantage, and provide examples of firms that have used technology to organize for sustained competitive advantage.
2. Understand the value chain concept and be able to examine and compare how various firms organize to bring products and services to market.
3. Recognize the role technology can play in crafting an imitation-resistant value chain, as well as when technology choice may render potentially strategic assets less effective.
4. Define the following concepts: brand, scale, data and switching cost assets, differentiation, network effects, and distribution channels.
5. Understand and provide examples of how technology can be used to create or strengthen the resources mentioned above.

Management has no magic bullets. There is no exhaustive list of key resources that firms can look to in order to build a sustainable business. And recognizing a resource doesn't mean a firm will be able to acquire it or exploit it forever. But being aware of major sources of competitive advantage can help managers recognize an organization's opportunities and vulnerabilities, and can help them brainstorm winning strategies. Also, these assets rarely exist in isolation. Oftentimes, a firm with an effective strategic position can create an arsenal of assets that reinforce one another, creating advantages that are particularly difficult for rivals to successfully challenge.

Imitation-Resistant Value Chains

While many of the resources below are considered in isolation, the strength of any advantage can be far more significant if firms are able to leverage several of these resources in a way that makes each stronger and makes the firm's way of doing business more difficult for rivals to match. Firms that craft an **imitation-resistant value chain** have developed a way of doing business that others will struggle to replicate, and in nearly every successful effort of this kind, technology plays a key enabling role. The **value chain** is the set of interrelated activities that bring products or services to market (see below). When we compare FreshDirect's value chain to traditional rivals, there are differences across every element. But most importantly, the elements in FreshDirect's value chain work together to create and reinforce competitive advantages that others cannot easily copy. Incumbents trying to copy the firm would be *straddled* across two business models, unable to reap the full advantages of either. And late-moving pure-play rivals will struggle, as FreshDirect's lead

imitation-resistant value chain

A way of doing business that competitors struggle to replicate and that frequently involves technology in a key enabling role.

value chain

The set of activities through which a product or service is created and delivered to customers.

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time allows the firm to develop brand, scale, data, and other advantages that newcomers lack (see below for more on these resources).

Key Framework: The Value Chain

The *value chain* is the "set of activities through which a product or service is created and delivered to customers."[31] There are five primary components of the value chain and four supporting components. The primary components are:

- *Inbound logistics*—getting needed materials and other inputs into the firm from suppliers
- *Operations*—turning inputs into products or services
- *Outbound logistics*—delivering products or services to consumers, distribution centers, retailers, or other partners
- *Marketing and sales*—customer engagement, pricing, promotion, and transaction
- *Support*—service, maintenance, and customer support

The secondary components are:

- *Firm infrastructure*—functions that support the whole firm, including general management, planning, IS, and finance
- *Human resource management*—recruiting, hiring, training, and development
- *Technology / research and development*—new product and process design
- *Procurement*—sourcing and purchasing functions

While the value chain is typically depicted as it's displayed in the following figure, goods and information don't necessarily flow in a line from one function to another. For example, an order taken by the marketing function can trigger an inbound logistics function to get components from a supplier, operations functions (to build a product if it's not available), or outbound logistics functions (to ship a product when it's available). Similarly, information from service support can be fed back to advise research and development (R&D) in the design of future products.

FIGURE 2.2 The Value Chain



When a firm has an imitation-resistant value chain—one that's tough for rivals to copy in a way that yields similar benefits—then a firm may have a critical competitive asset. From a strategic perspective, managers can use the value chain framework to consider a firm's differences and distinctiveness compared to rivals. If a firm's value chain can't be copied by competitors without engaging in painful trade-offs, or if the firm's value chain helps to create and strengthen other strategic assets over time, it can be a key source for competitive advantage. Many of the examples used in this book, including FreshDirect, Amazon, and Zara, illustrate this point.

An analysis of a firm's value chain can also reveal operational weaknesses, and technology is often of great benefit to improving the speed and quality of execution. Firms can often buy software to improve things, and tools such as *supply chain management* (SCM; linking inbound and outbound logistics with operations), *customer relationship management* (CRM; supporting sales, marketing, and in some cases R&D), and *enterprise resource planning* software (ERP; software implemented in modules to automate the entire value chain), can have a big impact on more efficiently integrating the activities within the firm, as well as with its suppliers and customers. But remember, these software tools can be purchased by competitors, too. While valuable, such software may not yield lasting competitive advantage if it can be easily matched by competitors as well.

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There's potential danger here. If a firm adopts software that changes a unique process into a generic one, it may have co-opted a key source of competitive advantage, particularly if other firms can buy the same stuff. This isn't a problem with something like accounting software. Accounting processes are standardized and accounting isn't a source of competitive advantage, so most firms buy rather than build their own accounting software. But using packaged, third-party SCM, CRM, and ERP software typically requires adopting a very specific way of doing things, using software and methods that can be purchased and adopted by others. Many of the firms covered in this text, including Netflix and Amazon, have elected to develop their own proprietary software solutions in large part because they see their uniqueness in certain operations as key to creating difficult-to-imitate competitive advantages.

Dell's Struggles: Nothing Lasts Forever

Michael Dell enjoyed an extended run that took him from assembling PCs in his dorm room as an undergraduate at the University of Texas at Austin to heading the largest PC firm on the planet. For years Dell's superefficient, vertically integrated manufacturing (where it built its own PCs rather than outsourcing manufacturing like nearly all other competitors) and direct-to-consumer sales combined to help the firm earn seven times more profit on its own systems when compared with comparably configured rival PCs.[32] And since Dell PCs were usually cheaper, too, the firm could often start a price war and still have better overall margins than rivals.

It was a brilliant model that had long proved resistant to imitation. While Dell sold direct to consumers, rivals had to share a cut of sales with the less efficient retail chains responsible for the majority of their sales. Dell's rivals struggled in moving toward direct sales because any retailer sensing its suppliers were competing with it through a direct-sales effort could easily choose another supplier that sold a nearly identical product (when firms see distribution partners as potential rivals, this is known as **channel conflict**). It wasn't that HP, IBM, Sony, and so many others didn't see the advantage of Dell's model—these firms were wedded to models that made it difficult for them to copy Dell.

But then Dell's killer model, one that had become a staple case study in business schools worldwide, began to lose steam. Nearly two decades of observing Dell had allowed the contract manufacturers serving Dell's rivals to improve manufacturing efficiency.[33] Component suppliers chose to locate near contract manufacturers, and assembly times fell dramatically. And as the cost of computing fell, the price advantage Dell enjoyed over rivals also shrank in absolute terms. That meant savings from buying a Dell weren't as big as they once were. On top of that, the direct-to-consumer model also suffered when sales of notebook PCs outpaced the more commoditized desktop market. Notebooks can be considered to be more differentiated than desktops, and customers often want to compare products in person—lift them, type on keyboards, and view screens—before making a purchase decision.

In time, these shifts knocked Dell from its ranking as the world's number one PC manufacturer. Dell has even abandoned its direct-only business model and now also sells products through third-party brick-and-mortar retailers. The firm has fallen on such hard times that management has "taken the firm **private**," working with investors (that include Michael Dell himself) to buy up all of Dell's publicly traded stock. Going private removes the relentless stock market punishment of Dell shares from continued bad quarterly results as executives try to find a path to recovery.[34] Dell's struggles as computers, customers, and the product mix changes all underscore the importance of continually assessing a firm's strategic position among changing market conditions. There is no guarantee that today's winning strategy will dominate forever.

channel conflict

Exists when a firm's potential partners see that firm as a threat. This threat could come because it offers competing products or services via alternative channels or because the firm works closely with especially threatening competitors.

private

As in "to go private" or "take a firm private." Buying up a publicly traded firm's shares. Usually done when a firm has suffered financially and when a turnaround strategy will first yield losses that would further erode share price. Firms (often called *private equity*, *buyout*, *LBO*, or *leveraged buyout firms*) that take another company private hope to improve results so that the company can be sold to another firm or they can reissue shares on public markets.

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Brand

brand
The symbolic embodiment of all the information connected with a product or service.

viral marketing
Leveraging consumers to promote a product or service.

A firm's **brand** is the symbolic embodiment of all the information connected with a product or service, and a strong brand can also be an exceptionally powerful resource for competitive advantage. Consumers use brands to *lower search costs*, so having a strong brand is particularly vital for firms hoping to be the first online stop for consumers. Want to buy a book online? Auction a product? Search for information? Which firm would you visit first? Almost certainly Amazon, eBay, or Google. But how do you build a strong brand? It's *not* just about advertising and promotion. First and foremost, customer experience counts. A strong brand *proxies quality* and *inspires trust*, so if consumers can't rely on a firm to deliver as promised, they'll go elsewhere. As an upside, tech can play a critical role in rapidly and cost-effectively strengthening a brand. If a firm performs well, consumers can often be enlisted to promote a product or service (so-called **viral marketing**). Firms that grew to gargantuan size before committing any substantial investment on advertising include Google, Skype, eBay, Facebook, LinkedIn, SnapChat, Twitter, and YouTube. Social services like Facebook and Twitter are viral marketing machines. Instagram, Pinterest, and Spotify are just some of the firms that have built thriving businesses with millions of followers by increasing its public awareness through social sharing. Early customer accolades for a novel service often mean that positive press (a kind of free advertising) will also likely follow.

But show up late and you may end up paying much more to counter an incumbent's place in the consumer psyche. Google's brand is so strong that it has become a verb, and the cost to challenge it is astonishingly high. Yahoo! and Microsoft's Bing each spent $100 million on Google-challenging branding campaigns, but the early results of these efforts seemed to do little to grow share at Google's expense.[35] Branding is difficult, but if done well, even complex tech products can establish themselves as killer brands. Consider that Intel has taken an ingredient product that most people don't understand, the microprocessor, and built a quality-conveying name recognized by computer users worldwide.

Scale

scale advantages
Advantages related to size.

economies of scale
When costs can be spread across increasing units of production or in serving multiple customers. Businesses that have favorable economies of scale (like many Internet firms) are sometimes referred to as being highly scalable.

Many firms gain advantages as they grow in size. Advantages related to a firm's size are referred to as **scale advantages**. Businesses benefit from **economies of scale** when the cost of an investment can be spread across increasing units of production or in serving a growing customer base. Firms that benefit from scale economies as they grow are sometimes referred to as being *scalable*. Many Internet and tech-leveraging businesses are highly scalable since, as firms grow to serve more customers with their existing infrastructure investment, profit margins improve dramatically.

Consider that in just one year during the firm's early growth, the Internet firm Blue Nile sold as many diamond rings with just 115 employees and one website as a traditional jewelry retailer would sell through 116 stores.[36] And with lower operating costs, Blue Nile can sell at prices that brick-and-mortar stores can't match, attracting even more customers and further fueling its advantages in economies of scale. Profit margins improve as the cost to run the firm's single website and operate its one warehouse are spread across increasing jewelry sales. The firm has begun to experiment with "web rooms"—consumer-education–focused storefronts that carry samples for inspection. "Web rooms" operate leanly with no for-sale inventory, no staff working for commission, and even in-store sales are handled from an iPad. The no-pressure, lean, multichannel approach and a 30-day money-back guarantee help first-time diamond buyers gain confidence, offering experiences and tools targeted at learning, inspection, and customization. The firm even encourages customers to comparison shop rivals with the Blue Nile app open, confident the firm's prices, touted as 20 to 40 percent below traditional retailers,[37] will beat the price of any rock certified by the industry-standard GIA ratings agency.[38] And the firm's "Dream Box" mobile app uses augmented reality to allow a customer to see how their hand will look with custom-designed Blue Nile

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bling.[39] Blue Nile has helped fuel over half a million wedding proposals, making the firm the largest online jewelry retailer, by far. With cost economics stacked against traditional jewelry stores it's no wonder 465 closed in a single year during Blue Nile's rise.[40]

A growing firm may also gain *bargaining power with its suppliers or buyers*. Apple's dominance of smartphone and tablet markets has allowed the firm to lock up 60 percent of the world's supply of advanced touch-screen displays, and to do so with better pricing than would be available to smaller rivals.[41] Similarly, for years eBay could raise auction fees because of the firm's market dominance. Auction sellers who left eBay lost pricing power since fewer bidders on smaller, rival services meant lower prices.

The scale of technology investment required to run a business can also act as a barrier to entry, discouraging new, smaller competitors. Intel's size allows the firm to pioneer cutting-edge manufacturing techniques and invest $7 billion on next-generation plants.[42] Rivals such as AMD and IBM once made their own chips, but sold off manufacturing when their smaller market shares couldn't justify the Intel-sized multi-billion dollar table stakes needed to stay in the game. And although Google was started by two Stanford students with borrowed computer equipment running in a dorm room, the firm today runs on an estimated 1.4 million servers.[43] The investments being made by Intel and Google would be cost-prohibitive for almost any newcomer to justify.

Switching Costs and Data

Switching costs exist when consumers incur an expense to move from one product or service to another. Tech firms often benefit from strong switching costs that cement customers to their firms. Users invest their time learning a product, entering data into a system, creating files, and buying supporting programs or manuals. These investments may make them reluctant to switch to a rival's effort.

switching costs

The cost a consumer incurs when moving from one product to another. It can involve actual money spent (e.g., buying a new product) as well as investments in time, any data loss, and so forth.

Similarly, firms that seem dominant but that don't have high switching costs can be rapidly trumped by strong rivals. Netscape once controlled more than 80 percent of the market share in Web browsers, but when Microsoft began bundling Internet Explorer with the Windows operating system and (through an alliance) with America Online (AOL), Netscape's market share plummeted. Customers migrated with a mouse click as part of an upgrade or installation. Learning a new browser was a breeze, and with the Web's open standards, most customers noticed no difference when visiting their favorite websites with their new browser.

Sources of Switching Costs

- Learning costs: Switching technologies may require an investment in learning a new interface and commands.
- Information and data: Users may have to reenter data, convert files or databases, or even lose earlier contributions on incompatible systems.
- Financial commitment: Can include investments in new equipment, the cost to acquire any new software, consulting, or expertise, and the devaluation of any investment in prior technologies no longer used.
- Contractual commitments: Breaking contracts can lead to compensatory damages and harm an organization's reputation as a reliable partner.
- Search costs: Finding and evaluating a new alternative costs time and money.
- Loyalty programs: Switching can cause customers to lose out on program benefits. Think frequent purchaser programs that offer "miles" or "points" (all enabled and driven by software).[44]

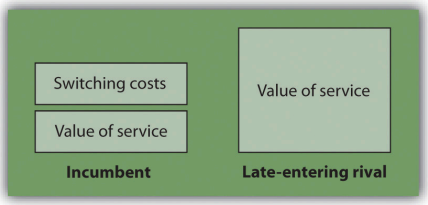
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It is critical for challengers to realize that in order to win customers away from a rival, a new entrant must not only demonstrate to consumers that an offering provides more value than the incumbent, they have to ensure that their value added exceeds the incumbent's value *plus* any perceived customer switching costs (see Figure 2.3). If it's going to cost you and be inconvenient, there's no way you're going to leave unless the benefits are overwhelming.

Data can be a particularly strong switching cost for firms leveraging technology. A customer who enters her profile into Facebook, movie preferences into Netflix, or grocery list into FreshDirect may be unwilling to try rivals—even if these firms are cheaper or offer more features—if moving to the new firm means she'll lose information feeds, recommendations, and time savings provided by the firms that already know her well. Fueled by scale over time, firms that have more customers and have been in business longer can gather more data, and many can use this data to improve their value chain by offering more accurate demand forecasting or product recommendations.

FIGURE 2.3
In order to win customers from an established incumbent, a late-entering rival must offer a product or service that not only exceeds the value offered by the incumbent, but also exceeds the incumbent's value and any customer switching costs.



Differentiation

Commodities are products or services that are nearly identically offered from multiple vendors. Consumers buying commodities are highly price-focused since they have so many similar choices. In order to break the commodity trap, many firms leverage technology to *differentiate* their goods and services. Data is not only a switching cost, it also plays a critical role in differentiation. Each time a visitor returns to Amazon, the firm uses browsing records, purchase patterns, and product ratings to present a custom home page featuring products that the firm hopes the visitor will like. Customers value the experience they receive at Amazon so much that the firm received the highest score ever recorded on the University of Michigan's American Customer Satisfaction Index (ACSI). The score was not just the highest performance of any online firm; it was the highest ranking that any service firm in any industry had ever received.

Apple is another firm that has distinguished itself through differentiation. Unlike rival offerings from Microsoft and Google, Apple mobile and computer operating systems only run on Apple hardware. This allows the firm to tightly integrate the experience across Apple products. Apple systems consistently receive high customer satisfaction ratings,[45] are considered easier to use, are more secure, and have fewer privacy issues.[46] While Apple's market share in computer operating systems is less than Microsoft Windows, and Apple's worldwide smartphone market share is less than Google's Android, Apple's differentiation (and the ability to avoid price-eroding, commodity-based competition of other hardware rivals) has helped make Tim Cook's firm the most profitable and valuable company in the United States.[47] Consider that in recent years, nine out of ten premium priced PCs sold in the United States are Macs[48]; and with the iPhone, Apple takes in an astonishing 92 percent of smartphone industry profits.[49]

Network Effects

network effects
Also known as Metcalfe's Law, or network externalities. When the value of a product or service increases as its number of users expands.

Facebook is by far the dominant social network worldwide. Microsoft Windows has a 90 percent market share in operating systems. eBay has an 80 percent share of online auctions. Why are these firms so dominant? Largely due to the concept of **network effects** (see Chapter 8). Network effects (sometimes called *network externalities* or *Metcalfe's Law*) exist when a product or service becomes more valuable as more people use it. If you're the first person with a Facebook account, then Facebook isn't very valuable. But with each additional user, there's one more person to communicate with. A firm with a big network of users might also see value added by third parties. Apple's iOS devices (the iPhone, iPod touch, and iPad) and Google's Android dominate rivals from Microsoft and

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BlackBerry in part because Apple and Google have tens of thousands more apps that run on and enhance these devices, and most of these apps are provided by firms other than Apple and Google. Third-party add-on products, books, magazines, or even skilled labor are all attracted to networks of the largest number of users, making dominant products even more valuable.

Switching costs also play a role in determining the strength of network effects. Tech user investments often go far beyond simply the cost of acquiring a technology. Users spend time learning a product; they buy add-ons, create files, and enter preferences. Because no one wants to be stranded with an abandoned product and lose this additional investment, users may choose a technically inferior product simply because the product has a larger user base and is perceived as having a greater chance of being offered in the future. The virtuous cycle of network effects[50] doesn't apply to all tech products, and it can be a particularly strong asset for firms that can control and leverage a leading standard. Consider Apple's iPhone and iPad with their closed systems versus the once-dominant but now rarely used Netscape browser, which was almost entirely based on open standards. Yet, in some cases where network effects are significant, they can create winners so dominant that firms with these advantages enjoy a near-monopoly hold on a market.

OpenTable: Network Effects That Fill Restaurants' Seats

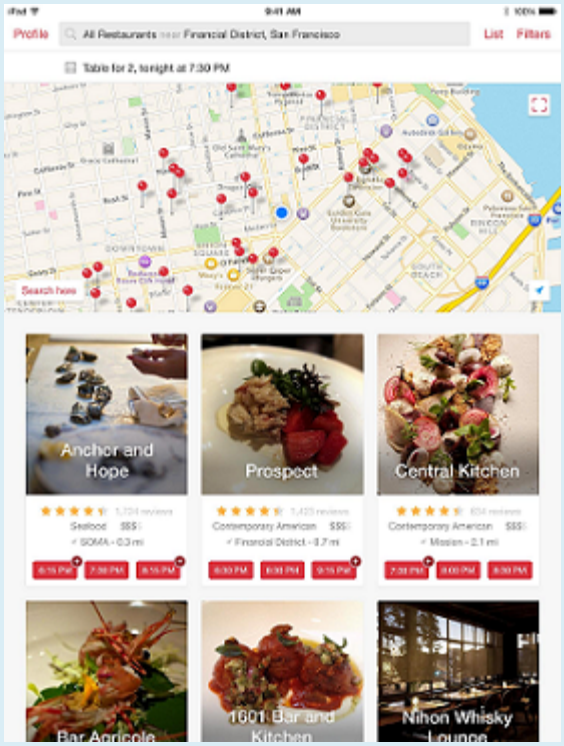
Network effects earned through making a market more efficient are at the center of OpenTable's dominance in restaurant reservations. By getting between restaurants and their customers, and adding lots of value along the way, OpenTable has built the world's largest online restaurant reservation system, one so dominant it is effectively a monopoly. OpenTable can get you a reservation at over 32,000 restaurants worldwide[51] (as recently as 2013, its largest US rival had only 1,000), and the firm handles roughly 99 percent of all online reservations in North America.[52]

The system delivers high value to the industry by exposing inventory and lowering search costs, thereby reducing frustration. Customers are attracted to the service that has the most restaurants, and restaurants are attracted to the service with the most customers. Strategists call this a *two-sided market*, and the strong network effects that result often crown one clear winner ahead of all other competitors. OpenTable's captive audience of restaurants and diners effectively creates a new *distribution channel* for introducing all sorts of additional value-added services, including loyalty programs to encourage repeat use and payments to lower customer wait times and free up more table inventory. The firm's industry dominance is so complete that Priceline Group (a firm that includes over half a dozen brands, including Booking.com, RentalCars.com, and Kayak.com in addition to Priceline.com) offered $2.6 billion to acquire the firm.[53]

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FIGURE 2.4
Roughly half of all reservations are made from the firm's mobile apps. Network effects make OpenTable the first place diners go for reservations. It is also the first choice for restaurants seeking diners. This dynamic helped the firm build a business valued at over $2.6 billion.



Source: OpenTable

Distribution Channels

distribution channels
The path through which products or services get to customers.

If no one sees your product, then it won't even get considered by consumers. So **distribution channels**—the path through which products or services get to customers—can be critical to a firm's success.

Apple Stores show firm-crafted retail distribution channels at their most effective. As mentioned earlier, one of Apple's key competitive strengths lies in the firm's differentiation vs. rival products, however firms offering highly differentiated offerings may face difficulty convincing potential customers of a product's unfamiliar benefits. Apple gear at a Best Buy might face price or simple feature checklist comparisons. However, Apple products offered at the Apple store give firm-trained employees an opportunity to present advantages of the company's unique products, how they work together, and free on-site customer support. While many in the business press thought the Apple store would be a dismal failure (it was introduced at a time when PC maker Gateway was shuttering its own failed retail experiment),[54] for Apple this formula has resulted in the single most successful retail chain in the United States on a sales-per-square-foot basis. Apple Store sales dwarf not just consumer electronics categories, but also clothing retailers, high-end jewelers, and every other store regardless of category.[55]

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TABLE 2.1 Top Retailers: Sales per Square Foot[56]

Rank	Firm	Sales / Sq. Ft.
1	Apple Stores	$4,798.82
2	Tiffany & Co.	$3,132.20
3	Michael Kors	$1,895.65
4	Lululemon Athletica	$1,675.16
5	Kate Spade	$1,558.00
6	Coach	$1,416.52
7	Kay Jewelers	$1,035.42
8	Tumi (travel goods)	$1,030.00
9	Costco	$1,032.00
10	Select Comfort (beds)	$1,023.07

Source: Fortune US retailers ranked by sales per square foot

More recently, Apple has leveraged its iTunes platform as a distribution channel to launch a new subscription service. Just nine months after launching Apple Music, the firm had attracted over 13 million paying subscribers to its streaming service.[57] Subscribing was easy, as anyone who had iTunes and who had bought something with Apple could sign up with a few taps, no download required.

Technology also opens up opportunities to leverage products provided by others to create new distribution channels to reach customers. Many firms offer **APIs** (application programming interfaces), essentially programming hooks that allow other firms to tap into their services. By publishing APIs, Uber has managed to add its service to apps and websites provided by United Airlines, OpenTable, and TripAdvisor.[58]

APIs

Programming hooks, or guidelines, published by firms that tell other programs how to get a service to perform a task such as send or receive data. For example, Amazon provides APIs to let developers write their own applications and websites that can send the firm orders.

Users can also be recruited to create new distribution channels for your products and services (usually for a cut of the take). You may have visited websites that promote books sold on Amazon. Website operators do this because Amazon gives them a percentage of all purchases that come in through these links. Amazon now has over one million of these "associates" (the term the firm uses for its **affiliates**), yet it only pays them if a promotion gains a sale. Google similarly receives some 30 percent of its ad revenue not from search ads, but from advertisements distributed within third-party sites ranging from lowly blogs to the *New York Times*.[59]

affiliates

Third parties that promote a product or service, typically in exchange for a cut of any sales.

Being dependent on distribution channels provided by other firms can present challenges if distribution partners suddenly decide to cut you off. When the iPhone was introduced, Google was Apple's exclusive map provider. However, Apple eventually launched its own map service, kicking out Google as a default option and relegating it to an iOS also-ran. Two years after the change, fewer than one in six iOS users had installed the Google Maps app on their devices, even though Apple's mapping product was initially considered inferior.[60] Fear of losing out on access to iPhone users is one reason why Google spends a reported $3 billion dollars to keep its search engine on Apple's mobile products.[61] And if Google can't buy itself into a distribution channel it can create one. Even though Microsoft and Apple embed their browsers with their operating systems, Google's Chrome remains the most widely used Web browser in the world.[62]

The ability to distribute products by bundling them with existing offerings can be a key advantage. But beware: sometimes these distribution channels can provide firms with such an edge that international regulators have stepped in to try to provide a more level playing field. European regulators have forced Microsoft to unbundle the firm's own Web browser and media player from Windows, and Google is also being fined for allegedly favoring its own products in searches over those provided by rivals.[63]

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What about Patents?

Intellectual property protection can be granted in the form of a patent for those innovations deemed to be useful, novel, and nonobvious. In the United States, technology and (more controversially with certain restrictions) even business methods (processes) can be patented,[64] typically for periods of twenty years from the date of patent application. Firms that receive patents have some degree of protection from copycats that try to identically mimic their products and methods.

Non-Practicing Entities

Commonly known as patent trolls, these firms make money by acquiring and asserting patents, rather than bringing products and services to market.

The patent system is often considered to be unfairly stacked against startups. US litigation costs in a single patent case average about $5 million,[65] and a few months of patent litigation can be enough to sink an early-stage firm. Large firms can also be victims. **Non-Practicing Entities** (NPEs), more commonly known as *patent trolls*, hold intellectual property not with the goal of bringing novel innovations to market but instead in hopes that they can sue or extort large settlements from others.[66] A $612 million settlement paid by BlackBerry (at the time known as Research in Motion) to the little-known holding company NTP is often highlighted as an example of the pain trolls can inflict.[67] Litigation threats are pushing rivals to cooperate in patent portfolio acquisition. Apple, EMC, Ericsson, Microsoft, RIM, and Sony pooled resources for a $4.5 billion purchase of some 6,000 patents formally held by the bankrupt telecom equipment firm Nortel.[68]

Even if an innovation is patentable, that doesn't mean that a firm has bulletproof protection. Some patents have been nullified by the courts upon later review (usually because of a successful challenge to the uniqueness of the innovation). Software patents are also widely granted, but notoriously difficult to defend. A unanimous ruling of the US Supreme Court recently ruled that simply taking an existing, well-known business method and applying technology to the process is no longer patent eligible.[69] Also, in many cases, coders at competing firms can write substitute algorithms that aren't the same, but accomplish similar tasks. For example, although Google's PageRank search algorithms are fast and efficient, Microsoft, Yahoo!, and others now offer their own noninfringing search that presents results with an accuracy that many would consider on par with PageRank. Patents do protect tech-enabled operations innovations at firms like Netflix, and design innovations like the iPod click wheel. And because of patents that overlap with Google's Android system and related mobile innovations, Microsoft actually makes more money from Samsung than from Skype, Windows Phone, and Xbox combined.[70] Patents can be extremely important and even lucrative, but in a study of the factors that were critical in enabling firms to profit from their innovations, Carnegie Mellon professor Wes Cohen found that patents were only the fifth most important factor. Secrecy, lead time, sales skills, and manufacturing all ranked higher.[71]

Key Takeaways

- Technology can play a key role in creating and reinforcing assets for sustainable advantage by enabling an imitation-resistant value chain; strengthening a firm's brand; collecting useful data and establishing switching costs; creating a network effect; creating or enhancing a firm's scale advantage; enabling product or service differentiation; and offering an opportunity to leverage unique distribution channels.
- The value chain can be used to map a firm's efficiency and to benchmark it against rivals, revealing opportunities to use technology to improve processes and procedures. When a firm is resistant to imitation, a superior value chain may yield sustainable competitive advantage.
- Firms may consider adopting packaged software or outsourcing value chain tasks that are not critical to a firm's competitive advantage. A firm should be wary of adopting software packages or outsourcing portions of its value chain that are proprietary and a source of competitive advantage.

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- Patents are not necessarily a surefire path to exploiting an innovation. Many technologies and business methods can be copied, so managers should think about creating assets like the ones previously discussed if they wish to create a truly sustainable advantage.
- Nothing lasts forever, and shifting technologies and market conditions can render once strong assets obsolete.

Questions and Exercises

1. Define and diagram the value chain.
2. Discuss the elements of FreshDirect's value chain and the technologies that FreshDirect uses to give the firm a competitive advantage. Why is FreshDirect resistant to imitation from incumbent firms? What advantages does FreshDirect have that insulate the firm from serious competition from startups copying its model?
3. Identify two firms in the same industry that have different value chains. Why do you think these firms have different value chains? What role do you think technology plays in the way that each firm competes? Do these differences enable strategic positioning? Why or why not?
4. How can information technology help a firm build a brand inexpensively?
5. Describe Blue Nile's advantages over a traditional jewelry chain. Can conventional jewelers successfully copy Blue Nile? Why or why not?
6. What are switching costs? What role does technology play in strengthening a firm's switching costs?
7. What are network effects? Name a product or service that has been able to leverage network effects to its advantage.
8. What role did network effects play in your choice of an operating system, a social network, a word processor, or a mobile phone?
9. How can technology be a distribution channel? Name a firm that has tried to leverage its technology as a distribution channel.
10. How does Apple compete with rivals? What competitive assets does the firm leverage when competing against Google, Microsoft, and others?
11. Do you think it is possible to use information technology to achieve competitive advantage? If so, how? If not, why not?
12. What are the potential sources of switching costs if you decide to switch cell phone service providers? Cell phones? Operating systems? Pay TV service?
13. Why is an innovation based on technology alone often subject to intense competition?
14. Can you think of firms that have successfully created competitive advantage even though other firms provide essentially the same thing? What factors enable this success?
15. What can a firm do to prepare for the inevitable expiration of a patent (patents typically expire after twenty years)? Think in terms of the utilization of other assets and the development of advantages through employment of technology.

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2.3 Barriers to Entry, Technology, and Timing

Learning Objectives

1. Understand the relationship between timing, technology, and the creation of resources for competitive advantage.
2. Argue effectively when faced with broad generalizations about the importance (or lack of importance) of technology and timing to competitive advantage.
3. Recognize the difference between low barriers to entry and the prospects for the sustainability of new entrant's efforts.

Some have correctly argued that the barriers to entry for many tech-centric businesses are low. This argument is particularly true for the Internet, where rivals can put up a competing website or deploy a rival app seemingly overnight. But it's absolutely critical to understand that market entry is *not* the same as building a sustainable business, and just showing up doesn't guarantee survival.

Platitudes like "follow, don't lead"[72] can put firms dangerously at risk, and statements about low entry barriers ignore the difficulty many firms will have in matching the competitive advantages of successful tech pioneers. Should Blockbuster have waited while Netflix pioneered? In a year where Netflix profits were up sevenfold, Blockbuster lost more than $1 billion, and today Blockbuster is bankrupt.[73] Should Sotheby's have dismissed seemingly inferior eBay? In the first three months of 2018, eBay made nearly half a billion dollars in profits. Sotheby's *lost* $6.5 million. Barnes & Noble waited seventeen months to respond to Amazon. In 2017, Amazon's profits totaled over $3 billion, while Barnes & Noble made only $22 million. By this time Amazon's market cap was over *2,000 times* greater than Barnes & Noble.[74] Today's Internet giants are winners because in most cases, they were the first to move with a profitable model and they were able to quickly establish resources for competitive advantage. With few exceptions, established offline firms have failed to catch up to today's Internet leaders.

Timing and technology alone will not yield sustainable competitive advantage. Yet both of these can be *enablers* for competitive advantage. Put simply, it's not the time lead or the technology; it's what a firm *does* with its time lead and technology. True strategic positioning means that a firm has created differences that cannot be easily matched by rivals. Moving first pays off when the time lead is used to create critical resources that are valuable, rare, tough to imitate, and lack substitutes. Anything less risks the arms race of operational effectiveness. Build resources like brand, scale, network effects, switching costs, or other key assets and your firm may have a shot. But guess wrong about the market or screw up execution, and failure or direct competition awaits. It is true that most tech can be copied—there's little magic in eBay's servers, Intel's processors, Oracle's database software, or Microsoft's operating systems that past rivals have not at one point improved upon. But the lead that each of these tech-enabled firms had was leveraged to create network effects, switching costs, and data assets, and helped build solid and well-respected brands.

But Google Arrived Late! Why Incumbents Must Constantly Consider Rivals

Gmail is the dominant e-mail provider today, but it took Google eight years to finally top early leaders Yahoo! Mail and Hotmail. Yahoo! and Hotmail were able to hold onto their lead in e-mail market share for several years after Gmail's introduction, likely because these firms quickly

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matched and nullified Gmail's most significant tech-based innovation (more free storage) before Google could inflict real damage.[75] Perhaps Yahoo! had learned from prior errors. The firm's earlier failure to respond to Google's emergence as a credible threat in search advertising gave Sergey Brin and Larry Page the time they needed to build the planet's most profitable Internet firm.

By some accounts, Google was actually the twenty-first notable firm to enter the Internet search market.[76] Yahoo! (and many Wall Street analysts) saw search as a commodity—a service the firm had subcontracted out to other firms including Alta Vista and Inktomi. Yahoo! saw no conflict in taking an early investment stake in Google or in using the firm for its search results. But Yahoo! failed to pay attention to Google's advance. As Google's innovations in technology, interface, and advertising remained unmatched over time, this allowed the firm to build its brand, scale, and advertising network (distribution channel) that grew from network effects because content providers and advertisers attract one another. These are all competitive resources that rivals have never been able to match.

Now Google (and Apple, too) are once again running from this playbook—turning the smartphone software market into what increasingly looks like a two-horse race. Many rivals, including Microsoft, had been trying to create a mobile standard for years, but their technical innovations offering little durable strategic value. It wasn't until app stores flourished, offered with a high-quality user experience, that dominant smartphone platforms emerged. Yes, Google and Apple arrived late, but nothing before them had created defensible strategic assets, and that left an opening.

Google's ability to succeed after being late to the search and mobile party isn't a sign of the power of the late mover; it's a story about the failure of incumbents to monitor their competitive landscape, recognize new rivals, and react to challenging offerings. That doesn't mean that incumbents need to respond to every potential threat. Indeed, figuring out which threats are worthy of response is the real skill here. Video rental chain Hollywood Video wasted over $300 million in an Internet streaming business years before high-speed broadband was available to make the effort work.[77] But while Blockbuster avoided the balance sheet–cratering gaffes of Hollywood Video, the firm also failed to respond to Netflix—a new threat that had timed market entry perfectly (see Chapter 4).

Firms that quickly get to market with the "right" model can dominate, but it's equally critical for leading firms to pay close attention to competition and innovate in ways that customers value. Take your eye off the ball and rivals may use time and technology to create strategic resources. Friendster was once known as the largest social network in the United States but has become virtually irrelevant today. And even the heir to social, Facebook, has been tripped up. Zuckerberg's slow-to-execute mobile strategy led to the rise of SnapChat, Instagram, and WhatsApp. Facebook eventually bought the latter two for $1 billion and $19 billion, respectively. Taking your eye off the competition can have a high price, indeed.[78]

Key Takeaways

- It doesn't matter if it's easy for new firms to enter a market if these newcomers can't create and leverage the assets needed to challenge incumbents.
- Beware of those who say, "IT doesn't matter" or refer to the "myth" of the first mover. This thinking is overly simplistic. It's not a time or technology lead that provides sustainable competitive advantage; it's what a firm does with its time and technology lead. If a firm can use a time and technology lead to create valuable assets that others cannot match, it may be able to sustain its advantage. But if the work done in this time and technology lead can be easily matched, then no advantage can be achieved, and a firm may be threatened by new entrants.

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Questions and Exercises

1. Does technology lower barriers to entry or raise them? Do low entry barriers necessarily mean that a firm is threatened?
2. Is there such a thing as the first-mover advantage? Why or why not?
3. Why did Google beat Yahoo! in search?
4. A former editor of the *Harvard Business Review*, Nick Carr, once published an article in that same magazine with the title "IT Doesn't Matter." In the article he also offered firms the advice: "Follow, Don't Lead." What would you tell Carr to help him improve the way he thinks about the relationship between time, technology, and competitive advantage?
5. Name an early mover that has successfully defended its position. Name another that had been superseded by the competition. What factors contributed to its success or failure?
6. You have just written a word processing package far superior in features to Microsoft Word. You now wish to form a company to market it. List and discuss the barriers your startup faces.
7. What kinds of strategic assets are Google's Android and Apple's iOS seeking to create and exploit? Do you think these firms will be more successful than rivals? Why or why not?

2.4 Key Framework: The Five Forces of Industry Competitive Advantage

Learning Objectives

1. Diagram the five forces of competitive advantage.
2. Apply the framework to an industry, assessing the competitive landscape and the role of technology in influencing the relative power of buyers, suppliers, competitors, and alternatives.

Professor and strategy consultant Gary Hamel once wrote in a *Fortune* cover story that "the dirty little secret of the strategy industry is that it doesn't have any theory of strategy creation."[79] While there is no silver bullet for strategy creation, strategic frameworks help managers describe the competitive environment a firm is facing. Frameworks can also be used as brainstorming tools to generate new ideas for responding to industry competition. If you have a model for thinking about competition, it's easier to understand what's happening and to think creatively about possible solutions.

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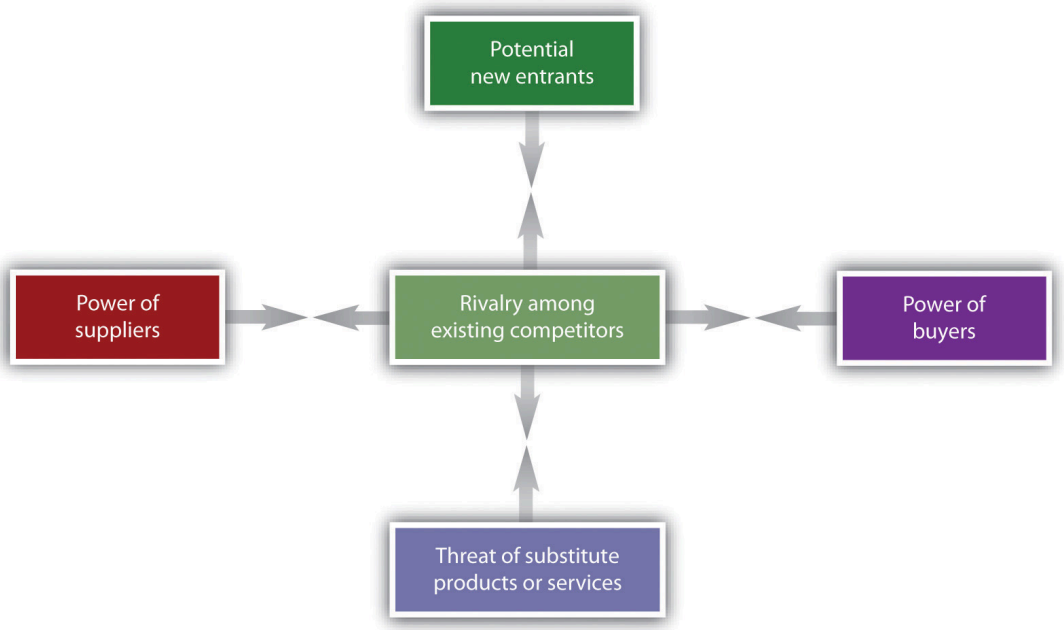
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One of the most popular frameworks for examining a firm's competitive environment is **Porter's five forces**, also known as the *Industry and Competitive Analysis*. As Porter puts it, "analyzing [these] forces illuminates an industry's fundamental attractiveness, exposes the underlying drivers of average industry profitability, and provides insight into how profitability will evolve in the future." The five forces this framework considers are (1) the intensity of rivalry among existing competitors, (2) the threat of new entrants, (3) the threat of substitute goods or services, (4) the bargaining power of buyers, and (5) the bargaining power of suppliers (see Figure 2.5).

Porter's five forces

Also known as Industry and Competitive Analysis. A framework considering the interplay between (1) the intensity of rivalry among existing competitors, (2) the threat of new entrants, (3) the threat of substitute goods or services, (4) the bargaining power of buyers, and (5) the bargaining power of suppliers.

FIGURE 2.5 The Five Forces of Industry and Competitive Analysis



New technologies can create jarring shocks in an industry. Consider how the rise of the Internet has impacted the five forces for music retailers. Traditional music retailers like Tower and Virgin found that customers were seeking music online. These firms scrambled to invest in new e-commerce channels out of what is perceived to be a necessity. Their *intensity of rivalry* increased because they not only compete based on the geography of where brick-and-mortar stores are physically located, they now compete online as well. Investments online are expensive and uncertain, prompting some firms to partner with *new entrants* such as Amazon. Free from brick-and-mortar stores, Amazon, the dominant new entrant, has a highly scalable cost structure while the old brick-and-mortar guys were left straddling both online and offline models, unable to gain the efficiency of the singularly focused Amazon that ran lean free of retail stores. Add to this the fact that in many ways the online buying experience is superior to what customers saw in stores. Customers can hear samples of almost all tracks, selection is seemingly limitless (the *long tail* phenomenon—see this concept illuminated in Chapter 4), and data is leveraged using *collaborative filtering* software to make product recommendations and assist in music discovery.[80] Tough competition, but it gets worse because CD sales aren't the only way to consume music. The process of buying a plastic disc now faces *substitutes* as digital music files become available on commercial music sites. Who needs the physical atoms of a CD filled with ones and zeros when you can buy the bits one song at a time? Or don't buy anything and subscribe to a limitless library instead.

From a sound quality perspective, the *substitute good* of digital tracks purchased online is almost always inferior to their CD counterparts. To transfer songs quickly and hold more songs on a digital music player, tracks are encoded in a smaller file size than what you'd get on a CD, and this smaller file contains lower playback fidelity. But the additional tech-based market shock brought on by digital music players (particularly the iPod) has changed listening habits. The convenience of carrying thousands of songs trumps what most consider just a slight quality degradation. iTunes

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sales rose to make Apple the number-one reseller of music, online or off. Apple can't rest on its laurels, either. The constant disruption of tech-enabled substitute goods has created rivals like Spotify and Pandora that don't sell music at all, yet have garnered tens of millions of users across desktop and mobile platforms. In 2015, recording industry revenue from streaming services eclipsed both digital downloads and physical sales, and the music industry posted its first overall sales growth in years.[81] Apple's catch-up need for a strong streaming service was widely given as the reason Apple purchased the streaming-savvy Beats for $3 billion. Most alarming to the industry is the other widely adopted substitute for CD purchases—theft. Illegal music "sharing" services abound, even after years of record industry crackdowns. And while exact figures on real losses from online piracy are in dispute, the music industry had seen album sales drop by 45 percent in less than a decade.[82] All this choice gives consumers (buyers) *bargaining power*. They demand cheaper prices and greater convenience.

The Internet can also create models that strengthen the *bargaining power of suppliers*. Consider the rise of taxi services such as Uber. In the old model, cab firms own the right to run a taxi through the purchase of expensive medallions. Drivers work as independent contractors and pay a "shift fee" to lease the cab from the medallion-owning cab firms. Drivers pay gas and insurance, too, and all this expense can cost drivers $150 upward per twelve-hour shift. Because of this, it's not uncommon for traditional cab drivers to run a shift where they can't even cover their costs.[83] By contrast, ride-sharing services cut out the medallion-owning middleman for anyone who could use their own car for transport, and the services often deliver enough fares to triple wages,[84] all while offering fares that can (depending on the city and cab supply) undercut cab rates by 30 percent.[85] According to the San Francisco Cab Drivers Association, one-third of its drivers ditched their registered cabs in a twelve-month span to drive for ride-sharing companies such as Uber and Lyft.[86] In some cities where Uber operates, business for traditional cabs is down 35 to 40 percent.[87] (For more about ride-sharing services, see Chapter 10)

price transparency
The degree to which complete information is available.

information asymmetry
A decision situation where one party has more or better information than its counterparty.

While it can be useful to look at changes in one industry as a model for potential change in another, it's important to realize that the changes that impact one industry do not necessarily impact other industries in the same way. For example, it is often suggested that the Internet increases bargaining power of buyers and lowers the bargaining power of suppliers. This suggestion is true for some industries like auto sales and jewelry where the products are commodities and the **price transparency** of the Internet counteracts a previous **information asymmetry**, where customers often didn't know enough information about a product to bargain effectively. But it's not true across the board.

In cases where network effects are strong or a seller's goods are highly differentiated, the Internet can strengthen supplier bargaining power. The customer base of an antiques dealer used to be limited by how many likely purchasers lived within driving distance of a store. Now with eBay, the dealer can take a rare good to a global audience and have a much larger customer base bid up the price. Switching costs also weaken buyer bargaining power. Wells Fargo has found that customers who use online bill pay (where switching costs are high) are 70 percent less likely to leave the bank than those who don't, suggesting that these switching costs help cement customers to the company even when rivals offer more compelling rates or services.

Tech plays a significant role in shaping and reshaping these five forces, but it's not the only significant force that can create an industry shock. Government deregulation or intervention, political shock, and social and demographic changes can all play a role in altering the competitive landscape. Because we live in an age of constant and relentless change, managers need to continually visit strategic frameworks to consider any market-impacting shifts. Predicting the future is difficult, but ignoring change can be catastrophic.

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Key Takeaways

- Industry competition and attractiveness can be described by considering the following five forces: (1) the intensity of rivalry among existing competitors, (2) the potential for new entrants to challenge incumbents, (3) the threat posed by substitute products or services, (4) the power of buyers, and (5) the power of suppliers.
- In markets where commodity products are sold, the Internet can increase buyer power by increasing price transparency.
- The more differentiated and valuable an offering, the more the Internet shifts bargaining power to sellers. Highly differentiated sellers that can advertise their products to a wider customer base can demand higher prices.
- A strategist must constantly refer to models that describe events impacting their industry, particularly as new technologies emerge.

Questions and Exercises

1. What are Porter's "five forces"?
2. Use the five forces model to illustrate competition in the newspaper industry. Are some competitors better positioned to withstand this environment than others? Why or why not? What role do technology and resources for competitive advantage play in shaping industry competition?
3. What is price transparency? What is information asymmetry? How does the Internet relate to these two concepts? How does the Internet shift bargaining power among the five forces?
4. How has the rise of the Internet impacted each of the five forces for music retailers?
5. In what ways is the online music buying experience superior to that of buying in stores?
6. What is the *substitute* for music CDs? What is the comparative sound quality of the substitute? Why would a listener accept an inferior product?
7. Based on Porter's five forces, is this a good time to enter the retail music industry? Why or why not?
8. What is the cost to the music industry of music theft? Cite your source.
9. Discuss the concepts of price transparency and information asymmetry as they apply to the diamond industry as a result of the entry of Blue Nile. Name another industry where the Internet has had a similar impact.
10. Under what conditions can the Internet strengthen supplier bargaining power? Give an example.
11. What is the effect of switching costs on buyer bargaining power? Give an example.
12. How does the Internet impact bargaining power for providers of rare or highly differentiated goods? Why?

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CHAPTER 3

Zara: Fast Fashion from Savvy Systems

3.1 Introduction

Learning Objective

1. Understand how Zara's parent company Inditex leveraged a technology-enabled strategy to become the world's largest fashion retailer.

It wasn't supposed to be called Zara. Spanish entrepreneur Amancio Ortega was brainstorming names for his new clothing shop and had settled on Zorba, after the classic movie *Zorba the Greek*. Unfortunately, there was already a bar in town with the same name, and the bar's owner was worried that patrons would be confused by a new, unaffiliated, non-boozy Zorba. By this time, the molds for the letters for Ortega's shop sign had already been cast, so they played around with what they could spell and came up with Zara, instead.[1] Zara is probably the more fashionable name, anyway, but the magic isn't in the moniker. For Zara, it's technology that has made all the difference in its rise to dominate the decidedly ungeeky fashion industry. That little shop with the second-choice name was the start of a world-spanning empire—an enterprise that is now the largest pure-play fashion retailer on the planet.

Today, Zara is the game-changing crown jewel in the multibrand empire of Inditex Corporation (Industrias de Diseño Textil), a firm that's bigger than Gap, H&M, Topshop, and anyone else in the space. The firm's supremacy is plotted and executed from "The Cube," the gleaming, futuristic headquarters located in the northern Spanish coastal city of La Coruña (or A Coruña in the local Galician language). The blend of technology-enabled strategy that Zara has unleashed deviates widely from the standard fashion retail playbook. Unlike rivals, Zara shuns advertising, rarely runs sales, and while nearly every other major player outsources manufacturing to low-cost countries, Inditex is highly vertically integrated, keeping huge swaths of its production process in-house. These counterintuitive moves are part of a recipe for success that's beating the pants off the competition and has catapulted Ortega to become the world's second wealthiest person (and at one point, even briefly passing Bill Gates for the top spot).

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FIGURE 3.1
Zara's operations are concentrated in Spain, but they have stores around the world, like these in Manhattan and Shanghai.



Source: Used with permission from Inditex.

In August 2008, sales edged ahead of Gap, making Inditex the world's largest fashion retailer.[2] Table 3.1 compares the two fashion retailers. While Inditex supports eight brands, Zara is unquestionably the firm's crown jewel and growth engine, accounting for roughly two-thirds of sales.[3]

TABLE 3.1 Gap vs. Inditex at a Glance

	Gap	Inditex
Revenue	$15.9 billion	€25.3 billion (approx. $31.3 billion)
Net Income	$848 million	€3.4 billion (approx. $4.2 billion)
Number of Stores	3,650	7,475
Number of Countries	50	96
Biggest Brand	Gap	Zara
Number of Other Brands	4	8
Based in	San Francisco, USA	Arteixo (near La Coruña), Spain
First Store Opened	1969	1975

Sources: Year-end 2017 figures from http://www.gapinc.com, http://www.inditex.com, and https://fashionunited.uk/news/business/inditex-posts-7-percent-profit-growth-in-fy17/2018031428641

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Why Study Zara?

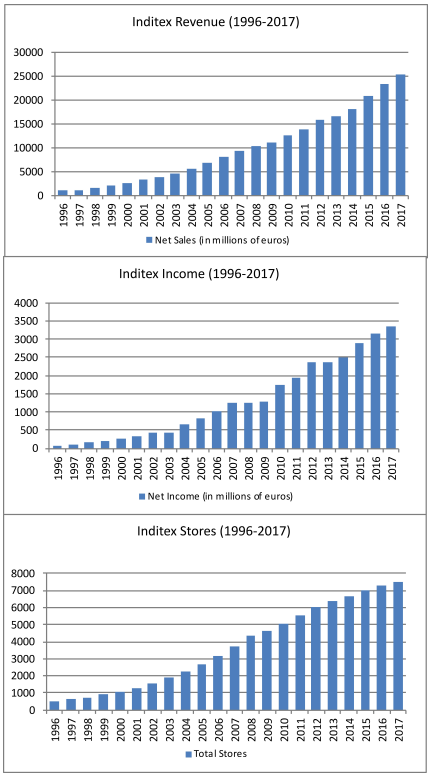
While competitors falter, Zara is undergoing one of the fastest global expansions the fashion world has ever seen, opening one store per day and entering new markets worldwide—ninety-three markets so far. The chain's profitability is among the highest in the industry.[4] The fashion director for luxury goods maker LVMH calls Zara "the most innovative and devastating retailer in the world."[5]

Zara's duds look like high fashion but are comparatively inexpensive (average item price is $27, although prices vary by country).[6] A Goldman analyst has described the chain as "Armani at moderate prices," while another industry observer suggests that while fashions are more "Banana Republic," prices are more "Old Navy."[7] Legions of fans eagerly await "Z-day," the twice-weekly inventory delivery to each Zara location that brings in the latest clothing lines for women, men, and children. One well-known fan of the brand is the Duchess of Cambridge. The day after her wedding to Prince William, the former Kate Middleton made an appearance in a cornflower blue, pleated polyester dress from Zara. The price was £49.99[8] for high-quality, inexpensive fashion that's good enough for a future queen.

Physical retailers are clearly struggling. Nieman Marcus is selling itself, H&M and Gap are shrinking their retail footprints, and Macy's is closing hundreds of stores. But pretty much the only reason Zara closes stores is to open even bigger ones to meet demand. As this chapter illustrates, Zara's super-efficient model leads to competitively priced merchandise, higher margins, fewer markdowns and write-offs, faster inventory turnover, reduced risk, and less advertising.[9]

In order to understand and appreciate just how counterintuitive and successful Zara's strategy is, and how technology makes all of this possible, it's important to first examine the conventional wisdom in apparel retail. To do that we'll look at former industry leader—Gap.

FIGURE 3.2 Inditex Revenue, Income, and Stores from 1996–2017
Inditex's extraordinary two-decade growth in revenue, profits, and store openings.



Source: Inditex annual reports.

Gap: An Icon in Crisis

Most fashion retailers place orders for a seasonal collection months before these lines make an appearance in stores. While overseas contract manufacturers may require hefty lead times, trying to guess what customers want months in advance is a tricky business. In retail in general and fashion in particular, there's a saying: inventory equals death. Have too much unwanted product on hand and you'll be forced to mark down or write off items, killing profits. For years, Gap sold most of what it carried in stores. Micky Drexler, a man with a radar-accurate sense of style and the iconic CEO who helped turn Gap's button-down shirts and khakis into America's business casual uniform, led the way. Drexler's team had spot-on tastes throughout the 1990s, but when sales declined in the early part of the following decade, Drexler was left guessing on ways to revitalize the brand, and he guessed wrong—disastrously wrong. Chasing the youth market, Drexler filled Gap stores with miniskirts, low-rise jeans, and even a much-ridiculed line of purple leather pants.[10] The throngs of teenagers he sought to attract never showed up, and the shift in offerings sent Gap's mainstay customers to retailers that easily copied the styles that Gap had made classic.

The inventory hot potato Drexler was left with crushed the firm. Gap's same-store sales declined for twenty-nine months straight. Profits vanished. Gap founder and chairman Don Fisher lamented, "It took us thirty years to get to $1 billion in profits and two years to get to nothing."[11] The firm's debt was downgraded to junk status.

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Drexler was out and for its new head the board chose Paul Pressler, a Disney executive who ran theme parks and helped rescue the firm's once ailing retail effort. Under Pressler, Gap's struggles continued, largely due to bad bets on colors and styles.[12] Pressler's tenure saw same-store sales decline in eighteen of twenty-four months.[13] The marketing model used by Gap to draw customers in via big-budget television promotion had collapsed. A *Fortune* article on Pressler's leadership was titled "Fashion Victim." *BusinessWeek* described his time as CEO as a "Total System Failure."[14] Under the firm's third CEO in a decade and after years of restructuring that resulted in the closure of hundreds of stores, Gap profits have returned, even as its struggles continue. The firm's admiration of Inditex, and its inability to act on this envy, remains clear. Says one Gap exec, "I would love to organize our business like Inditex, but I would have to knock the company down and rebuild it from scratch,"[15] a statement that perfectly reflects the power of Zara's imitation-resistant value chain.

contract manufacturing

Outsourcing production to third-party firms. Firms that use contract manufacturers don't own the plants or directly employ the workers who produce the requested goods.

Contract Manufacturing: Lower Costs at What Cost?

Conventional wisdom suggests that leveraging cheap **contract manufacturing** in developing countries can keep the cost of goods low. Firms can lower prices and sell more product or maintain higher profit margins—all good for the bottom line. But many firms have also experienced the ugly downside to this practice. Global competition among contract firms has led to race-to-the-bottom cost-cutting measures. Too often, this means that in order to have the low-cost bid, contract firms skimp on safety, ignore environmental concerns, employ child labor, and engage in other ghastly practices.

FIGURE 3.3 Building Collapse in Bangladesh



Source: Wikimedia, http://en.wikipedia.org/wiki/File:Dhaka_Savar_Building_Collapse.jpg.

The apparel industry in particular has been plagued by accusations of sweatshop labor and unsafe working conditions. Incidents such as the Spring 2013 Bangladesh Rana Plaza disaster, which killed more than 1,100 people in the collapse of an illegally constructed eight-story building housing multiple contract garment factories, underscore the human toll of unacceptable contract manufacturing practices. Walmart, The Children's Place, and Benetton were among the firms said to have purchased clothing from firms operating in Rana Plaza.[16] The track record of Bangladeshi garment factories has been notably grim. In the dozen years prior to the Rana Plaza incident, over 700 workers in Bangladesh were killed in garment factory fires.[17] While Gap was not implicated in the Rana Plaza incident, the firm was singled out as a protest target because it is one of the largest importers of clothing from Bangladesh[18] and it refused to sign a safety accord backed by H&M and Zara, among others.[19]

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Big firms are big targets, and those that fail to adequately ensure their products are made under acceptable labor conditions risk a brand-damaging backlash that may turn off customers, repel new hires, and leave current staff feeling betrayed. Today's managers need to think deeply, not only about their own firm's ethical practices, but also those of all of their suppliers and partners.

Tech for Good: The Fair Factories Clearinghouse

The problem of sweatshop labor and dismal industry practices has plagued the clothing industry for years. Managers often feel the pressure to seek ever-lower costs and all too often end up choosing suppliers with unacceptably poor practices. Even well-meaning firms can find themselves stung by corner-cutting partners that hide practices from auditors or truck products in from unmonitored off-site locations. The results can be tragic for those exploited, and can carry lasting negative effects for the firm. The sweatshop moniker continues to dog Nike years after allegations were uncovered and the firm moved aggressively to deal with its problems.[20]

Nike rival Reebok (now part of Adidas) has always taken working conditions seriously. The firm even has a vice president of human rights and has made human dignity a key platform for its philanthropic efforts. Reebok invested millions in developing an in-house information system to track audits of its hundreds of suppliers along dimensions such as labor, safety, and environmental practices. The goal in part was to identify any bad apples, so that one division, sporting goods, for example, wouldn't use a contractor identified as unacceptable by the sneaker line.

The data was valuable to Reebok, particularly given that the firm has hundreds of contract suppliers. But senior management realized the system would do even more good if the whole industry could share and contribute information. Reebok went on to donate this system and provided critical backing to help create the nonprofit organization Fair Factories Clearinghouse. With management that included former lawyers for Amnesty International, the Fair Factories Clearinghouse (FairFactories.org) provides systems where apparel and other industries can share audit information on contract manufacturers. Launching the effort wasn't as easy as sharing the technology. The US Department of Justice needed to provide a special exemption and had to be convinced the effort wouldn't be used by buyers to collude and further squeeze prices from competitors (the system is free of pricing data).

Suppliers across industries now recognize that if they behave irresponsibly the Fair Factories system will carry a record of their misdeeds, notifying all members to avoid the firm. As more firms use the system, its database becomes broader and more valuable. To its credit, Nike has since joined the Fair Factories Clearinghouse.

Key Takeaways

- Zara has used technology to dominate the retail fashion industry as measured by sales, profitability, and growth.
- Excess inventory in the retail apparel industry is the kiss of death. Long manufacturing lead times require executives to guess far in advance what customers will want. Guessing wrong can be disastrous, lowering margins through markdowns and write-offs.
- Contract manufacturing can offer firms several advantages, including lower costs and increased profits. But firms have also struggled with the downside of cost-centric contract manufacturing when partners have engaged in sweatshop labor, poor working conditions, and environmental abuse.
- Firms with products manufactured under unacceptable labor conditions face multiple risks, including legal action, brand damage, reduced sales, lower employee morale, and decreased appeal among prospective employees.

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Questions and Exercises

1. Has anyone shopped at Zara? If so, be prepared to share your experiences and observations with your class. What did you like about the store? What didn't you like? How does Zara differ from other clothing retailers in roughly the same price range? If you've visited Zara locations in different countries, what differences did you notice in terms of offerings, price, or other factors?
2. What is the "conventional wisdom" of the fashion industry with respect to design, manufacturing, and advertising?
3. What do you suppose are the factors that helped Gap to at one point rise to be first in sales in the fashion industry? Why do you suppose Gap profits collapsed?
4. Where do Gap clothes come from? Who makes them? Why? Are there risks in this approach?
5. Describe the downside of working with a supplier exposed as having used unethical practices. How does this potentially damage a firm? How can technology play a role in helping a firm become more socially responsible with its supply sourcing?
6. Describe the Fair Factories Clearinghouse. Which firm thought of this effort? Why did they give the effort away? Think in terms of strategic resources: what happens as more firms join this effort and share their data?

3.2 Don't Guess, Gather Data—Make Small Batches of What Customers Want & Ship It Fast!

Learning Objective

1. Contrast Zara's approach with the conventional wisdom in fashion retail, examining how the firm's strategic use of information technology influences design and product offerings, manufacturing, inventory, logistics, marketing, and ultimately profitability.

PDAs

Personal Digital Assistants, an early name for handheld mobile computing devices.

Having the wrong items in its stores hobbled Gap for roughly a decade. But how do you make sure stores carry the kinds of things customers want to buy? Try asking them. Zara's store managers lead an intelligence-gathering effort that heavily influences the products that the firm produces. Armed with custom apps on mobile devices (initially Windows **PDAs**, now touch-screen iPods) staff regularly chat up customers to gain insight on what patrons would like to see on store racks and shelves. A Zara manager might casually ask, "What if this skirt were in a longer length?" "Would you like it in a different color?" "What if this V-neck blouse were available in a round neck?" Staff enter responses on their mobile devices and send these insights back to headquarters. Managers are motivated to use these systems and accurately record data because they have skin in the game. As much as 70 percent of salaries can come from store sale performance,[21] with an additional 10 percent of the firm's overall profit increase shared across all firm employees.[22]

Another level of data gathering starts as soon as the doors close. Then the staff turns into a sort of investigation unit in the forensics of trendspotting, looking for evidence in the piles of unsold items that customers tried on but didn't buy. Are there any preferences in cloth, color, or styles offered among the products in stock? Record these insights, as well.[23]

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Information on what's selling is also tallied via the stores' **point-of-sale (POS) system**—the cash registers that ring up sales and deduct sold items from inventory. Nearly every retailer in every industry has a POS system, and the sales data gathered from these systems is very important. But Zara goes beyond most firms by also leveraging staff to gather more data via PDA and other means. This helps point to new products that customers want to see Zara produce, while also helping to uncover reasons why some products are being rejected.[24] In essence, the POS tells the firm *what's selling*, while PDA and related data tell the firm *what customers at a given location want to see on shelves*. All this valuable data allows the firm to plan new styles and issue rebuy orders based on *feedback* rather than hunches and guesswork. The goal is to improve the frequency and quality of decisions made by the design and planning teams.

point-of-sale (POS) system

Transaction processing systems that capture customer purchases. Cash registers and store checkout systems are examples of point-of-sale systems. These systems are critical for capturing sales data and are usually linked to inventory systems to subtract out any sold items.

Design

Rather than create trends by pushing new lines via catwalk fashion shows, Zara designs follow evidence of customer demand. The firm's chairman and CEO notes, "Our business model is the opposite of the traditional model. Instead of designing a collection long before the season, and then working out whether clients like it or not, we try to understand what our customers like, and then we design it and produce it."[25] Data on what sells and what customers want to see goes directly to "The Cube," where teams of some three hundred designers crank out an astonishing thirty thousand items a year[26] versus two thousand to four thousand items offered up at big chains like H&M (the world's third largest fashion retailer) and Gap.[27] H&M has offered lines by star designers like Stella McCartney, Karl Lagerfeld, and Kenzo Takada, as well as celebrity collaborations with The Weeknd and Zara Larsson (which, cheekily put Swedish pop star "Zara's" fashions in H&M stores). By contrast, the Zara design staff relies heavily on young, hungry *Project Runway* types fresh from design school. There are no prima donnas in "The Cube." Team members must be humble enough to accept feedback from colleagues and share credit for winning ideas. Individual bonuses are tied to the success of the team, and teams are regularly rotated to cross-pollinate experience and encourage innovation. Design staff regularly reach out to store managers electronically and via phone, and even sometimes fly managers back to headquarters in Spain to view mockups and consult on design.[28] The idea—those closest to customers are better equipped than the corner office VP at knowing what customers want.[29]

Manufacturing and Logistics

> *"Since the beginning, the idea has been to understand what the customer wants first and then have an integrated manufacturing and logistics system to be able to deliver it to them quickly." – Zara CEO Pablo Isla*[30]

In the fickle world of fashion, even seemingly well-targeted designs could go out of favor in the months it takes to get plans to contract manufacturers, tool up production, then ship items to warehouses and eventually to retail locations. But getting locally targeted designs quickly onto store shelves is where Zara really excels. In one telling example, when one pop star played a set of concerts in Spain, teenage girls arrived to the final show sporting a Zara knockoff of the outfit she wore during her first performance.[31] The average time for a Zara concept to go from idea to appearance in store is fifteen days; compare that to their rivals, who receive new styles once or twice a season. Smaller tweaks arrive even faster. If enough customers come in and ask for a round neck instead

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of a V neck, a new version can be in stores within just ten days.[32] To put that in perspective, Zara is *twelve times* faster than Gap despite offering roughly *ten times* more unique products![33] At H&M, it takes three to five months to go from creation to delivery—and they're considered one of the best. Other retailers need an average of six months to design a new collection and then another three months to manufacture it. VF Corp (Lee, Wrangler) can take nine months just to design a pair of jeans, while J.Jill needs a year to go from concept to store shelves.[34] At Zara, most of the products you see in stores didn't exist three weeks earlier, not even as sketches.[35] Says one analyst, "Think of Zara not as a brand, but as a very speedy chameleon that adapts instantly to fashion trends."[36]

vertical integration

When a single firm owns several layers in its value chain.

value chain

The set of activities through which a product or service is created and delivered to customers.

greige

Goods to be further customized based on designer/manager collaboration.

The firm is able to be so responsive through a competitor-crushing combination of **vertical integration** and technology-orchestrated coordination of suppliers, just-in-time manufacturing, and finely tuned logistics. Vertical integration is when a single firm owns several layers in its **value chain**.[37] While H&M has nine hundred suppliers and no factories, nearly 60 percent of Zara's merchandise is produced in-house, with an eye on leveraging technology in those areas that speed up complex tasks, lower cycle time, and reduce error. Profits at Zara come in part from blending math with a data-driven fashion sense. Inventory optimization models help the firm determine how many of which items in which sizes should be delivered to each specific store during twice-weekly shipments, ensuring that each store is stocked with just what it needs.[38] Outside the distribution center in La Coruña, fabric is cut and dyed by robots in twenty-three highly automated factories. Zara is so vertically integrated, the firm makes 40 percent of its own fabric and purchases most of its dyes from its own subsidiary. Roughly half of the cloth arrives undyed so the firm can respond as any midseason shifts in taste and trends. When cotton prices rose to record levels, Zara was able to shift offerings away from more costly fabrics, preserving margins. By contrast, during that same period rival H&M saw profits drop 10 percent largely due to margin pressure.[39] Other local suppliers provide on-demand, partially finished **greige** (pronounced gray) goods to be further customized based on designer/manager collaboration. After cutting and dying, many items are stitched together through a network of local cooperatives that have worked with Inditex so long they don't even operate with written contracts. The firm does leverage some contract manufacturers, but most of those used for trendy clothes are fairly close (Portugal, Morocco, and Turkey). There are far cheaper places to seek partners, but for Zara, speed beats manufacturing costs and drives profits.[40] Any contractors employed in farther regions (the firm has used partners in Asia and Latin America) produce staple items with longer shelf lives, such as t-shirts and jeans, but such goods account for only about one-eighth of dollar volume (also lessening exposure to events associated with poor partner labor practices, which have occurred). [41]

All of the items the firm sells end up in a 5-million-square-foot distribution center in La Coruña (that's about as big as ninety football fields), or a similar facility in Zaragoza in the northeast of Spain.[42] The facilities move over 17 million items every week,[43] with no item staying in-house for more than seventy-two hours. Ceiling-mounted racks and customized sorting machines patterned on equipment used by overnight parcel services, and leveraging Toyota-designed logistics, whisk items from factories to staging areas for each store. Clothes are ironed in advance and packed on hangers, with security and price tags affixed. This system means that instead of wrestling with inventory during busy periods, employees in Zara stores simply move items from shipping box to store racks, spending most of their time on value-added, sales-focused functions like helping customers find what they want.[44]

RFID

Small chip-based tags that wirelessly emit a unique identifying code for the item that they are attached to. Think of RFID systems as a next-generation bar code.

Zara inventory is smart. Security tags are custom made to also include **RFID**-technology. RFID (radio frequency identification) tags wirelessly emit a unique identifying code for the individual item that they are attached to. As an item moves around the Zara distribution center, or into Zara stores, wall mounted or hand-held scanners can listen in, track product, and take inventory. RFID lets Zara know where products are, so if a customer asks for an item in a store (perhaps in a different size or color), staff using custom apps on an iPod Touch can immediately tell if a product is in store, in a nearby store, or if it can be ordered from the distribution center or Zara.com. Firms from Walmart to JCPenny have struggled to effectively implement RFID, but Zara's vertical integration is an advantage here, as well. Since the entire supply chain is under Zara control and all items flow through one of two warehouses, Zara can affix tags to all products before sending them out to

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stores (a challenge for other retailers that have third-party suppliers ship to multiple warehouses or directly to stores). Stores remove tags when customers buy items (avoiding any privacy concern that customer goods may be electronically tracked post-purchase).[45] Stores then send tags back to Zara warehouses for reuse (reassigning a tag's unique identification number to a new clothing item). Although tags only cost ten cents, with hundreds of millions of items sold each year, these costs would easily add up, so the reusable tag system makes solid financial sense (Zara bought so many tags at launch that it actually consumed one in every six tags produced for the entire apparel industry that year).[46] RFID tags also allow Zara staff to take in-store inventory four times as often as the pre-RFID rate, with greater accuracy, and using one forth the staff.[47]

RFID Tags in Use

Watch RFID tags announce inventory items from warehouse to store, increasing efficiency and customer service.



View the video online at: http://www.youtube.com/embed/EplinGX_sBc?rel=0

To get products into stores quickly, trucks serve destinations that can be reached overnight, while chartered cargo flights serve farther destinations within forty-eight hours.[48] Air freight ships via Air France–KLM Cargo and Emirates Air, and flights coordinate outbound shipment of all Inditex brands with return legs loaded with raw materials and half-finished clothes items from locations outside of Spain. Zara is also a pioneer in going green, with an environmental strategy that includes the use of renewable energy systems at **logistics** centers and biodiesel for the firm's trucking fleet.

logistics

Coordinating and enabling the flow of goods, people, information, and other resources among locations.

Stores

Most products are manufactured for a limited production run. While running out of bestsellers might be seen as a disaster at most retailers, at Zara the practice delivers several benefits.

First, limited runs allow the firm to cultivate the exclusivity of its offerings. While a Gap in Los Angeles carries nearly the same product line as one in Milwaukee, each Zara store is stocked with items tailored to the tastes of its local clientele. A Fifth Avenue shopper quips, "At Gap, everything is the same," while a Zara shopper in Madrid says, "You'll never end up looking like someone else."[49] Upon visiting a Zara, the CEO of the National Retail Federation marveled, "It's like you walk into a new store every two weeks."[50]

Second, limited runs encourage customers to buy right away and at full price. Savvy Zara shoppers know the newest items arrive on black plastic hangers, with store staff transferring items to

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wooden ones later on. Don't bother asking when something will go on sale; if you wait three weeks the item you want has almost certainly been sold or moved out to make room for something new. Says one twenty-three-year-old Barcelona shopper, "If you see something and don't buy it, you can forget about coming back for it because it will be gone."[51] A study by consulting firm Bain & Company estimated that the industry average markdown ratio is approximately 50 to 70 percent, and less than 1 percent of JCPenney revenue came from items bought at full price.[52] Contrast this with Zara, where 85 percent of products are sold without a discount.[53]

The constant parade of new, limited-run items also encourages customers to visit often. The average Zara customer visits the store seventeen times per year, compared with only three annual visits made to competitors.[54] Even more impressive—Zara puts up these numbers with almost no advertising. The firm's founder has referred to advertising as a "pointless distraction." The assertion carries particular weight when you consider that during Gap's collapse, the firm increased advertising spending but sales dropped.[55] Fashion retailers such as H&M spend as much as 4 percent of revenue promoting their products, while ad spending at Inditex ranges from 0.3 to 0.05 percent.[56]

Finally, limited production runs allow the firm to, as Zara's CEO once put it, "reduce to a minimum the risk of making a mistake, and we do make mistakes with our collections."[57] Failed product introductions are reported to be just 1 percent, compared with the industry average of 10 percent.[58] The overall number of unsold items at Zara is less than 10 percent of inventory, while the industry average often runs as high as 20 percent.[59] So even though Zara has higher manufacturing costs than rivals, Inditex gross margins are nearly 60 percent, compared to 39 percent at Gap.[60]

While stores provide valuable frontline data, headquarters plays a major role in directing in-store operations. Software is used to schedule staff based on each store's forecasted sales volume, with locations staffing up at peak times such as lunch or early evening. The firm claims these more flexible schedules have shaved staff work hours by 2 percent. This constant refinement of operations throughout the firm's value chain has helped reverse a prior trend of costs rising faster than sales.[61]

Even the store displays are directed from "The Cube," where a basement staging area known as "Fashion Street" houses a Potemkin village of bogus storefronts meant to mimic some of the chain's most exclusive locations throughout the world. It's here that workers test and fine-tune the chain's award-winning window displays, merchandise layout, and even determine the in-store soundtrack. Every two weeks, new store layout marching orders are forwarded to managers at each location.[62]

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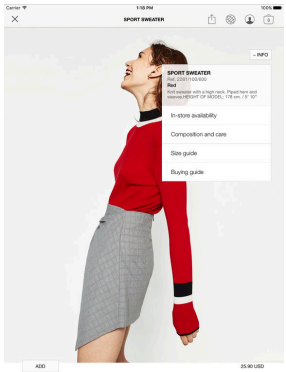
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Integrating E-Commerce: Omnichannel = More Sales + Better Customer Experience

While Zara continues to offer limited-run products, it has boosted its e-commerce efforts. Inditex see e-commerce as a critical part of the firm's **omnichannel** strategy, which blends online and offline sales in ways that best benefit the customer. The company sees the link between online and offline sales as being so fluid, it doesn't even breakout online sales as a separate category. For example, roughly two-thirds of online shopping returns are done in-store, while one-third of online orders are scheduled for in-store pickup. Many of the returns are exchanges for new sizes that are easier to assess in person.[63] And if an item isn't available in the current location, online orders handled from in-store apps might surface an item in the right size or color available online, allowing store managers to rescue a sale and satisfy the customer. A review of fashion e-commerce apps rated Zara's offering as best-in-class,[64] and there is no evidence that online shopping is cannibalizing in-store sales.[65] In fact, one analyst estimates e-commerce contributes about €2.2 billion to sales, or around 9 percent of overall revenue.[66]

While Zara's products are very competitively priced, the uniqueness of the firm's product line does give it some price cushioning that vendors of more commoditized clothing don't enjoy. For example, fashion retailer Primark quit its e-commerce experiment after seeing that shipping costs for commodity shirts were similar to their sales price.[67] Zara's approach to online seems to blend perfectly with the company's overall strategy/technology alignment.

FIGURE 3.4
Zara's iPad App
This image from Zara's 5-star-rated app shows in-store availability, as well as a style-guide, size guide, and garment care information.



Source: Zara-supplied image in iTunes app store - June 2017

omnichannel

An approach to retail that offers consumers an integrated and complementary set of shop, sales, and return experiences (e.g., retail store, online, and sometimes even phone and catalog).

information system (IS)

An integrated solution that combines five components: hardware, software, data, procedures, and the people who interact with and are impacted by the system.

return on investment (ROI)

The amount earned from an expenditure.

Technology ≠ Systems. Just Ask Prada.

Here's another interesting thing about Zara. Given the sophistication and level of technology integration within the firm's business processes, you'd think that Inditex would far outspend rivals on tech. But as researchers Donald Sull and Stefano Turconi discovered, "Whether measured by IT workers as a percentage of total employees or total spending as a percentage of sales, Zara's IT expenditure is less than one-fourth the fashion industry average."[68] Zara excels by targeting technology investment at the points in its value chain where it will have the most significant impact, making sure that every dollar spent on tech has a payoff.

Contrast this with high-end fashion house Prada's efforts at its flagship Manhattan location. The firm hired the Pritzker Prize–winning hipster architect Rem Koolhaas to design a location Prada would fill with jaw-dropping technology. All items for sale in the store would sport radio frequency identification (RFID) tags. Walk into a glass dressing room and customers could turn the walls opaque, then into a kind of combination mirror and heads-up display. By wirelessly reading the tags on each garment, dressing rooms would recognize what was brought in and make recommendations of matching accessories as well as similar products that patrons might consider. Customers could check inventory, and staff wielding PDAs could do the same. A dressing room camera would allow clients to see their front and back view side-by-side as they tried on clothes.

It all sounded slick, but execution of the vision was disastrous. Customers didn't understand the foot pedals that controlled the dressing room doors and displays. Reports surfaced of fashionistas disrobing in full view, thinking the walls went opaque when they didn't. Others got stuck in

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dressing rooms when pedals failed to work, or doors broke, unable to withstand the demands of the high-traffic tourist location. The inventory database was often inaccurate, regularly reporting items as out of stock even though they weren't. As for the PDAs, staff reported that they "don't really use them anymore" and that "we put them away so tourists don't play with them." The investment in Prada's in-store technology was also simply too high, with estimates suggesting the location took in just one-third the sales needed to justify expenses.[69]

The Prada example offers critical lessons for managers. While it's easy to get seduced by technology, an **information system (IS)** is actually made up of more than *hardware* and *software*. An IS also includes *data* used or created by the system, as well as the *procedures* and the *people* who interact with the system.[70] Getting the right mix of these five components is critical to executing a flawless information system rollout. Financial considerations should forecast the **return on investment (ROI)**—the amount earned from an expenditure—of any such effort (i.e., what will we get for our money and how long will it take to receive payback?). And designers need to thoroughly test the system before deployment. At Prada's Manhattan flagship store, the effort looked like tech that was chosen because it seemed fashionable rather than functional.

Key Takeaways

- Zara store management and staff use mobile devices and POS systems to gather and analyze customer preference data, and to plan future designs based on feedback, rather than on hunches and guesswork.
- Zara's combination of vertical integration and technology-orchestrated supplier coordination, just-in-time manufacturing, and logistics allows it to go from design to shelf in days instead of months.
- RFID tags help Zara keep better track of inventory–improving warehouse-to-store distribution, and makes it easier to locate items that customers want to purchase.
- Advantages accruing to Inditex include fashion exclusivity, fewer markdowns and sales, lower marketing expenses, and more frequent customer visits.
- Zara's IT expenditures are low by fashion industry standards. The spectacular benefits reaped by Zara from the deployment of technology have resulted from targeting technology investment at the points in the value chain where it has the greatest impact, and not from the sheer magnitude of the investment. This is in stark contrast to Prada's experience with in-store technology deployment.
- While information technology is just hardware and software, information systems also include data, people, and procedures. It's critical for managers to think about systems, rather than just technologies, when planning for and deploying technology-enabled solutions.

Questions and Exercises

1. In what ways is the Zara model counterintuitive? In what ways has Zara's model made the firm a better performer than Gap and other competitors?
2. What factors account for a firm's profit margin? What does Gap focus on? What factors does Zara focus on to ensure a strong profit margin?
3. How is data captured in Zara stores? Using what types or classifications of information systems? How does the firm use this data?
4. What role does technology play in enabling the other elements of Zara's counterintuitive strategy? Could the firm execute its strategy without technology? Why or why not?
5. Why has Zara's RFID rollout been less problematic than those at Walmart and JCPenney? How does Zara's use of RFID reduce concerns that customer products will be tracked post-purchase? How does Zara reduce the expense associated with tagging each item? How does RFID improve efficiency and customer service?

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6. How does technology spending at Zara compare to that of rivals? Advertising spending? Failed product percentages? Markdowns?
7. What risks are inherent in the conventional practices in the fashion industry? Is Zara susceptible to these risks? Is Zara susceptible to different risks? If so, what are these?
8. Consider the Prada case mentioned in the sidebar "Technology ≠ Systems." What did Prada fail to consider when it rolled out the technology in its flagship location? Could this effort have been improved for better results? If you were put in charge of this kind of effort, what would determine whether you'd go forward with the effort or not? If you did go forward, what factors would you consider and how might you avoid some of the mistakes made by Prada?

3.3 Moving Forward

Learning Objectives

1. Detail how Zara's approach counteracts several profit-eroding challenges that many fashion retailers struggle with.
2. Identify the environmental threats that Zara is likely to face, and consider options available to the firm for addressing these threats.

The holy grail for the strategist is to craft a sustainable competitive advantage that is difficult for competitors to replicate. And for two decades Zara has delivered the goods. But that's not to say the firm is done facing challenges.

Consider the limitations of Zara's Spain-centric, just-in-time manufacturing model. By moving all of the firm's deliveries through just two locations, both in Spain, the firm remains hostage to anything that could create a disruption in the region. Firms often hedge risks that could shut down operations—think weather, natural disaster, terrorism, labor strife, or political unrest—by spreading facilities throughout the globe. If problems occur in northern Spain, Zara has no such fallback.

In addition to the **operations** vulnerabilities above, the model also leaves the firm potentially more susceptible to financial vulnerabilities during periods when the euro strengthens relative to foreign currencies, especially the dollar (to which many developing nations peg their currency). A stronger euro means Zara's Spain-centric costs would rise at higher rates compared to competitors. Rising transportation costs are another concern. If fuel costs rise, the model of twice-weekly deliveries that has been key to defining the Zara experience becomes more expensive to maintain.

operations

The organizational activities that are required to produce goods or services. Operations activities can involve the development, execution, control, maintenance, and improvement of an organization's service and manufacturing procedures.

Still, Zara is able to make up for some cost increases by raising prices overseas (when the Euro is strong vs. the dollar, Zara items can cost 40 percent or more than they do in Spain). Zara reports that all North American stores are profitable, and that it can continue to grow its presence, serving forty to fifty stores with just two US jet flights a week.[71] Management has considered a logistics center in Asia, but expects current capacity will suffice for now.[72]Another possibility might be a regional center. China has surpassed France to become Zara's second largest market after Spain,[73] meaning some of the clothing that Zara sells travels from Asia to Spain, only to be routed back to stores in China.[74] If Zara could replicate what it does in Spain with a facility in China, Vietnam, or other nation in the region, this could give the firm more global sourcing flexibility and likely decrease cost. Still, experts remain skeptical of Zara's ability to replicate the firm's high-tech, flexible capacity half a world away.[75] One advisor to the firm voices concerns in having "two brains, one in Spain and one in China."[76] A similar facility in the Maquiladora region of northern Mexico could serve the US markets via trucking capacity similar to the firm's Spain-based access to Europe, while also providing a regional center to serve expansion throughout the Western Hemisphere. Rising

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incomes and a cultural link to Spain make Latin America look like an increasingly attractive market, but the United States may not be as ripe for growth. While Zara now has over fifty stores in the United States and is running a profitable stateside business, one industry watcher calls the United States a "graveyard of European retailers."[77] Among US expansion challenges cited are American fashionistas' tendency to be concentrated on the coasts and American sizes often being significantly different in cut than the rest of the world.[78]

showrooming

The concept where customers browse at physical retailers, but purchase products from lower-cost online rivals.

Rivals have studied the Zara recipe, and while none has attained the efficiency of Amancio Ortega's firm, many are trying to learn from the master. There is precedent for contract firms closing the cycle time gap with vertically integrated competitors that own their own factories. Dell (a firm that once built its own PCs while nearly all its competitors used contract labor) has seen its manufacturing advantage from vertical integration fall as the partners that supply rivals have mimicked its techniques and have become far more efficient.[79] In terms of the number of new models offered, clothing is actually more complex than computing, suggesting that Zara's value chain may be more difficult to copy. Still, H&M has increased the frequency of new items in stores and is eyeing shifting some contract manufacturing away from Asia and closer to its European markets.[80] Forever 21 and Uniqlo get new looks within six weeks, and Renner, a Brazilian fast fashion rival, rolls out mini collections every two months.[81] Online firms may also nibble at Zara's customer base. European online retailers such as ASOS and Boohoo are growing quickly and can be super-speedy by eliminating the hop to the store and getting product directly to consumers.[82] Evolving technology, such as the app by retailer Zalando, which allows customers to snap a photo of an item and search for similar styles, may also create so-called "**showrooming**" pressure, where customers browse a retailer but buy competing items online.[83] Rivals have a keen eye on Inditex, with the CFO of luxury goods firm Burberry claiming the firm is a "fantastic case study" and "we're mindful of their techniques."[84]

Finally, firm financial performance can also be impacted by broader economic conditions. When the economy falters, consumers simply buy less and may move a greater share of their wallets to less-stylish and lower-cost offerings from deep discounters like Walmart. Zara is also particularly susceptible to conditions in Europe, since that market accounts for roughly two-thirds of firm sales.[85] Global expansion will provide the firm with a mix of locations that may be better able to endure downturns in any single region. Recent Spanish and European financial difficulties have made clear the need to decrease dependence on sales within one region, underscoring the importance of the firm's continued, aggressive pace of opening stores in new markets worldwide.

Zara's winning formula can only exist through management's savvy understanding of how information systems can enable winning strategies (many tech initiatives were led by José Maria Castellano, a "technophile" business professor who became Ortega's right-hand man in the 1980s).[86] It is technology that helps Zara identify and manufacture the clothes customers want, get those products to market quickly, and eliminate costs related to advertising, inventory missteps, and markdowns. A strategist must always scan the state of the market as well as the state of the art in technology, looking for new opportunities and remaining aware of impending threats. With systems so highly tuned for success, it may be unwise to bet against "The Cube."

Key Takeaway

- Zara's value chain is difficult to copy; but it is not invulnerable, nor is future dominance guaranteed. Zara management must be aware of the limitations in its business model, and must continually scan its environment and be prepared to react to new threats and opportunities.

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Questions and Exercises

1. The Zara case shows how information systems can impact every single management discipline. Which management disciplines were mentioned in this case? How does technology impact each?
2. Would a traditional Internet storefront work well with Zara's business model? Why or why not?
3. Zara's just-in-time, vertically integrated model has served the firm well, but an excellent business is not a perfect business. Describe the limitations of Zara's model and list steps that management might consider to minimize these vulnerabilities.
4. What challenges might Zara face in expanding to China or to the United States? Do you think Zara should increase capacity in Spain or open a regional distribution center in another part of the world? What are the pros and cons of each approach?
5. Search online to find examples of firms that suffered production problems because they employed just-in-time manufacturing or kept limited inventory on hand. What caused the production problems? List any steps you can think of that the firms might consider to minimize the potential of such problems from occurring in the future. What role might technology play in your solution?

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CHAPTER 4

Netflix in Two Acts: Sustaining Leadership in an Epic Shift from Atoms to Bits

4.1 Introduction

Learning Objectives

1. Understand the basics of the two subscription services that Netflix has operated, DVD-by-mail and video streaming. Also appreciate that the dynamics at work in these two services are fundamentally different in many key ways that influence product offerings, operating cost, competitors, and more.
2. Recognize that the firm has experienced wild swings in market perception and stock performance as it attempts the difficult transition from relying on a model that fewer users want (DVD-by-mail subscriptions) to one that is fueling higher growth worldwide (video streaming).

Perhaps no CEO in recent memory has experienced more significant whipsaw swings than Netflix cofounder Reed Hastings. In less than three years, Hastings had gone from tech industry pinnacle to business press punching bag, to bounce back and again be considered (as *BusinessWeek* headlined) one of "Silicon Valley's Elite."[1]

For years, Netflix was known for best-in-class service, regularly and repeatedly ranking atop multiple customer satisfaction surveys. Hastings had been appointed to the board of directors of two of the tech industry's most influential firms—Microsoft and Facebook.[2] *Fortune* featured Hastings on its cover as "Businessperson of the Year," and Netflix's profits, customer base, and stock had each hit an all-time high.

But concerns over transitioning the firm to a future where Internet streaming dominates and DVDs go away resulted in a painful series of self-inflicted wounds that left the firm reeling. A poorly communicated repricing scheme was followed by a botched attempt to split the firm into two separate services. This caused an exodus of nearly 1 million customers in three months, a collapse of the firm's share price, and calls for Hastings's resignation (see the sidebar in section 3, "The Qwikster Debacle").[3] Since then, Hastings has aggressively expanded the firm's customer base at home and abroad; he's sponsored the creation of critically acclaimed, original content; and a series of Street-beating earnings reports has fueled the firm's previously beaten-down stock to record highs.

While the DVD business built Netflix into a sector-dominating powerhouse, Hastings is correct in understanding that digital streaming is where consumers, technology, and the industry are headed. The need to transition was clear to Netflix execs, but the business of streaming video is radically different from DVD-by-mail in several key ways, including content costs, content availability,

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revenue opportunities, rivals and their motivation, and more. Netflix is unquestionably the largest and strongest global player in streaming content today, however, many wonder if it can maintain long-term dominance through a costly content war and a diverse set of players with wildly different strengths (Disney with content, Apple with hardware customers, Amazon giving product away as a free perk), and competitive motivations.

Why Study Netflix?

Studying Netflix gives us a chance to examine how technology helps firms craft and reinforce a competitive advantage. Even more importantly, Netflix provides one of the very rare examples of a firm that has continued to lead as the firm shifts focus from one business model to the next. While the still profitable DVD-by-mail business is dying, many will still want to read this section for key learning. Topics covered in this section include how technology played a starring role in developing assets such as scale, brand, and switching costs that combined to repel well-known rivals and place Netflix atop its industry. This section also introduces important business and technology concepts such as the long tail, collaborative filtering, and the value of the data asset. In the second part of this chapter, we examine Netflix, the sequel, and the firm's transition to video streaming. This section looks at the very significant challenges the firm faces as its primary business shifts from shipping the atoms of DVDs to sending bits over the Internet. We'll see that a highly successful firm can still be challenged by technical shifts, and we'll learn from Netflix's struggles as well as its triumphs. This section gives us an opportunity to examine issues that include digital goods, licensing, content creation, international growth and regulation, supplier power, crowdsourcing, platform competition, legal and regulatory issues, and technology infrastructure. We'll also look at the kinds of competitive advantages that Netflix is crafting now that it's fully committed to a video streaming future.

How Netflix Works: A Model in Transition

Netflix got its start offering a DVD-by-mail service for a monthly, flat-rate subscription fee. Under this model, customers don't pay a cent in mailing expenses, and there are no late fees. Videos arrive in red Mylar envelopes that are addressed and postage-paid for reuse in disc returns. When done watching videos, consumers just slip the DVD back into the envelope, reseal it with a peel-back sticky strip, and drop the disc in the mail. Users make their video choices in their "request queue" at Netflix.com. If a title isn't available, Netflix simply moves to the next title in the queue. Consumers use the website to rate videos they've seen, specify their viewing preferences, get video recommendations, check out title details, and even share their viewing habits and reviews.

This model helped Netflix grow into a giant, but Hastings knew that if his firm was to remain successful, it would have to transition from mailed DVDs to streamed video. Says Hastings, "We named the company Netflix for a reason; we didn't name it DVDs-by-mail."[4] Today the firm is so focused on digital distribution that it offers its streaming-only subscription as the default option for consumers. The default page at Netflix.com doesn't even mention DVDs; the disc subscription service that Netflix built its user base with has become an optional add-on that the firm is actively discouraging new consumers from joining. For less than $8 a month ($11 if you want HD and 2 simultaneous streams, $14 for Ultra HD with 4 streams), customers gain unlimited access to the entire Netflix streaming library (which is far smaller than the number of DVDs available for mailing). Netflix streaming is available on PCs, as well as all major tablets, smartphones, and Internet-connected televisions, DVD players, video game consoles, and a wide variety of specialty TV streaming hardware.

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Netflix at 100M Subscribers - How Netflix Changed TV

Newsweek Media Group recaps the rise of Netflix streaming service and compares it to rivals.



View the video online at: //www.youtube.com/embed/XL6zNexyt8o?rel=0

Key Takeaways

- Netflix operates via a DVD subscription and video-streaming model. These started as a single subscription, but are now viewed as two separate services. Although sometimes referred to as "rental," the model is really a substitute good for conventional use–based media rental.
- Many firms are forced to deal with technology-fueled disruption that can challenge the current way they do business. However, successfully transitioning to a new business model is often extremely difficult, even for firms that were dominant under a prior operating model.

Questions and Exercises

1. Describe the two separate Netflix offerings.
2. During his time as CEO of Netflix, Hastings has also served roles for other firms. What additional managerial roles outside of Netflix has Reed Hastings accepted? Why might these roles potentially be important for Netflix?
3. Can you think of once-successful firms that were forced to radically redesign their businesses based on technology change? How did the firms in your list fare with the new model—better or worse than their prior success? Why do you suppose they experienced the outcomes you've identified?

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4.2 Act I: David Becomes Goliath: Crafting Killer Assets for DVD-by-Mail Dominance

Learning Objectives

1. Recognize the downside the firm may have experienced from an early IPO.
2. Appreciate why other firms found Netflix's market attractive, and why many analysts incorrectly suspected Netflix was doomed.
3. Understand how many firms have confused brand and advertising, why branding is particularly important for online firms, and the factors behind Netflix's exceptional brand strength.
4. Understand the *long tail* concept, and how it relates to Netflix's ability to offer the customer a huge (the industry's largest) selection of movies
5. Know what *collaborative filtering* is, how Netflix uses collaborative filtering software to match movie titles with the customer's taste, and in what ways this software helps Netflix garner sustainable competitive advantage.
6. Describe the sources of Netflix's size advantage in the DVD-by-mail business, and how this large scale is a difficult-to-create asset for any startups trying to compete in DVD-by-mail. Understand the role that scale economies play in Netflix's strategies, and how these scale economies pose an entry barrier to potential competitors.
7. Recognize how Netflix built a data asset and why this asset was so valuable in the firm's original business model.
8. Understand the role that market entry timing has played in the firm's success.

Reed Hastings once said his biggest strategic regret was taking his firm public too early. Once public, the firm was required to disclose its financial position, and the whole world soon learned that Netflix was on a profit march with a remarkable growth trajectory.[5] The news was like blood in the water, attracting two very big sharks. First came Blockbuster, a firm with forty million card-carrying customers and a name synonymous with home video rental. Following Blockbuster was Walmart, not just a *Fortune* 500 firm, but *Fortune* One—the *biggest* firm in the United States as ranked by revenues. One analyst referred to the firm's impending competition as "The Last Picture Show" for Netflix,[6] and another called the firm a "worthless piece of crap," setting a $3 target on a stock that was then trading at $11 a share.[7] How did Netflix respond? With constant customer and revenue growth, record profits, and a stock price that skyrocketed past $400. Like the triumphant final scene in a feel-good movie, the dot-com did it. David knocked off not one but two Goliaths.

Understanding how this dot-com won the DVD-by-mail business provides a useful lesson in the execution of successful strategy. Netflix was able to create critical and mutually reinforcing resources—*brand*, *scale*, and a *data asset*—that rivals simply could not match. The Netflix example also underscores lessons from Chapter 2 that timing and technology can be critical in nurturing assets for competitive advantage.

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Brand Strength from Best-in-Class Customer Experience

First let's look at the Netflix brand. Don't confuse brand with advertising. During the dot-com era, firms thought brands could be built through Super Bowl ads and expensive television promotion. Advertising can build awareness, but *brands are built through customer experience*. This is especially critical online, where opinion spreads virally and competition is just a click away. During the firm's ascendency in the DVD-by-mail business, Netflix wasn't simply a provider of good customer experience; it was often ranked the best. The firm was top in the American Customer Satisfaction Index (ACSI) and Nielsen rankings, while ratings agency ForeSee named Netflix the number one e-commerce site in eleven out of twelve surveys conducted (placing it ahead of Apple and Amazon).

Blockbuster and Walmart, however, discovered that their strong consumer awareness didn't translate into any advantage when competing with Netflix. While both firms were well known, neither name was synonymous with a DVD-by-mail subscription service. Reed Hastings's early market entry and effective execution made Netflix the first firm consumers thought of. Everyone else in the space had to spend big to try to create awareness alongside the mindshare leader.

Scale from the Distribution Network

The high degree of customer satisfaction that Netflix enjoyed is tightly linked with the firm's size-based advantages. Yes, even though Netflix was the upstart, it managed to gain relevant scale greater than Blockbuster (even though that firm had 7,800 stores) and Walmart (with its nation-leading sales might). It did so by building and leveraging an asset that neither competitor had: a nationwide network of fifty-eight highly automated distribution centers that collectively could deliver DVDs overnight to some 97 percent of the US population. Drop a disc in the mail, and in most cases you'd get a new one the next day. No one else had a comparable network at launch, so the lack of scale among rivals harmed their customer experience, weakening their brand.

Scale from Selection: The Long Tail

Netflix appeal also came from the scale of the firm's entertainment selection. A traditional video store would stock a selection of roughly 3,000 DVD titles on its shelves. Netflix, however, offered its customers over 125,000 unique DVD titles. The battle over who had the better selection wasn't even close. This nearly limitless selection allows Internet retailers to leverage what is often called the **long tail** (the tail refers to the large number of products unavailable through conventional retail stores, see Figure 4.1). Customers saw advantage in having vast choice. Roughly 75 percent of DVDs Netflix shipped were from back-catalog titles, versus the 70 percent of Blockbuster rentals that came from new releases.[8] While some debate the size of the profitable tail, two facts are critical to keep above this debate: (1) selection attracts customers, and (2) the Internet allows large-selection inventory efficiencies that offline firms can't match.

long tail

In this context, it refers to an extremely large selection of content or products. The long tail is a phenomenon whereby firms can make money by offering a near-limitless selection.

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FIGURE 4.1 The Long Tail



The Big Customer Base—Delivering True Economies of Scale

While Netflix's warehouse network and product selection were greater than those of rivals, these assets could be bought by a competitor with a big wallet. Says Netflix's vice president of operations, "Anyone can replicate [our] operations if they wish. It's not going to be easy. It's going to take a lot of time and a lot of money."[9] The yearly cost to run a Netflix-comparable nationwide delivery infrastructure is about $300 million.[10] This is where another critical component of scale comes in—the size of the firm's customer base.

In Chapter 2 we learned that *scale economies* are achieved by firms that leverage the cost of an investment across increasing units of production. If the entry price for getting into the national DVD-by-mail game is $300 million, but one firm has far more customers than the other (see Figure 4.2 for estimates in the one-time Netflix versus Blockbuster competition), then the bigger firm has a better cost structure and better profit prospects and should be able to offer better pricing. Walmart had the cash to compete with Netflix but decided doing so would require a massive investment and extended periods of loss to unseat the early-moving leader, so Walmart pulled the plug on their DVD-by-mail effort. Blockbuster decided to fight to the death—and lost. The firm never had the necessary threefold scale advantages (distribution centers, selection, and customers) needed to create a competitive DVD-by-mail business.

FIGURE 4.2 Economies of Scale

Running a nationwide sales network cost an estimated $300 million a year. But Netflix had several times more subscribers than Blockbuster did. Which firm had economies of scale?[11]



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Leveraging the Data Asset: Collaborative Filtering and Beyond

Netflix also keeps customers happy in brand-building ways by leveraging its massive and growing arsenal of user data. Data is collected when customers rate movies they've seen, and this data on customer likes and dislikes is fed into a proprietary Netflix recommendation system called Cinematch. Cinematch is a software technology known as **collaborative filtering**. These systems monitor trends among customers and use this data to personalize an individual customer's experience. Firms use collaborative filtering systems to customize webpages and make all sorts of recommendations, including products, music, and news stories.

collaborative filtering
A classification of software that monitors trends among customers and uses this data to personalize an individual customer's experience.

Recommended titles made up over 60 percent of the content that Netflix users placed in their DVD request queues—an astonishing penetration rate. This data is also a switching cost. Drop Netflix for a rival, and the average user abandons the two hundred or more films they've rated. The year after Blockbuster and Walmart launched copycat efforts, the Netflix **churn rate** actually fell.[12] It seems that even though big-name rivals had arrived with shiny new offerings, the Netflix value proposition was actually growing stronger over time.

churn rate
The rate at which customers leave a product or service.

Cinematch data also offers Netflix operational advantages. The firm examines inventory availability in the warehouse closest to a given customer and tailors recommendations to favor movies that are in stock so that users aren't frustrated by a wait.

Netflix also learned to make studios happy by leveraging Cinematch to help them find an audience for their back catalog of movies and television shows. The firm developed a revenue-sharing system where studios could offer Netflix their DVD catalog at a wholesale price in exchange for a cut of Netflix subscriber revenues each time someone requests a given DVD. This was huge for studios; suddenly they had a way to extend the profit-earning life of their movie and TV catalogs, and all without requiring a dime extra in additional marketing. As an example of this power, consider that Netflix delivered more revenue to Fox from the critically acclaimed but box-office-weakling film *The Last King of Scotland* than it did from the blockbuster film *X-Men: The Last Stand*.[13]

Winning Act I

Blockbuster tried to combat Netflix on the playing field that Reed Hastings had defined, but the results were disastrous. During the three-year period that included the launch of its "Total Access" DVD-by-mail effort, Blockbuster lost over $4 billion and closed hundreds of stores.[14] The firm never recovered and was eventually purchased by Dish Network at a bankruptcy auction.[15]

As for Netflix, what delivered the firm's triple scale advantage of the largest selection, the largest network of distribution centers, and the largest customer base, along with the firm's industry-leading strength in brand and data assets? Moving first. Timing and technology don't always yield sustainable competitive advantage, but in this case, Netflix leveraged both to craft an extraordinarily valuable and mutually reinforcing pool of assets.

But as we'll see in Section 3, while technology shifts helped Netflix attack Blockbuster's once-dominant position, even newer technology shifts may threaten Netflix. As they like to say in the mutual fund industry, "Past results aren't a guarantee of future returns."

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Key Takeaways

- Analysts and managers have struggled to realize that dot-com start-up Netflix could actually create sustainable competitive advantage, beating back challenges in its initial and highly successful DVD-by-mail business, from Walmart and Blockbuster, among others.
- Data disclosure required by public companies may have attracted these larger rivals to the firm's market.
- In understanding the initially successful DVD-by-mail business, technology leveraged across the firm's extensive distribution network offers an operational advantage that allows the firm to reach nearly all of its customers with one-day turnaround.
- Durable brands are built through customer experience, and technology lies at the center of the Netflix top satisfaction ratings, and hence the firm's best-in-class brand strength.
- Physical retailers are limited by shelf space and geography. This limitation means that expansion requires building, stocking, and staffing operations in a new location.
- Internet retailers serve a larger geographic area with comparably smaller infrastructure and staff. This fact suggests that Internet businesses are more scalable. Firms providing digital products and services are potentially far more scalable, since physical inventory costs go away.
- The ability to serve large geographic areas through lower-cost inventory means Internet firms can provide access to the long tail of products, potentially earning profits from less popular titles that are unprofitable for physical retailers to offer.
- Netflix technology revitalizes latent studio assets. Revenue sharing allows Netflix to provide studios with a costless opportunity to earn money from back catalog titles—content that would otherwise not justify further marketing expense or retailer shelf space.
- The strategically aligned use of technology by this early mover has allowed Netflix to gain competitive advantage through the powerful resources of brand, data and switching costs, and scale.
- Collaborative filtering technology has been continually refined, but even if this technology is copied, the true exploitable resource created and leveraged through this technology is the data asset.

Questions and Exercises

1. What were Netflix's sources of competitive advantage in the DVD-by-mail business?
2. Does Netflix have a strong brand? Offer evidence demonstrating why the firm's brand is or isn't strong. How is a strong brand built?
3. Scale advantages are advantages related to size. In what key ways is Netflix "bigger" than the two major competitors who tried to enter the DVD-by-mail market?
4. What is the long tail? How "long" is the Netflix tail in the DVD-by-mail business compared to traditional video stores?
5. What "class" of software does Netflix use to make movie recommendations? Think about Chapter 2: Which key competitive resource does this software "create"? What kinds of benefits does this provide to the firm? What benefits does it provide to Netflix's suppliers?
6. Could a new competitor match Netflix's recommendation software? If it did, would this create a threat to Netflix? Why or why not?
7. What is the Netflix churn rate and what are the reasons behind this rate?

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4.3 Act II: Netflix and the Shift from Mailing Atoms to Streaming Bits

Learning Objectives

1. Understand the shift from atoms to bits, and how this is impacting a wide range of industries.
2. Identify how digital products differ from physical products and specify how the streaming business is substantially different from the DVD-by-mail business.
3. Know the methods that Netflix is using to attempt to address these differences.
4. Understand how the "First Sale Doctrine" applies to physical versus virtual products.
5. Understand key terms such as windowing, fixed versus marginal costs, and bandwidth caps.
6. Discuss how Netflix is attempting to create competitive advantage through exclusive catalog offerings, despite not being able to secure a "longest tail."
7. Identify opportunities for Netflix to further strengthen and leverage its data asset, and detail how the asset can offer the firm competitive advantage.
8. Understand that while scale in DVD-by-mail differs from scale in streaming, some scale advantages may be achievable.
9. Understand opportunities and challenges as Netflix seeks to expand its subscription streaming offerings to international markets.
10. Recognize how Netflix made streaming widely available on products offered by many different consumer electronics firms and why the Netflix approach offers advantages over offerings from Apple or other consumer-electronics firms.
11. Identify the major issues driving what is widely considered to have been a disastrous rollout and recall of the Qwikster service, and intelligently discuss options that may have limited the fallout in transitioning the firm's business.
12. Describe crowdsourcing and discuss the positive benefits from code contests that Netflix has conducted.

Atoms to Bits

Nicholas Negroponte, the former head of MIT's Media Lab, wrote a now-classic essay on the shift from atoms to bits. Negroponte pointed out that most media products are created as bits—digital files of ones and zeros that begin their lives on a computer. Music, movies, books, and newspapers are all created using digital technology. When we buy a CD, DVD, or even a "dead tree" book or newspaper, we're buying physical atoms that are simply a container for the bits that were created in software—a sound mixer, a video editor, or a word processor.

The shift from atoms to bits is realigning nearly every media industry. Newspapers struggle as readership migrates online and once-lucrative classified ads and job listings shift to the bits-based businesses of Craigslist and LinkedIn. Apple and Spotify rule the new world of music without selling a single CD, while the atom-selling "record store" chains of the past are gone. Amazon jumped into the atoms-to-bits shift when it developed the Kindle digital reader. Who needs to kill a tree, spill ink, fill a warehouse, and roll a gas-guzzling truck to get you a book? Kindle can slurp your purchases through the air and display them on a device lighter than a paperback. When the Kindle was released, many thought it to be an expensive, niche product for gadget lovers, but in less than four years, the firm was selling more electronic books than print titles.[16] With video games shifting to digital downloads, any firm relying on the sale of physical game discs and cartridges is also in a world of hurt. GameStop, the largest gaming retail chain, has closed over 650 stores in four years.[17] The new plan: shift to new, non-gaming stores focused on mobile phones and computing accessories.

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The DVD-by-mail business, as important as it was for Netflix's rise to category-defining growth and much-envied profitability, is now going away. In 2010, Netflix had 19.5 million DVD subscribers,[18] but the number had fallen 3 million by 2018.[19] The decline has prompted the firm to close roughly twenty distribution centers nationwide,[20] as well as a call center supporting the DVD business.[21] The DVD business is still a money-maker and there's no need to slaughter a cash cow that can still be milked. In the first three months of 2018, DVDs earned Netflix $56 million in profit on just $99 million in revenue during. Margins too sweet to warrant a shutdown are helped by innovations, such as a custom sorting machine that operates five times more efficiently than prior worker-heavy efforts.[22] Streaming needs an entirely new competitive playbook. Just about everything in the streaming business is different: content availability, content acquisition costs, the legal and regulatory environments, potential opportunities for revenue and expansion, potential partners, competitors, and their motivation.

The Qwikster Debacle

We can learn a lot from Reed Hastings's deft management of Netflix in the firm's ascendency to industry-leading dominance in the DVD-by-mail and video streaming businesses, but Hastings has also presided over what some have called one of the worst product launches of all time,[23] the announcement and repeal of the Qwikster service, and there are lessons to be learned from examining the firm's painful stumbles as well.

The damage started when the $10 base Netflix service was unbundled into two separate $8 plans: one for DVD-by-mail and one for streaming over the Internet. For customers who still expected both discs and streaming, the move effectively constituted a 60 percent price hike. Following the plan change, the firm's Facebook page quickly amassed over 44,000 negative comments, "Dear Netflix" complaints became a trending topic on Twitter, and customers began referring to the firm's CEO as "Greed Hastings."[24] Two months later the firm announced it would split into two distinct services with two separate websites. The switch reads as a primer on what not to do when transitioning a business. The unpopular price hikes were followed by changes that would have actually made the firm's products *harder* to use by forcing customers to access two different websites, each with a separate database of offerings. Adding to the pain was the embarrassment of a botched rebranding of the DVD-by-mail service under the new name Qwikster. At the time of the rebranding announcement, Netflix had secured the domain Qwikster.com, but not the Twitter handle @Qwikster. The latter was owned by a guy whose drug-referencing, foul-mouthed tweets were accompanied by a profile picture of a pot-smoking Elmo from *Sesame Street*. Hastings, who stood at the peak of the industry just a few weeks earlier, had become both a target of customer vitriol and an industry laughing stock, the subject of *Saturday Night Live* skits and comedian punch lines. Netflix quickly dropped plans for the Qwikster split, but it chose to hold firm with the price increase that started the slide. Over the course of ninety nightmarish days, Netflix lost over 800,000 customers, its stock tumbled from $304 a share to below $75 (eventually falling to near $50), and its market value shed over $12 billion, including $2.3 billion in a single day.

When announcing Qwikster, Hastings wrote in a blog post, "My greatest fear at Netflix has been that we wouldn't make the leap from success in DVDs to success in streaming. Most companies that are great at something—like AOL dialup or Borders bookstores—do not become great at new things people want (streaming for us) because they are afraid to hurt their initial business…Companies rarely die from moving too fast, and they frequently die from moving too slowly." But in this case the poorly handled transition, served up with little user dialog or warning, was too much, too soon. Hastings has since admitted, "We moved too quickly for our customers."[25] In 2014, the Netflix streaming price increase was handled with far more customer sensitivity. The firm announced that while it was raising rates by $1 a subscriber, it would only apply to new customers; existing customers would be grandfathered in with a two-year grace period before seeing their bills go up.[26] The result? There was no notable customer outrage or protest.

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Digital Products and Marginal Costs

Imagine you're an auto manufacturer. Before you can begin producing any vehicles you'll need to make some investments to get started. These **fixed costs** might include buying land and building a manufacturing plant. There are also costs associated with each individual unit produced. These are the **marginal costs** and would include things like the parts, materials, labor, and energy used to produce each additional car.

It's often argued that the marginal cost of digital goods is effectively zero. That's because computers can make limitless duplicates of digital content—no material required—and the Internet can be used to almost instantly distribute content to customers. In practice there are some costs associated with digital distribution. These might include the costs that a firm must pay to telecommunications providers that connect them to the Internet (the more a firm transmits, the more it typically has to pay), or the cost of running programs on the servers of other companies (see the cloud computing discussion in Chapter 14). For example, to deliver streaming video, Netflix actually uses computers provided by the cloud computing services of Amazon (making Amazon and Netflix both partners and competitors, a phenomenon often referred to as ***coopetition***, or *frenemies*[27]). License fees can also add to the marginal costs of Netflix streaming. While computing costs might total just a nickel for each video streamed, if content providers charge Netflix a per-unit basis for streamed content, then this also gets added to marginal costs.

fixed costs

Costs that do not vary according to production volume.

marginal costs

The costs associated with each additional unit produced.

coopetition

Coopetition or Frenemies is a situation where firms may both cooperate and compete with one another.

Content Acquisition: Escalating Costs, Limited Availability, and the "Long-Enough Tail"

The old DVD-by-mail business allowed Netflix to offer up the longest tail of video content that money could buy. An over one-hundred-year-old US Supreme Court ruling known as the "**First Sale Doctrine**" made this possible. This ruling states that a firm can distribute physical copies of legally acquired copyright-protected products. For Netflix this means that if studios sell their DVDs retail, they can't prevent Netflix or anyone else from buying DVDs at full price and distributing the discs to others. (The ruling makes possible all sorts of efforts, including library lending and video rental.) But the "First Sale Doctrine" applies only to the atoms of the physical disc, not to the bits needed in streaming, so Netflix can't offer Internet streaming without separate streaming licenses.[28] That's a big problem for Netflix. Licensing costs are skyrocketing, and some firms are outright refusing to make their content available for streaming on Netflix.

First Sale Doctrine

A US Supreme Court ruling stating that an individual who knowingly purchases a copy of a copyrighted work from the copyright holder receives the right to sell, display or otherwise dispose of that particular copy, notwithstanding the interests of the copyright owner.

While studios offer new films and television shows each year, the number of firms offering high-demand content remains more or less fixed, essentially operating as an oligopoly with concentrated supplier power. In fact, just six firms control over 90 percent of US media consumed.[29] Also realize that video content is perfectly differentiated, and as we learned in the Strategy and Technology chapter, providers of differentiated goods also have stronger bargaining power. Want to license the new *Star Wars* movie? There's only one owner who can provide that content: Disney. By contrast, in the DVD days, content acquisition was more like buying a commodity since, even if studios wouldn't directly sell Netflix their discounted discs, Netflix could always buy discs from any retailer selling to the public. Adding to the power-shift to content providers: while the number of influential studios has remained roughly the same, over the past several years the ranks of bidders jostling elbows at the streaming media negotiating table has increased. Amazon; Hulu; Walmart's Vudu; Sony-backed Crackle and its service to stream video over console, handheld and VR platforms; streaming services provided by Comcast, Verizon, Dish, and other pay-TV providers; and a host of overseas rivals are all in a mix that can push content prices higher. Also, when you buy a DVD you own it for life, but streaming costs are usually licensed for a limited time period, and renewal costs have been increasing over time. Consider that the Starz network initially licensed its content to Netflix for $30 million but the network turned down *ten times* that amount to renew the deal just

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three years later.[30] The trends are troubling. Netflix's recent cost of acquiring streaming content rose to forty-three times the amount it spent just five years earlier! [31]

Streaming licensing deals also complicate a firm's long-term planning and cost estimates because rates can vary widely. Studios might offer titles via a flat rate for unlimited streams, a rate according to a service's overall subscribers, a per-stream rate, a rate for a given number of streams, a premium for exclusive content, and various permutations in between. Some vendors have been asking as much as $4 per stream for more valuable content—a fee that would quickly erase profits in Netflix's fixed-price subscription fee. And some deals may require separate licenses to stream to international markets.

windowing

Making content available to a given distribution channel (in theaters, through hospitality channels like hotels and airlines, on DVD, via pay-per-view, via pay cable, and later broadcast on commercial TV) for a specified time window, usually under a different revenue model.

Title availability is also complicated by a distribution practice known as **windowing**. Content is available to a given distribution channel (in theaters, through hospitality channels like hotels and airlines, on DVD, via pay-per-view, via pay cable, and later broadcast on commercial TV) for a specified time window, usually under a different revenue model (ticket sales, disc sales, and license fees for broadcast). Other media businesses offer content windows, as well. Book publishers release more expensive hardcovers months before cheaper paperbacks are issued. Music artists window content by limiting streaming, or only offering new-track streaming for paying subscribers.[32]

Even though most studios welcome streaming revenue, most don't want to undercut higher-revenue early windows. Adding to this complexity are exclusivity contracts negotiated by many key channels—in particular, the so-called *premium* television networks like HBO, Showtime, and Starz. Windows controlled by pay television channels can be particularly challenging, since many have negotiated exclusive access to content as they strive to differentiate themselves from one another. This exclusivity means that if HBO or Showtime has exclusive rights to broadcast a film, it's pulled from all other services until any exclusive pay-television time window closes. Want to be a player in the streaming media business? You'd better lawyer up.

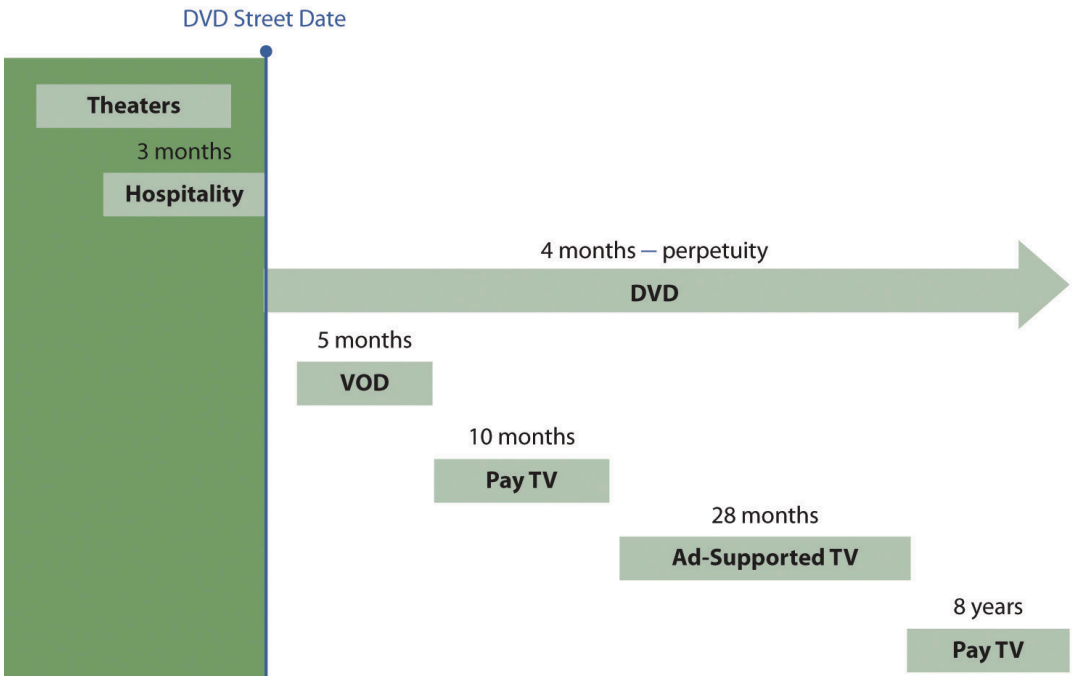
Another problem: Some firms steadfastly refuse to offer Netflix streaming rights. Time Warner's HBO offers the HBO Go app that serves up current shows and back catalog original programming free to anyone already subscribed to the pay channel, and it offers the HBO Now on-demand streaming service for those who don't want a channel subscription, but it won't license to Netflix. Who would pay $15 for HBO's service if Netflix could offer the same content and more for just $9? HBO did agree to take $300 million of Amazon's money to offer up a limited selection of HBO-back-catalog series, but the three-year deal leaves out current programming as well as ultra-hot titles like *Game of Thrones*.[33]

Taken together, all these content acquisition factors make it clear that attempts to profitably shift the long tail from atoms to bits will be significantly more difficult than buying DVDs and stacking them in a remote warehouse. The difference in content acquisition between the atoms (DVDs) and bits (streaming) businesses has forced Netflix to shift from offering the *longest tail* to a *long-enough tail*, a service that might not have all of what you want but that consistently has something for everyone. In a statement to investors, Netflix makes this clear: "We are actively curating our service rather than carrying as many titles as we can."[34]

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FIGURE 4.3 Film Release Windows



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Supplier Power and Atoms to Bits

The winner-take-all and winner-take-most dynamics of digital distribution can put suppliers at a disadvantage. Studios may be wary of granting Netflix increasing power over product distribution, and as such, they may be motivated to keep rivals around. If firms rely on one channel partner for a large portion of deals, that partner has an upper hand in negotiations. For years, record labels and movie studios complained that Apple's dominance of iTunes allowed them little negotiating room in price setting. A boycott where NBC temporarily lifted television shows from iTunes is credited with loosening Apple's pricing policies. Similarly, when Amazon's Kindle dominated the e-reader market, Amazon enforced a $9.99 price on electronic editions, even as publishers lobbied for higher rates. It wasn't until Apple arrived with a creditable e-reader rival in the iPad that Amazon's leverage was weakened to the point where publishers were allowed to set their own e-book prices.[35] Streaming licensing fees have become an important part of studio profitability, and an increase in Netflix streaming scale offers the firm even more leverage. However, Hastings is wary of zero-sum negotiations and the bad blood this can create between his firm and suppliers, stating publicly that the firm's goal is to develop the kinds of partnerships where both sides benefit.[36]

Exclusives and Original Content

One way Netflix can counter rivals with exclusive content is to offer exclusive content of its own. The firm has secured the initial sole streaming rights for several popular shows, including *Mad Men*, *Breaking Bad*, and *The Walking Dead*. Netflix secured a $300-million-a-year deal with Disney, giving the service first-run exclusive streaming access to Disney shows (including Pixar, Marvel, and Lucasfilm).[37] However, these deals all have a shelf life and there's no guarantee they'll continue. Disney has recently announced it would begin its own streaming service to launch after the Netflix deal expires. Disney's ultra-valuable movie assets include not only the beloved Disney films, but also Marvel, Star Wars, Pixar, it has bid to acquire the Fox film library, plus it owns select television titles from ABC and ESPN, among others. Starting a new streaming service is difficult (note the

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examples of Walmart's Vudu, Fandango streaming, and the shuttered Verizon/RedBox service) but these deep, high-demand assets and intent to build more will instantly make Disney streaming a force to be reckoned with.[38] Especially worrisome for Netflix is Disney CEO's stated intent to offer his service at a discount to Netflix.[39] And the home of the Magic Kingdom would like to capture a bit of Netflix's own pixie dust for its share price. By May 2018, Netflix had briefly popped above both Disney and Comcast in market capitalization.[40]

Netflix realized early on that it couldn't rely on partners for long-term relationships and consistent pricing, so the firm has aggressively backed the development of multiple original offerings for debut on its service, with an estimated 1,000 original series on Netflix by year end 2018.[41] Hits include *Stranger Things*, *Orange Is the New Black*, *13 Reasons Why*, *The Crown*, *Unbreakable Kimmy Schmidt*, several series based on Marvel's *The Defenders* superheroes franchise, and new episodes of the cult comedy *Arrested Development*, revived several years after it was canceled by Fox Television. The firm has also rebooted *One Day at a Time* and tapped the original casts of *Full House* and *Gilmore Girls* for revivals. The firm's growing library of exclusive children's content includes shows based on DreamWorks characters *All Hail King Julian* (from *Madagascar*) and *The Adventures of Puss and Boots* (from *Shrek*), plus rebooting the series for *How to Train Your Dragon* and the classic *Magic School Bus* (with Kate McKinnon now voicing "The Frizz"), and the tween-appealing *Lemony Snicket's Series of Unfortunate Events*. Reality hits include the rebooted *Queer Eye*, the cake-tastrophes of *Nailed It*, while talk shows offer the weekly *Joel McHale Show*, and David Letterman's *My Next Guest*. Netflix is also the new King of Comedy, releasing a new stand-up special each week with a roster of big name comics including Amy Schumer, Sarah Silverman, Dave Chappelle, Jim Gaffigan, Hasan Minhaj, Chris Rock, and Jerry Seinfeld. Netflix has also produced several original movies, but hasn't had a film buzz akin to a first-run box office hit. Original movie efforts include vehicles for Brad Pitt (*War Machine*), Idris Elba (*Beasts of No Nation*), Kevin James (*True Memoirs of an International Assassin*), Will Smith (*Bright*), and a multi-film deal with Adam Sandler. Even the Obamas have signed a deal to produce "scripted series, unscripted series, docu-series, documentaries and features" that focus on themes the president and first lady pursued during their eight years in the White House.[42] Talent can become tainted, with Netflix distancing itself from several stars facing harassment (and worse) allegations (Kevin Spacey, Louis C.K., Aziz Ansari), but with a deep bench, the firm can easily withstand the loss of fallen stars. While Netflix is often mum on exact viewer numbers, many shows have received significant critical acclaim. By 2018, Netflix originals had won two Oscars, four Golden Globes, and scores of Emmys.[43] And while the Netflix Original Adam Sandler film *The Ridiculous Six* was widely panned, within 30 days it became the most-viewed movie ever on Netflix. Netflix is now solidly re-cast as an original content provider; with its own financial documents, the firm has referred to itself as a "television network," and its own titles represent about 80 percent of US viewing.[44]

OTT

Over-The-Top, an industry term referring to media services that are provided over the Internet instead of through conventional broadcasting mechanisms like cable or TV broadcast.

Being the sugar daddy to original content doesn't come cheap. The first two seasons of *House of Cards* reportedly cost $100 million, and Netflix outbid both HBO and AMC for rights to the project.[45] The first season of *The Crown* cost $130 million for ten episodes—at the time the most expensive television series in history.[46] And not all original content has been a success—the firm's $90 million *Marco Polo* series was widely panned.[47] Despite this, Reed Hastings has pegged the firm's 2018 original content bill at a whopping $7.5 billion–$8 billion, a twenty-six-fold increase in five years, an amount similar to all of the non-sports programming across all of Disney's networks, and well ahead of any streaming rivals.[48] Netflix credits original content with subscriber growth and increased customer engagement,[49] and analysts also suspect the content helps reduce customer churn.[50] Netflix's worldwide subscriber numbers continue to outpace even Wall Street's lofty expectations. The firm's 125 million subscribers reported in early 2018[51] were larger than the roughly 94 million subscribers in the *entire* US pay television market, and compared to individual US pay channels, Netflix has a US subscriber base that dwarfs all others.[52] Meanwhile, among pay television providers, Comcast reported four straight quarters of customer declines, Verizon is losing over 20,000 customers a quarter, and Charter Communications, the third largest cable firm in the US, lost 100,000 customers in a year.[53] (Side note: You may hear streaming services referred to as **OTT**. That stands for *Over-The-Top*, as in running on top of Internet service that customers get through cable providers and others.) Netflix can spend big as long as its subscriber base continues to grow.

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Profitability is helped since subscriptions are booked right away, while the cost of producing titles can be spread out over several quarters. Netflix skeptics wonder if constantly growing production costs will ever outpace what the large subscriber base brings in.[54]

The first batch of Netflix-backed originals (including *House of Cards*, *Orange Is the New Black*, and *Arrested Development*) gave the firm exclusive first-window US streaming rights, but even though these titles lead with the claim of being "A Netflix Original Series," they are actually licensed from other studios. Since Netflix doesn't outright own these properties, early seasons of *House of Cards* are available from competitors—including Comcast, Vudu, and Amazon (distribution rights for *House of Cards* are actually owned by Sony; the show is produced by Media Rights Capital). Lionsgate, which controls licensing of *Orange Is the New Black*, has made that series available to others as well.[55] Streaming *House of Cards* internationally will require Netflix to pay up again. Licensing costs only about half of what Netflix would pay for full ownership; however, with the value of original content now proven, Netflix has begun to do deals for complete ownership of some new projects, a level of control that HBO has with many of its series. Ownership keeps titles as worldwide-exclusive to Netflix (an option that becomes even more valuable as the firm aggressively expands abroad), and it could allow Netflix to pursue additional revenue streams, such as DVD sales or licensing to other channels and services.[56]

The new Netflix looks less like an Amazon shipping center and more like a must-watch network, offering the kind of critically and culturally resonant content one would find on HBO or AMC. Says Netflix chief content officer Ted Sarandos, "The goal is to become HBO faster than HBO can become us."[57] How have they done? By 2016, it was estimated Netflix had a viewership larger than any network, including ABC, CBS, Fox, and NBC.[58] *The Verge* claims Netflix wants to "be Disney."[59] Watch out, mouse!

Streaming and the Data Asset

Netflix has one very critical asset that is far stronger than what rivals, especially cable television networks, can assemble: a growing and exquisitely detailed treasure trove of data. This data asset is used to make more accurate recommendations, improve user interface design, and help the firm determine the appropriate cost for acquiring content, and it can even shape creative decisions in original program offerings.

The data gathered via streaming can be more revealing than ratings received via DVD-by-mail. Even if someone doesn't rate a given title, if they binge-watch multiple episodes, Netflix has a pretty good indicator that the user likes the show. The reverse is usually true for the unrated property that a user streamed for the first fifteen minutes and never came back to.[60] In the DVD-by-mail days if you didn't take the time to rate a show, the firm had no idea if you'd actually watched shows you'd received, watched them multiple times, finished watching titles you started, and so forth. Once captured, this data can be fed into the firm's collaborative filtering software to further group user tastes and help subscribers discover the content most likely to delight them. Netflix possesses not only several hundred genres, or even several thousand, but also over seventy-six thousand (and climbing) unique ways to describe different types of movies. While Netflix does employ a team of "entertainment classification experts" to initially tag and rate movie characteristics, the real magic happens during data analysis.[61] Each user's Netflix screen is the result of analyzing terabytes of data. Every recent click, view, review, early abandon, and guide page view, as well as other data, is considered in order to identify the content the firm believes users will most likely want to see. Some 75 to 80 percent of what people watch on the service comes from Netflix recommendations, not search.[62] Says the firm's VP of innovation, "If one member in this tiny island expresses an interest for anime, then we're able to map that person to the global anime community." Netflix estimates that the strength of the personalization engine saves the firm about $1 billion a year, mostly in the customer satisfaction that prevents churn. If a customer can't find something they like in about a minute of viewing one or two screens, "risk of the user abandoning our service increases substan-

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tially." Netflix is now crunching and comparing user preferences across 190 nations, worldwide—a level of profile detail and user preferences that no one can come close to matching.[63]

A/B test

A randomized group of experiments used to collect data and compare performance among two options studied (A and B). A/B testing is often used in refining the design of technology products, and A/B tests are particularly easy to run over the Internet on a firm's website. Amazon, Google, and Facebook are among the firms that aggressively leverage hundreds of A/B tests a year in order to improve their product offerings.

Data analysis doesn't just drive the collaborative filtering software for user recommendations; it's also used to tailor and improve the experience over time. Like Google, Amazon, and many other firms, Netflix will roll out new features to a subset of users, running an **A/B test** to determine how the new stacked up against the old. If feature A is better than feature B, then A will be rolled out to everyone. Metrics used to evaluate the slew of constant tests include sign-up, viewing, and retention rates.[64] (For more about A/B testing, see Chapter 7.)

The data also helps Netflix make better content investments. When licensing new work, Netflix examines a variety of inputs, including things like actors' names and title genre, to determine the likely size of an audience and that property's value to the firm.[65] When content comes up for renewal, Netflix crunches the data, including how often a given title has been viewed, its user rating score, and key viewing trends. All this helps the firm determine just how much a given asset is worth, and it directly informs decisions on choosing projects and setting budgets.[66] Says content chief Sarandos, "I can justify the spend with our data and do so with a far greater degree of confidence than the television networks."[67] While many observers gasped when Netflix chose to pass on Viacom's hefty price tag on a big bundle of popular kids' shows that included *Dora the Explorer* and *SpongeBob SquarePants*, the decision-making of Hastings and Sarandos was informed by data. And even though rival Amazon swooped in to grab the Nickelodeon titles for Amazon Prime, Netflix opted to choose replacement Disney titles, such as the SpongeBob-beating tween ratings champ, *Phineas and Ferb*.[68] Data-driven decision-making isn't perfect, but it's a lot more reliable than the gut instinct of studio heads that still drives many media industry deals.

Data also informs the original content investments that Netflix is making. For example, Netflix made the decision to revive *Arrested Development* in part based on its ability to monitor customer attitudes toward the original series over time. The series was a cult hit—it was one of the most popular programs on DVD and streaming—and data clearly showed that interest had steadily grown since cancellation.[69] Content chief Sarandos says, "We can bring to the table really factual and data-based information." By one estimate, Netflix shows have an 80 percent success rate, vs. 30 to 40 percent for traditional television network shows.[70]

Netflix also uses data to create ultratailored audience promotions. When advertising *House of Cards* to Netflix users, director David Fincher cut seven different trailers for the series. Some of these focused on female characters, some played up that the series was a political thriller, others highlighted actor Kevin Spacey, and one focused on Fincher himself. Netflix would only show you a *House of Cards* suggestion if its math thought you'd like it,[71] and any trailers that a given user saw on Netflix were chosen and targeted based on their viewing history.[72]While Reed Hastings has clearly said he won't let data interfere with the creative process or dictate terms to showrunners,[73] Netflix's data-driven insights can offer value if artists request a look. For example, firm data is said to have been used by showrunners on *Orange Is the New Black* to influence casting.[74]

disintermediation

Removing an organization from a firm's distribution channel. Disintermediation collapses the path between supplier and customer.

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Disintermediation, Digital Distribution, and Gathering Customer Data

The purchase of NBC/Universal by Comcast, the largest cable television provider in the United States, has consolidated content and distribution in a single firm. The move can be described as both vertical integration (when an organization owns more than one layer of its value chain) and **disintermediation** (removing an organization from a firm's distribution channel).[75] Some also consider Netflix's move into the content creation business a form of vertical integration as it moves backward in the value chain.[76] Disintermediation in the video industry offers two potentially big benefits. First, studios don't need to share revenue with third parties; they can keep all the money generated through new windows. Also critically important, if a studio goes directly to consumers, then studios get to collect and keep a potentially valuable data asset. If another firm sits between a supplier and its customers, the supplier loses out on a key resource for competitive advantage. For more on the value of the data asset in maintaining and strengthening customer relationships, see Chapter 15.

Netflix and Comcast have had a contentious relationship, with the cable giant accusing Netflix of free-riding on cable infrastructure and Netflix labeling Comcast net neutrality's public enemy number one. But with Netflix available from so many television-connected alternatives ("smart" TV apps, video games, devices such as Apple TV, Chromecast, and Fire TV), Comcast risked losing its slot as the first screen customers brought up when hunting for video entertainment. When Comcast isn't front-and-center, it knows less about the choices customers are making and it misses out on an opportunity for customer engagement (advertising, offering up its own content, etc). Netflix is now integrated into Comcast's Xfinity X1 search platform, including voice search. Comcast will even sell Netflix and take a finder's fee (although apparently no other revenue is swapped from the agreement). Dish Network and other providers have a similar relationship with Netflix. The desire to be the "one screen to find them all" (and gather data) has led Apple and Amazon to end their feud and bring Amazon Video to Apple TV, and Amazon has also mimicked Comcast and Apple by integrating premium cable content and selling subscriptions to cable channel streaming from within the Prime Video interface.[77]

Streaming Changes Viewing Habits and Frees Creative Constraints

Conventional, schedule-driven television viewing is being replaced by the new "WWW"—the ability to view *what* you want, *when* you want it, on *whatever* screen is available.[78] As apps replace channels and content is available at all times across all screens, the streaming experience is liberating both consumers and content creators from constraints of channel-driven "linear TV." Consider the phenomenon of ***binge-watching***, or viewing several episodes of a program in a single sitting. As Sarandos puts it, "In the world of weekly serialized television you get fifty minutes of joy watching a show and then 10,000 minutes of waiting for the next one."[79] Over that time, users can lose track of characters and complex plot lines, and they may be distracted, miss an episode, and stop viewing all together. With streaming, users are likely to watch multiple episodes at once. Shortly after *Arrested Development* debuted, 10 percent of viewers watched a string of fifteen episodes.[80]

binge-watching

Viewing several episodes of a program in a single sitting.

For producers, writers, and directors, the creative side feels less constrained, too. Netflix execs state, "If you give people a more creative format, then they can tell their stories better."[81] With streaming, there's no need to plan cliffhangers at the end of a program or even write for the standard time lengths, like the twenty-two-minute standard for commercial sitcom television. The revived *Arrested Development* has one episode that's just fifteen minutes long. Binge-watching also works well for programming with dense and complicated storytelling, such as the Netflix-backed sci-fi series *Sense8*. A blog post from Netflix underscores the appeal of working for the streaming service rather than a traditional network: "Because we are not allocating scarce prime-time slots like linear TV does, a show that is taking a long time to find its audience is one we can keep nurturing. This allows us to prudently commit to a whole season, rather than just a pilot episode."[82] The

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kind of artistic creativity offered by streaming makes Netflix, as stated by the *Hollywood Reporter*, "one of the most attractive buyers of original programming in town."[83] Netflix is also investing billions in expanding studio infrastructure in California, and it plans to forgo significant filming tax incentives offered by regions that include New York, Georgia, and British Columbia. This might put production costs 25 to 30 percent higher,[84] but the benefit may be in luring the very best creative talent with an incentive to not leave home for months at a time. In the words of one industry observer, "If you are an A-list actor or a mid-career TV creator at your professional peak, the idea that you can make your show and still kiss your kids at night—without moving them to another state—means Netflix would become an all-powerful magnet."[85]

Breaking Bad to Netflix, "Thanks!"

"I don't think you'd be sitting here interviewing me if it weren't for Netflix. In its third season, 'Breaking Bad' got this amazing nitrous-oxide boost of energy and general public awareness because of Netflix. Before binge-watching, someone who identified him- or herself as a fan of a show probably only saw 25 percent of the episodes."[86]

Breaking Bad creator Vince Gilligan in a *New York Magazine* interview

Customer Experience, Complexity, Pricing, and Brand Strength

While the world of bits offers firms the ability to take advantage of different pricing models for digital entertainment, Netflix had been steadfast in insisting that all of its content will be available anywhere for a single monthly subscription fee. (It does vary the fee based on the quality of the stream and the number of simultaneous screens that can be used. This is in contrast to firms like Apple, Google, Amazon, Hulu, and cable operators, who all offer a mix of pricing schemes that might include buying content, pay-per-view, commercially supported content, and subscription for additional premium offerings.

In the Netflix view, you shouldn't have to choose between commercial content, pay-per-view, buying a title, or waiting for a viewing window. While the service is defined simply, competition is defined broadly—the firm is really in a battle to be a first-choice entertainment destination across all possible offerings. As the firm stated in a letter to shareholders, "Our North Star is to win more of our members' 'moments of truth'...when our member wants to relax, enjoy a shared experience with friends and family, or is just bored. They could play a video game, surf the Web, read a magazine, channel surf, buy a pay-per-view movie, put on a DVD, turn on Hulu or Amazon Prime, or they could tap on Netflix. We want our members to choose Netflix in these moments."[87] Simplicity seems to be working. While Netflix's customer satisfaction tanked following the firm's pricing split and Qwikster debacle, less than two years later consumers had rated Netflix more positively than any of its peers, including offerings from Amazon, Apple, and Google—all of which offer more complex media pricing.[88]

Streaming and Scale Advantages

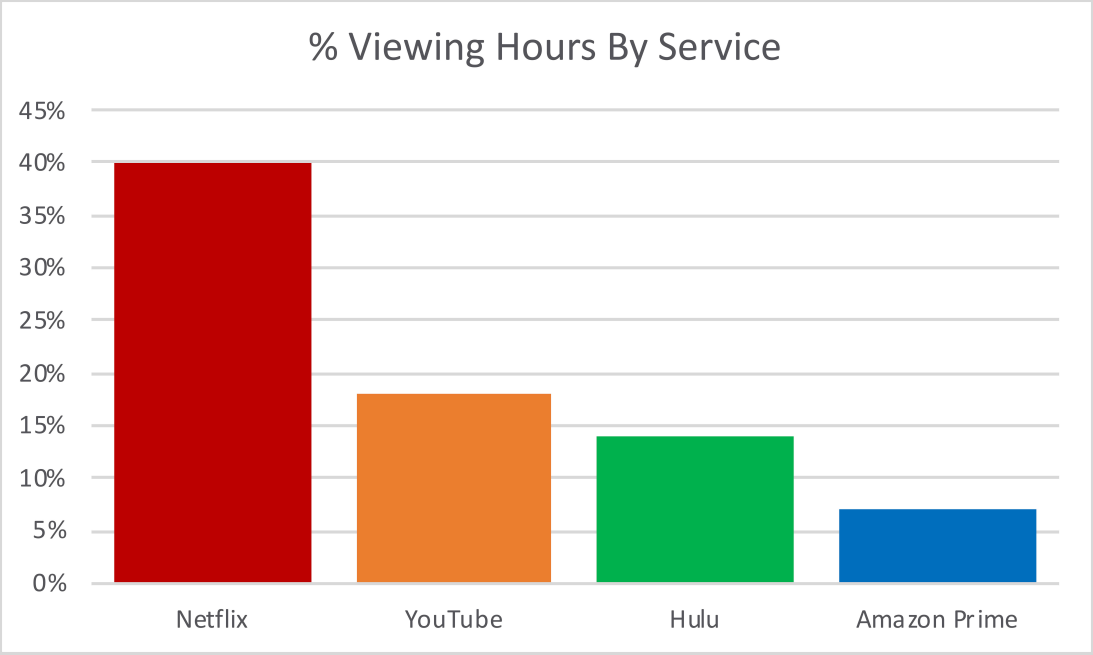
Despite rising costs, a difficult-to-control cost structure, and increased competition, there are still key advantages that can be created by a leading player in the streaming business, and Netflix hopes that its advantages will be large enough to sustain it as the dominant firm for years to come. First, regarding scale, while studios may charge more for deals involving more users, the firm with more

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users is likely to be able to pay far more than smaller rivals. A studio would rather accept a $200 million check from Netflix than three $50 million checks from smaller players. Start talking exclusives, and advantage once again goes to the biggest player.

FIGURE 4.4 Streaming in US Households
Data on US streaming shows users spend more time on Netflix than all other services combined.



Source: MarketingCharts, July 6, 2017; https://www.marketingcharts.com/digital-78398.

Size-based advantages come from both the scale of a firm's streaming library (a longer tail) and the scale of the customer base (the ability to pay for that tail). Once a firm gets big, there's a virtuous cycle where more titles attract more customers, and more customers increase a firm's ability to bid on attractive content. A larger, more profitable firm also gains pricing advantages. As of this writing, the Netflix basic offering is cheaper than HBO, Hulu, and Showtime (although deep-pocketed Amazon is cheaper).[89] Netflix doesn't just see growth as a way to advance profitability; it sees it as a vital competitive asset to keep competitors at bay. Netflix can spend so much more than competitors because it has more subscribers than rivals. And while Amazon's content spend is about 2/3rd of Netflix's bill,[90] Netflix is seeing roughly five times more usage[91]—scale economies in action.

Hastings clearly understands scale advantage, having shared in a letter to shareholders: "From a high-level, HBO is our closest comparison . . . We have more content, more viewing, a broader brand proposition, are on-demand on all devices, and are less expensive . . . [As] we grow, our content and service can continue to get better."[92] Since new customers often gravitate toward the best-known firms and favor products recommended by friends, dominant firms should also see customer acquisition costs, as a percentage of sales, go down.

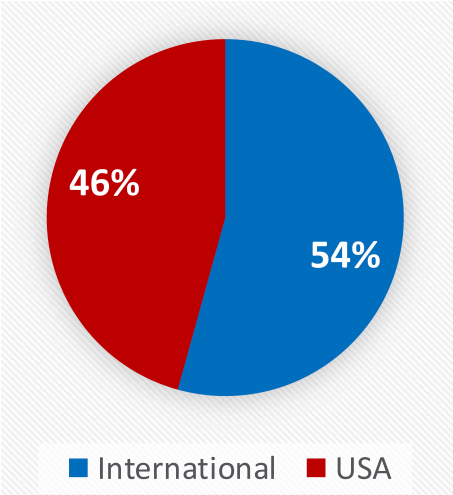
The March to Global Dominance

Global expansion plays a key role in the Netflix drive for scale-driven dominance. Netflix sees the magic number for long-term profitable scale in any given market as 20 to 30 percent of households,[93] and getting there will be a land-grab. Global expansion is complicated by powerful regional players such as Claro Video, Sky NOW TV, LOVEFiLM (the Amazon-owned "Netflix of Europe"), and HBO Nordics, but Netflix is the biggest global player—by far.[94] By January 2016, Netflix announced that the service was available in over 190 countries around the world.[95]

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FIGURE 4.5 Netflix Domestic/ International Subscriber Mix
The now-profitable international subscribers segment now makes up more than half of all Netflix subscribers.



Source: Data from Netflix Financial Reports Q1 2018; https://ir.netflix.com/static-files/6684946a-085d-4da2-97b3-b5a9d612b60f.

Expanding internationally is not without cost. Entering new markets involves heavy up-front expenses, including ramping up marketing campaigns to create awareness and securing licenses for both American and local content. Some Netflix content is already locked up by foreign rivals (France's Canal Plus already has the rights to *House of Cards*). Legal issues can present a country-by-country challenge as well. For example, French law requires a wait time of three years after a film is released in theaters before it can be streamed online (similar rules at Cannes led Netflix to pull out of the film festival).[96] France also requires distributors to invest in local production[97] (a reason why Netflix is producing shows such as *Marseille*, billed as a French *House of Cards)*.[98] French legal issues and taxation policies proved so onerous that they prompted Netflix to move its European headquarters from France to Amsterdam.[99] Nations with heavy censorship laws (like China) will also pose challenges. But Netflix global bet is now paying off. For the first time, Netflix's international segment turned an annual profit in 2017, and international subscribers now make up more than half the firm's user base.[100]

It's a Multiscreen World: Getting to Netflix Everywhere

Another major challenge in the migration from DVD to streaming involved getting content to the television. While Apple had its own low-cost television add-on and Amazon had partnered with TiVo, Netflix was still streaming only on PCs. An internal team at Netflix developed a prototype set-top box that Hastings himself supported offering. But most customers aren't enthusiastic about purchasing yet another box for their set top, the consumer electronics business is brutally competitive, and selling hardware would introduce an entirely new set of inventory, engineering, marketing, distribution, and competitive complexities.

Netflix eventually decided to think beyond one hardware alternative and instead recruit others to provide a wealth of choice. The firm developed a software platform and makes this available to manufacturers seeking to include Netflix access in their devices. It was an especially smart move given the explosion in content watching that occurs on screens that are not televisions, and Netflix tools made it easier to build apps. Today, Netflix streaming is available either as an app or baked directly into over a thousand consumer electronics products, including televisions, DVD players, video game consoles, phones, and tablets.[101] And that internally developed Netflix set-top box? The group was spun out to form Roku, an independent firm that launched their own low-cost Netflix streamer, and which today is a publicly traded firm with the largest share among television streaming devices.[102]

By working with consumer electronics firms, offering Netflix streaming as a feature or an app, Hastings's firm has ended up with more television access than either Amazon or Apple, despite the fact that both of these firms got their streaming content to the television first. Today, Netflix access is considered a must-have component for any Internet-connected media device. Partnerships have helped create distribution breadth, giving Hastings an enviable base through which to grow the video streaming business.

While you can get Netflix from your TV, game system, phone, DVD player, or streaming-specific hardware like Chromecast, Fire TV, or Roku, Netflix has been slow to show up as an icon offered through the cable provider set-top box. Cable providers are leery of streaming services that don't require their networks, fearing that rich product offerings accessible without channel subscriptions could prompt existing subscribers to become cord cutters (eliminating cable all together) or cord shavers (who drop premium cable channels). By comparison, the HBO Now streaming service is less of a threat to cable firms, since a channel subscription (where cable firms get their monthly

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cut) also includes unlimited streaming, and is usually the same price or less than if you bought just streaming a la carte direct from HBO.

So What's It Take to Run This Thing?

It might surprise many to hear that the bulk of the Netflix computing infrastructure runs on Amazon's servers. But using Amazon Web Services (AWS—see Chapter 7 for more details) has enabled Netflix to grow its services by millions of customers without adding any data center capacity since 2008. Lots of firms offer cloud services, and Microsoft may have seemed a more logical partner than Amazon. Hastings was a Microsoft board member at the time Netflix was shopping for cloud providers, and Microsoft was seen as less of a competitor than Amazon. But Netflix engineers determined that Amazon was the "biggest and baddest" cloud house around, with unmatched expertise in providing computing scale and power (the firm does keep some infrastructure in Google's cloud, largely as a fall-back). Netflix doesn't see owning its own data centers as a way to create a substantial, defensible advantage.[103] Instead, it lets Amazon handle the hardware while the Netflix engineering staff of over 700 focus on creating the second-to-none software needed by the video-streaming giant.

Netflix is the biggest AWS customer, drawing "many tens of thousands" of servers at a time.[104] This barrage of bits collectively represent 3 trillion events per day including streaming 125 million hours of TV shows and movies each day,[105] recording user actions for use in personalization, calculating collaborative filtering recommendations for each Netflix user, video encoding, digital rights management, and additional number crunching. The Netflix chief cloud architect has boasted, "We're using Amazon more efficiently than the retail arm of Amazon is… We're pretty sure about that."[106]

Netflix's storage appetite is voracious. The master copies of all the shows and movies that the firm streams, plus all the additional data cataloged and used for personalization and machine learning collectively amount to upwards of 12 PB of data per day routed through an Amazon S3 data warehouse that itself contains 100 PB of highly compressed chunk of Amazon cloud storage.[107] Each time a studio uploads a file to Netflix, the firm leverages the Amazon cloud to rapidly configure more than a hundred specially sized copies (for example, large HD files for big screens and files that are much smaller for streaming to phones over a 3G network). Netflix also uses so-called complexity-based encoding, which shrinks files based on the type of content being streamed. This technique keeps all the high-definition bits needed for a fast-paced movie action sequence (think an *Avengers* fight scene), but strips out excess data from simpler titles like color-uniform children's cartoons (like the uniform character colors in *My Little Pony*). The benefits? Streaming quality gets a boost and less bandwidth is used, potentially speeding connections while saving money for Netflix and its data-plan-limited customers.[108]

In order to keep high-demand content streaming as speedily as possible, Netflix runs a nightly analysis to figure out which titles are going to be popular the next day. Titles in high demand (say, the new installment of a recently released popular television series) are queued up on flash storage, which is more expensive but faster than conventional hard drives. In an effort to further speed content to consumers, Netflix places its own storage appliances in or near the networks of key Internet service providers worldwide and then uses predictive models to make sure content is close to most-likely requesters before they even ask for it.[109] Regularly distributing the firm's highest-demand titles and caching it in these "islands of access" around the world reduces the number of overall customer requests that come into Amazon's cloud. There are firms that Netflix could hire to distribute its content at caching locations close to users—this is the business of so-called content delivery network (CDN) companies like Akamai, CDNetworks, and Limelight. But Netflix has such a high volume of traffic that scattering its own special-purpose servers around the globe helps keep a fast film flow while holding costs limbo-low. Want to see a look at their global map that places cached Netflix content at Internet service providers and **colocation facilities** worldwide? Visit "How Netflix Works With ISPs Around the Globe to Deliver a Great Viewing Experience" on the Netflix Technical Blog. [110]

colocation facility

Sometimes called a "colo," or carrier hotel; provides a place where the gear from multiple firms can come together and where the peering of Internet traffic can take place. Equipment connecting in colos could be high-speed lines from ISPs, telecom lines from large private data centers, or even servers hosted in a colo to be closer to high-speed Internet connections.

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Pro Tip for the Technical: *Nearly every firm we're studying has a public blog posted by its technical staff. In years past firms would hold their technology cards close to their vests, but in a tough job market, many firms see that publicizing their work, especially things that rely on additional assets like a massive data store or scale, won't compromise competitiveness, and may help lure intrigued talent. Search online. You'll see sites offering inside tech insights at Airbnb, Amazon, Facebook, Google, Netflix, Rent the Runway (their blog is called The Dress "Code"), Uber, and more. You may find additional blogs for data science and analytics, and if you're interviewing with a firm, spending time in their blogs is a basic expectation among interviewers.*

As the pioneer in the field, Netflix has been forced to build most of the software it needs from scratch. In-house user interface specialists focus on designing easy-to-use software for a variety of devices. The television interface designer is known as the "ten-foot guy," since that's about the distance between the user and the big screen. The designer for laptops is the "two-foot guy," and the tablet designer is the "eighteen-inch guy."[111] So-called *localization specialists* work on making sure each of the available interfaces is customized to the appropriate language for each of the over forty-five countries where Netflix is offered.

Also surprising—Netflix gives away a huge portion of software that its team has developed. Source code relating to competitive advantage in the media streaming industry remains under wraps (think collaborative filtering systems and the firm's decision-driving analytics), but Netflix has been especially generous in sharing tools that it feels will also be useful to a wide variety of cloud users across industries. Among the firm's better-known open source contributions is code that tests the robustness of systems running in the cloud. Examples include the playfully named "chaos monkey," which simulates random system failure, and the "security monkey," which probes for hacking holes.[112] Intel and eBay are among the multibillion-dollar firms leveraging Netflix software, and the Obama campaign directly attributed Netflix code with helping shift computing needs to the West Coast when East Coast operations were taken out by Hurricane Sandy.[113] With more geeks worldwide using this open-source code, there's a greater chance the tools will be improved by others, which would eventually benefit Netflix as well.

Crowdsourcing and Code Contests: The Netflix Prize and Beyond

While Netflix is widely considered to have a best-in-class collaborative filtering engine in Cinematch, the firm also realizes that it has no monopoly on math. So the firm previously ran a competition, known as the Netflix Prize, ponying up $1 million to the first team that could improve Cinematch scores by 10 percent. For contest purposes, Netflix released a subset of ratings data, stripped of customer identity,[114] and over 30,000 teams from over 170 countries eventually entered the contest. The winning team consisted of engineers that entered the competition on separate teams. It included a pair of coders from Montreal; two US researchers from AT&T Labs; a scientist from Yahoo! Research, Israel; and a couple of Austrian college students turned consultants.[115] It's safe to say that without the Netflix Prize, these folks would likely never have met, let alone collaborated.

The Netflix Prize is an example of crowdsourcing, a technique in which a firm states a problem it would like solved, the reward it will provide, and then makes this available to a broader community in the form of an open call. While Netflix did not implement the final winning algorithm as introduced, it had already begun incorporating changes based on learning from submissions even before the contest was complete.[116] The effort was also a public relations bonanza, with articles on the effort (and Netflix superior Cinematch software) appearing in major news and business publications worldwide.

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The positive crowdsourcing experience has led Netflix to run several other contests, including one rewarding hackers for improving the firm's open source cloud tools. Not only does the firm benefit from code submissions, the contest also has a recruiting payoff. Says one manager about these efforts, "We can see people who already know our code base and are doing interesting things."[117]

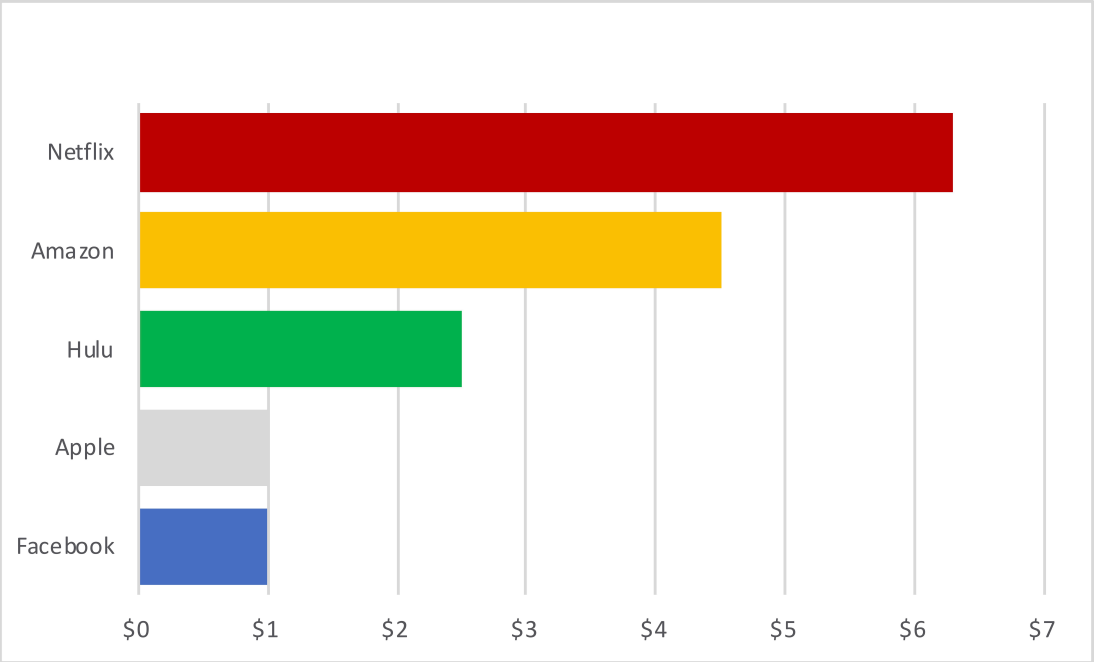
A Crowded Field of Rivals and Other Challenges

While Netflix has a strong global lead, picking a winner in the race for delivering bits to a multi-screen world is still very much an uncertain bet. The market remains highly fragmented, with a long list of potential competitors and a varied list of models for reaching consumers. Netflix is often mentioned among the talking heads on business networks as part of the FAANG stocks, but all of the other firms in that group: Facebook, Amazon, Apple, and Google, which collectively represent nearly 30 percent of Nasdaq market value,[118] have *very* different business models, with streaming being a secondary line of business in every firm not starting with an "N". While new startups seem unlikely to threaten Netflix given the firm's scale advantages, the more significant threat is from firms that have thriving businesses in other areas. These firms can come to market with cash that lets them credibly crash the Netflix party, and they may be more willing to endure short- and midterm losses as they try to steal share from the leader. Amazon is integrating its own streaming service into televisions and consumer devices, putting Amazon instant video into its successful Kindle Fire products, launching the sub-$100 Fire TV streaming and gaming set-top box, and a sub-$40 Fire TV streaming stick, and aggressively expanding its content library. Amazon may be losing a billion dollars a year in streaming,[119] but Jeff Bezos has motivation beyond subscription: viewing video as a free add-on that encourages adoption of the firm's Amazon Prime shipping service and as a way to ensure that Kindle can serve up an iPad-rivaling depth of content. Apple's iTunes offers video purchases and "rentals" across PCs and Macs, as well as the iPod, iPhone, iPad, and an aggressively redesigned, Siri-powered Apple TV. Microsoft offers an online rental and purchase service via Xbox. Google offers thousands of television shows and movies over YouTube via both ad-supported and rental models, and it continues to refine Google TV as well as the Google Play online store. And all of these firms are digging deep into their cash-filled wallets. The *New York Times* has suggested that Amazon may try to outspend Netflix in the next few years.[120] Bezos already broke the record for the most expensive series (previously held by Netflix *The Crown*), when Amazon dropped a quarter of a billion for a series based in the *Lord of the Rings* universe.[121] Amazon and Apple have both spent $1 billion or more on non-sports content in 2017.[122] Google estimates aren't available, but the firm is relentlessly pushing its YouTube Red subscription service, and will follow the *Cobra Kai* series starring cast members from the original *Karate Kid*, with shows featuring Will Smith, Priyanka Chopra, and LeBron James, and has licensed big events like the Coachella live stream.[123] Comcast's Universal Studios is among the major film studios that has experimented with direct streaming to consumers over Facebook, and Zuck is expected to spend $1 billion on originals in 2018.[124] Even CBS has tried to seed its own self-branded "All Access" streaming service by offering the exclusive *Star Trek: Discovery* series. With Netflix offering apps on so many of these competing platforms, the firm's frenemies list is a long one. Networks and content providers also have their own offerings: many stream content on their own websites; Comcast and Verizon have apps that stream content to phones, PCs, and tablets; and Hulu is a joint venture backed by NBC, Fox, and other networks. Netflix also faces me-too subscription efforts from its previously vanquished DVD-by-mail rivals, Blockbuster (now part of Dish network, a firm AT&T intends to acquire) and Walmart (which owns Vudu).

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FIGURE 4.6 Non-Sports Original Content Spending in $Billion
Content spending in billions in 2017 (Facebook is a 2018 estimate).



Source: Data from R. Molla, "Netflix spends more on content than anyone else on the internet—and many TV networks, too," Recode, Feb 26, 2018, https://www.recode.net/2018/2/26/17053936/how-much-netflix-billion-original-content-programs-tv-movies-hulu-disney-chart.

A bits-based business can also be risky if the infrastructure is unreliable. If a store or warehouse has a problem, a firm can try to service customers from another location. But if the technology that supports your services breaks and redundancy fails, then your entire business is brought to its knees. Netflix and its cloud provider, Amazon, have suffered a series of such outages in the past, and any repeated reliability concerns risk prompting customers to seek alternatives.[125] But since everyone in streaming has a service that lives in the cloud (either private, like Apple's, or rented from a provider, like Amazon AWS), nearly everyone is vulnerable to issues with online reliability.

Then there's the issue of unhappy consumer Internet service providers. Netflix streaming uses up more North American broadband traffic than any other service, and more than YouTube, Hulu, Amazon, HBO Go, iTunes, and BitTorrent *combined*![126] Many Internet service providers aren't pleased by the firm's growth, viewing Netflix as a rapidly expanding, network-clogging traffic hog. Netflix pays its own ISPs to connect the firm to the Internet and to support its heavy volume of outbound traffic, but cable companies that control the so-called last mile to your home (usually with little to no competition) want Netflix to pay more. Netflix has cut deals with Comcast and Verizon to connect directly to their networks to improve streaming performance. This runs contrary to principles of *net neutrality*—that is, the principle that all Internet traffic should be treated equally and that ISPs should not discriminate, slow down access, or charge differentially by user, content, site, platform, application, type of attached equipment, or modes of communication[127] (for more, see Chapter 16). A 2015 FCC rule change did "address threats to the open Internet by, among other things, prohibiting [broadband] providers from interfering with an individual's ability to access Netflix's video service," but the ultimate fate of these rulings remains in flux.[128] Internet access and usage rules in global markets also continue to develop, and Hastings has also called for stronger net neutrality protections in Europe.[129]

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Another threat is that several ISPs, including Comcast, AT&T, and Charter, have experimented with **bandwidth caps** that place a ceiling on a customer's total monthly consumption (users can usually bump up the ceiling, but they have to pay for it). Today, few US users are running into the ceiling, but that may change as more family members sport tablets, smartphones, and other streaming devices and as new, traffic-heavy technologies like FaceTime and Skype become more widely used. In Canada, Netflix has already lowered stream quality to deal with that nation's more restrictive traffic consumption limits.

bandwidth caps

A limit, imposed by the ISP (e.g., a cable or telephone company) on the total amount of traffic that a given subscriber can consume (usually per each billing period).

If bandwidth is capped, then consumers might pay a penalty (or pay more) just for being Netflix customers. And if Netflix has to pay to cut special deals with ISPs, then it'll have less money for content and innovation and may pass on some costs to consumers in the form of higher subscription prices (Netflix already lets users downgrade quality and consume less data, allowing mobile subscribers, in particular, to avoid maxing out their data plans). Others worry that a loss of net neutrality will hurt entrepreneurship and innovation since only the largest players will be able to pay for the best access. Cable outfits see it differently, stating that their profits allow them to make investments in faster, more reliable networks, which actually empowers the next-gen Zuckerbergs. Netflix has been fiercely critical of the cable industry and continues to push for net neutrality reforms, but if fast-lane access or bandwidth caps become commonplace, the firm could suffer.

Hacking Corporate Culture

A few years back, Reed Hastings wrote what is now considered one of the most highly influential documents on corporate culture. Hastings started this as a sort of letter to himself, where he wrote down what he wished he'd known when he started his journey in entrepreneurship twenty years earlier.[130] As the founder of two successful software firms (before Netflix, Hastings founded and led Pure Software, a firm that he eventually sold for three-quarters of a billion dollars), Hastings has learned a lot along the way. Facebook COO (chief operating officer) Sheryl Sandberg calls the slide deck of Hastings's notes, titled *Netflix Culture: Freedom & Responsibility*, "the most important document ever to come out of the Valley." That's high praise from one of the most powerful women in business—and likely an influencing factor on why Hastings was chosen as a Facebook board member.

Hastings outlined the central tenet: "We want responsible people who are self-motivating and self-disciplined, and we reward them with freedom."[131] Included in the document are some suggestions that run counter to widespread industry practices. For example, while many firms delay compensation, shelling out stock options over time in vesting periods that act as "golden handcuffs" to aid in employee retention, all Netflix employee compensation vests immediately. Netflix wants employees motivated by the challenge and excitement of the firm's operating environment, eliminating any clock punchers waiting for a calendar date to arrive. "During the trying time for Netflix [when stock dropped to one-sixth its value following the Qwikster debacle], our culture helped us hold everything together…there was a lot of strength and resilience on the management team."[132]

Also unusual is the firm's vacation policy: there is none at Netflix. Employees are encouraged to do what they need to in order to get the job done and to take the time off that they need and feel they deserve. Hastings himself takes plenty of vacation to set an example to other employees, claiming, "I do some of my creative thinking on vacation." The policy requires honesty and maturity, but that's precisely the kind of employee Netflix is after.

Employees at Netflix are among the highest paid in Silicon Valley. The firm regularly monitors top pay at peer firms—and then adds 10 to 20 percent on top of that number. As a result, it can hire just about anyone it wants. Get fired from Netflix? Severance is described as ultragenerous as well. The policy is meant to "remove guilt as an obstacle to management parting ways with subpar performers."[133] Managers are directed to only keep those employees they'd be "willing to fight for."[134]

Rather than view the firm as a family (as many firms claim to be), Hastings's analogy for his company is a sports team. The goal is to have star performers in every position. But unlike a sports team, a growing firm doesn't have a finite set of slots on its roster, so there's more room for talent growth. The team analogy also translates into other directives—don't hire "brilliant jerks," and "cutthroat" behavior toward fellow employees is not tolerated. Frankness is encouraged, how-

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ever. The firm regularly uses so-called "stop, start, continue" feedback, where anyone can give any other employee their thoughts on what they should stop doing, start doing, and continue doing. The technique is also used in group employee review sessions.[135]

Want more insight on life at Netflix? See the article at https://jobs.netflix.com/culture.

No Turning Back

While the firm is seeing a decreased payout from its investment in its warehouse infrastructure, nearly all assets have a limited lifespan. That's why corporations depreciate assets, writing their values down over time. The reality is that the shift from atoms to bits isn't flicking on like a light switch; it is a hybrid transition taking place over several years. Try to make the transition to streaming only too quickly, and as the Qwikster debacle showed, customers may leave. But move too slowly and rivals can gain ground. If Netflix can grab compelling content at manageable costs, broaden distribution options, grow its customer base, and lock them in with the switching costs created by customer data and recommendation engines (all big "ifs"), it just might cement its position as a key player in a bits-only world.

Reed Hastings already has a long history as one of the savviest strategic thinkers in tech, and Netflix seems to be pulling off the extraordinarily difficult task of transitioning from one tech-centric industry disruption to another, all while leading the pack in both categories. And while analysts have underestimated Hastings in the past, the firm's sky-high stock price and pundit expectations seem to have swung the other way. Positive recent statements about the globally ambitious firm include: "[Netflix] is quickly becoming one of the most powerful media companies in the world" and "the streaming video giant could soon become the next $100 billion tech company."[136] Does the firm deserve the hype? As the networks say, stay tuned!

TABLE 4.1 Netflix DVD-by-Mail vs. Streaming

	Netflix DVD-by-Mail	Netflix Streaming	Notes
Content Acquisition Costs	Fixed.	Variable and increasing. No consistency in licensing parameters (variants include per subscriber, per use, per stream, duration of deal, exclusivity). Has pushed Netflix to back exclusive content in hopes of drawing customers with high-quality, unique, first-run offerings.	Starz turned down a Netflix 10x offer to renew licensing just three years after first pact. US "first sale doctrine" means Netflix can buy and send out DVDs, but this ruling doesn't apply to streaming/broadcast. Costs increase as each film or series is uniquely differentiated but may have multiple streaming network bidders, pushing prices higher.

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	Netflix DVD-by-Mail	Netflix Streaming	Notes
Competitors	Mostly vanquished (bankrupt, inefficient Blockbuster bought by Dish). Indirect competition from Redbox kiosks but rival selection is small without delivery convenience.	Numerous with different models.	Digital video content available from Amazon, Apple, Dish/Blockbuster, Google/YouTube, Hulu, Walmart/Vudu, cable providers (OnDemand), pay channels (e.g., HBO Go), Sony, and soon Disney, plus many International rivals focused on select markets.
Competitor Motivation	Market has little appeal for new entrants.	Maturing tech firms see streaming as a growth market, and revenue models/goals vary (subscription/PPV/download-to-own, advertising, to fuel hardware purchases). Cable channels and cable providers fear subscriber loss.	Many rivals are highly profitable in other industries/have resources for expansion and to sustain prolonged competition. Pay channels fear their content will be devalued if Netflix is both cheaper and has a greater selection. Cable providers/channels fear cord cutting/shaving customers.
Plans	Fixed price per month based on number of DVDs at a time. High-volume customers that frequently return DVDs are unprofitable.	Unlimited monthly subscription to all content.	Rival plans vary and include: subscription, free/commercial-supported, rental, pay-per-view, download to own.
Innovation	Very limited since DVD content is fixed by the studios and burned onto a disc.	Opportunities for new content and revenue models.	Although Netflix states it will not consider anything beyond flat-rate subscriptions, streaming does offer the potential for mixed revenue streams (premium priced "windows," ad-supported offerings with ability to gather/leverage high-value customer data), and the ability to launch new content/services DVDs can't match (social, interactive premium content).
Availability	Any DVD that can be purchased (125,000-title long tail).	Limited to what studios will license (a shorter tail, fewer new/hit titles), or to new, original content that Netflix sponsors.	Content is licensed from studios (content owners) or cable channels (if channels have the right to relicense broadcast/streaming rights to others). HBO and others won't share. Pay channels get exclusives in "windows" that may require content to be pulled from streaming.

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	Netflix DVD-by-Mail	Netflix Streaming	Notes
Delivery Infrastructure	Tough to duplicate (at one point as many as 58 warehouses). Staffed and maintained—require steady/increasing subscribers to keep margins high.	Currently uses public cloud (Amazon), but with proprietary technology. Also includes a distribution network of servers located at ISPs and colocation facilities worldwide.	Postal costs to increase while service may decrease (Saturday eliminated, delivery speed slowed). Public cloud use means rivals have access to similar delivery infrastructure assets. ISPs threaten end-user bandwidth caps that may lower streaming appeal.
Delivery To	Any device with a DVD player. Selected on Web, delivery in about a day.	Any network-connected screen (TV, PC, mobile) with a Netflix client. Instantly browse, preview, watch, and rate content.	Blu-ray likely the last physical standard. The future is streaming and Netflix has the largest partner platform, integrating in game consoles, TVs, DVD players, mobile devices, and more. Device partnerships are not exclusive to Netflix and rivals are expanding streaming reach with similar integration.
Global Expansion	Expensive to replicate infrastructure regionally.	Can be served from the cloud, but reliant on local backbone and last-mile broadband.	DVD-by-mail needs cheap/fast local postal networks. Streaming costs are mostly dropping worldwide, but availability limited in some areas, quality varies, and bandwidth caps may limit appeal.
Market Outlook/ Challenges	US DVD-by-mail is mature and likely to decrease. Profit margins associated with running a nationwide warehouse network will go down if subscribers drop/ shift to streaming.	A growing but highly unpredictable business in terms of future costs, content availability, rival intensity, appeal vs. alternatives, and more. Key is in creating strategic assets that others can't match, but what are they? Brand, scale advantages, and data drove DVD-by-mail dominance.	Uncertain if Netflix will continue to gain streaming subscribers ahead of rivals fast enough to offset rising content costs.

Key Takeaways

- The shift from atoms to bits is impacting all media industries, particularly those relying on print, video, and music content. Content creators, middlemen, retailers, consumers, and consumer electronics firms are all impacted.
- Netflix's shift to a streaming model (from atoms to bits) is limited by access to content and in methods to get this content to televisions.
- The firm is right to be concerned that it needs to quickly transition to a new business model and that there are many potential advantages to the early mover who can create dominance in that space; however, the firm also made several blunders in its Qwikster attempt at this migration, and the failure of the firm to execute this shift effectively offers many lessons for firms considering customer-impacting changes.
- While the "First Sale Doctrine" allows Netflix to send out physical DVDs to subscribers, this law doesn't apply to streaming.
- Windowing, exclusives, and other licensing issues limit available content, and inconsistencies in licensing rates make profitable content acquisitions a challenge. Although the marginal cost for digital goods is zero, this benefit doesn't apply to licensees.

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- Licensing issues will make it impossible to create a long tail as long as it is enjoyed in the DVD-by-mail business. Its new model is about providing a "long enough tail" to attract and retain subscribers.
- Netflix is attempting to secure exclusive content and to fund the creation of original programming for first-window rights. This makes the new, streaming-centric Netflix seem more like a premium pay channel (e.g., HBO or Showtime).
- Netflix offers more programming than pay channels, has a larger customer base and more viewing hours than these channels, is available in more countries worldwide, can stream to customers who don't have a cable TV subscription, and is less expensive than most premium cable channels.
- Streaming allows the firm to collect and leverage data for improved customer targeting, to help build models on content value, to promote original content in highly targeted ways, to allow for "binge-watching," and to potentially serve the needs of original content producers who are freed from distribution timing and content length constraints that conventional networks place on their work.
- Netflix makes its streaming technology available to hardware firms, and it has facilitated the development of streaming apps for a host of consumer electronics devices. As a result, Netflix streaming is available on more devices than any competing rival service.
- Netflix's competitors in streaming are large, deep pocketed, and may have different motivations for offering streaming content (such as generating ad revenue, pay-per-view content sales, or as an incentive to make existing hardware platforms more attractive).
- International expansion offers the prospect of significant growth but is complicated by many issues, including increased licensing costs and disparate legal requirements.
- Netflix also faces threats from ISPs, including bandwidth caps and additional charges to ensure the quality of streaming efforts.
- The massive networks streaming delivery and operations infrastructure are largely hosted on the Amazon Web Services (AWS) cloud computing platform. This platform is available to all competitors, and it represents a cost that is potentially more variable as the firm grows than would be the case with a series of fixed-cost data centers. However, Netflix frees itself from dealing with many operational issues by contracting with Amazon, and it frees the firm to focus on proprietary systems that are a source of competitive advantage for the firm.
- Netflix is a significant creator of and contributor to software offerings—especially those that can be used to support cloud computing. The firm also uses crowdsourcing and code contests to fuel innovation. Both of these efforts also help the firm identify potential staffers and partners.
- The Netflix work culture is in many ways radically different from that of peers. The firm has shared its approach toward corporate culture, and this is increasingly having an influence on many firms—especially those in Silicon Valley.

Questions and Exercises

1. Contrast Netflix's two businesses: DVD-by-mail and streaming. How do costs differ? How are these costs likely to change over time? How is subscriber interest in these services likely to change over time? What factors influence the reliability of each service? What threats are each of these businesses likely to face?
2. Who are the rivals to the Netflix streaming effort? Do any of these firms have advantages that Netflix lacks? What are these advantages?
3. Why would a manufacturer of DVD players be motivated to offer the Netflix "Watch Now" feature in its products?
4. Make a chart of the various firms offering video-streaming services. List the pros and cons of each, along with its revenue model. Which efforts do you think will survive a shakeout? Why?
5. Is Netflix a friend or foe to the studios? Make a list of reasons why they would "like" Netflix, and why studios might be fearful of the firm.

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6. What is disintermediation, and what incentives do studios have to try to disintermediate Netflix?
7. Why can't Netflix secure a long tail of streaming content that is the same size as its content catalog in the DVD-by-mail business? What is Netflix doing to make its streaming catalog more appealing than rival offerings?
8. Is streaming content provided by studios a commodity or differentiated good? How does this influence supplier power? How has this changed in the shift from DVD-by-mail to streaming subscriptions?
9. What advantages does Netflix have over premium cable television channels? What advantages do these channels have over Netflix? Do you think this is a winner-take-all market, or is there room enough for multiple players?
10. How does Netflix build its data asset? In what ways does it leverage this data asset? Why is the data asset stronger under streaming than it was for the DVD-by-mail business?
11. Why is streaming potentially better for consumers and for content producers? Why is Netflix a potentially attractive partner for content creators (producers, writers, directors)?
12. Can scale be achieved in the streaming industry? If so, how? Or if not, why not?
13. What challenges does Netflix face as it expands internationally? What advantages does international expansion offer?
14. Why didn't Netflix vertically integrate and offer its own set-top box for content distribution?
15. What has been the impact of Netflix's move from single plan pricing to separate pricing for streaming and DVD-by-mail? What factors motivated this move? Do you think splitting the service into separate plans was a wise move? Why or why not? What errors did the firm make in the "Qwikster debacle"? What could the firm have done differently? Do you think this would have had a positive impact on the firm? Why or why not?
16. How does Netflix rank in terms of customer satisfaction today? What factors do you suppose are behind this ranking?
17. Investigate the current state of net neutrality. What is the current status of ISPs' right to offer a fast lane or impose bandwidth caps? Who would you side with, Netflix or the large ISPs? Why?
18. Investigate Netflix's stock price. One of the measures of whether a stock is "expensive" or not is the price-earnings ratio (share price divided by earnings per share). P/Es vary widely, but historic P/Es are about fifteen. What is the current P/E of Netflix? Do you think the stock is fairly valued based on prospects for future growth, earnings, and market dominance? Why or why not? How does the P/E of Netflix compare with that of other well-known firms, both in and out of the technology sector? Arrive in class with examples you are ready to discuss.
19. What are the risks and benefits to Netflix in using Amazon's cloud computing platform?
20. How has Netflix leveraged crowdsourcing and code contests?
21. In what ways do Netflix employee policies differ from those of most other firms? Does Netflix seem like the kind of firm you'd like to work for? Why or why not?

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CHAPTER 5

Moore's Law and More: Fast, Cheap Computing, and What This Means for the Manager

5.1 Introduction

Learning Objectives

1. Define Moore's Law and understand the approximate rate of advancement for other technologies, including magnetic storage (disc drives) and telecommunications (fiber-optic transmission).
2. Understand how the price elasticity associated with faster and cheaper technologies opens new markets, creates new opportunities for firms and society, and can catalyze industry disruption.
3. Recognize and define various terms for measuring data capacity.
4. Consider the managerial implications of faster and cheaper computing on areas such as strategic planning, inventory, and accounting.

Faster and cheaper—those two words have driven the computer industry for decades, and the rest of the economy has been along for the ride. Today it's tough to imagine a single industry not impacted by more powerful, less expensive computing. Faster and cheaper puts mobile phones in the hands of peasant farmers, puts a free video game in your Happy Meal, and drives the drug discovery that may very well extend your life.

Some Definitions

This phenomenon of "faster, cheaper" computing is often referred to as **Moore's Law**, after Intel cofounder Gordon Moore. Moore didn't show up one day, stance wide, hands on hips, and declare "behold my law," but he did write a four-page paper for *Electronics* magazine in which he described how regular advances in the process of chip making enabled more powerful chips to be manufactured at cheaper prices.[1]

Moore's Law

Chip performance per dollar doubles every eighteen months.

Moore's friend, legendary chip entrepreneur and Caltech professor Carver Mead, later coined the "Moore's Law" moniker. That name sounded snappy, plus as one of the founders of Intel, Moore had enough geek cred for the name to stick. Moore's original paper offered language only a chip designer would love, so we'll rely on the more popular definition: *chip performance per dollar dou-*

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bles every eighteen months (Moore's original paper stated transistors per chip, a proxy for power, would double every two years, but many sources today refer to the *eighteen*-month figure, so we'll stick with that since managers are often blindsided by unanticipated rate of technology change). Intel has recently speculated that Moore's Law may slow to a doubling every 2.5 years.[2] Even at that rate, we're still talking about ridiculously accelerating power and plummeting costs, a concept vital for managers to be aware of. And even as Intel's server, desktop, and laptop microprocessors hit their limit, others have pointed out that the calculating power of smartphones has actually outpaced the predictions of Moore's Law.[3]

Moore's Law at 50

Hear Intel co-founder Gordon Moore discuss Moore's Law at 50, and watch scenes showing the microprocessor manufacturing process.



View the video online at: http://www.youtube.com/embed/ylgk3HEyZ_g?rel=0

microprocessor
The part of the computer that executes the instructions of a computer program.

Moore's Law applies to chips—broadly speaking, to *processors* and chip-based storage: think of the stuff in your consumer electronics that's made out of silicon.[4] The **microprocessor** is the brain of a computing device. It's the part of the computer that executes the instructions of a computer program, allowing it to run a Web browser, word processor, video game, or virus. For processors, Moore's Law means that next-generation chips should be twice as fast in about *eighteen* months, but cost the same as today's models (or from another perspective, in about a year and a half, chips that are same speed as today's models should be available for half the price).

random-access memory (RAM)
The fast, chip-based volatile storage in a computing device.

volatile memory
Storage (such as RAM chips) that is wiped clean when power is cut off from a device.

nonvolatile memory
Storage that retains data even when powered down (such as flash memory, hard disk, or DVD storage).

Random-access memory (RAM) is chip-based memory. The RAM inside your personal computer is **volatile memory**, meaning that when the power goes out, all is lost that wasn't saved to **nonvolatile memory** (i.e., a more permanent storage media like a hard disc or flash memory). Think of RAM as temporary storage that provides fast access for executing computer programs and files. When you "load" or "launch" a program, it usually moves from your hard drive or flash storage to those RAM chips, where it can be more quickly executed by the processor.

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Cameras, MP3 players, USB drives, mobile phones, and even many lightweight notebook computers often use **flash memory** (sometimes called *flash RAM* or *flash storage*). It's not as fast as the RAM used in most traditional PCs, but holds data even when the power is off (so flash memory is also nonvolatile memory). You can think of flash memory as the chip-based equivalent of a hard drive. Apple's MacBook Air was one of the first commercial notebook computers to offer chip-based, nonvolatile memory as an alternative to laptop hard drives, although now several manufacturers and models also use the technology. The big advantage? Chips are **solid state electronics** (meaning no moving parts), so they're less likely to fail, and they draw less power. Data can also be accessed faster from flash memory than from conventional hard drives. For RAM chips and flash memory, Moore's Law means that in *eighteen* months you'll pay the same price as today for twice as much storage.

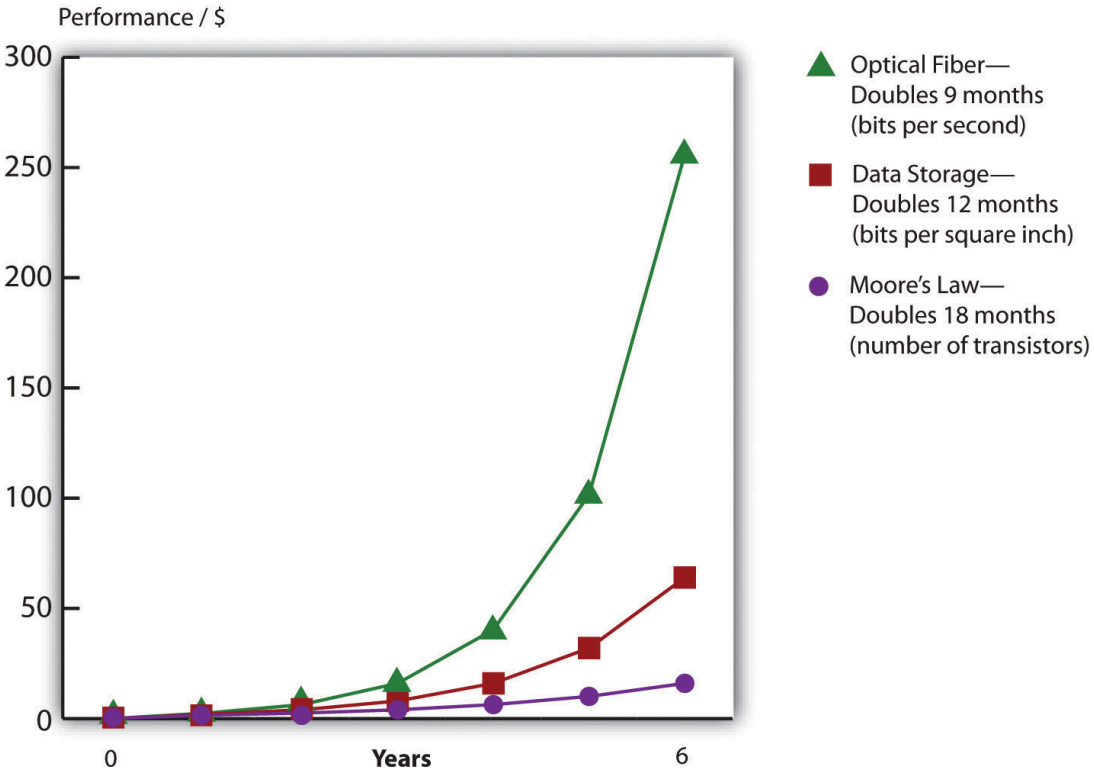
flash memory

Nonvolatile, chip-based storage, often used in mobile phones, cameras, and MP3 players. Sometimes called flash RAM, flash memory is slower than conventional RAM, but holds its charge even when the power goes out.

solid state electronics

Semiconductor-based devices. Solid state components often suffer fewer failures and require less energy than mechanical counterparts because they have no moving parts. RAM, flash memory, and microprocessors are solid state devices. Hard drives are not.

FIGURE 5.1 Advancing Rates of Technology (Silicon, Storage, Telecom)



Source: Adopted from Shareholder Presentation by Jeff Bezos, Amazon.com, 2006.

Computer chips are sometimes also referred to as **semiconductors** (a substance such as silicon dioxide used inside most computer chips that is capable of enabling as well as inhibiting the flow of electricity). So if someone refers to the *semiconductor industry*, they're talking about the chip business.[5]

semiconductor

A substance such as silicon dioxide used inside most computer chips that is capable of enabling as well as inhibiting the flow of electricity. From a managerial perspective, when someone refers to semiconductors, they are talking about computer chips, and the semiconductor industry is the chip business.

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optical fiber line
A high-speed glass or plastic-lined networking cable used in telecommunications.

Strictly speaking, Moore's Law does not apply to other technology components. But other computing components are also seeing their price versus performance curves skyrocket exponentially.[6] Data storage doubles every twelve months. Networking speed is on a tear, too. With an equipment change at the ends of the cables, the amount of data that can be squirted over an **optical fiber line** has, at times, doubled every nine months.[7] These numbers should be taken as rough approximations and shouldn't be expected to be strictly precise over time. And predictability precision is tough to achieve. For example, some think the advance in hard drive storage (sometimes referred to as Kryder's Law[8]) is decelerating,[9] while others think it is poised to accelerate.[10] Others have claimed that network speeds are now doubling about every twenty-one months.[11] And as mentioned earlier, some say the rate of microprocessor performance relative to Moore's predictions is either slowing or accelerating, depending on if you're looking at traditional PCs or smartphones. Despite any fluctuation, it's clear that the price/performance curve for many technologies is exponential, offering astonishing improvement over time. While the pace of change may vary over time, these graphs (or recalibrated versions, if you like) are useful to managers as rough guides regarding future computing price/performance trends. As so many examples in this text have illustrated, managers without an eye on technology's advancing capabilities are often leading candidates for professional roadkill.

Get Out Your Crystal Ball

price elasticity
The rate at which the demand for a product or service fluctuates with price change. Goods and services that are highly price elastic (e.g., most consumer electronics) see demand spike as prices drop, whereas goods and services that are less price elastic are less responsive to price change (think heart surgery).

Faster and cheaper makes possible the once impossible. As a manager, your job will be about predicting the future. First, consider how the economics of Moore's Law opens new markets. When technology gets cheap, **price elasticity** kicks in. Tech products are highly *price elastic*, meaning consumers buy more products as they become cheaper.[12] And it's not just that existing customers load up on more tech; entire *new markets* open up as firms find new uses for these new chips, technology becomes embedded in new products, and fast/cheap technology enables new services.

Just look at the *evolving waves of computing* we've seen over the previous decades.[13] In the *first wave* in the 1960s, computing was limited to large, room-sized mainframe computers that only governments and big corporations could afford. Moore's Law kicked in during the 1970s for the *second wave*, and minicomputers were a hit. These were refrigerator-sized computers that were as speedy as or speedier than the prior generation of mainframes, yet were affordable for work groups, factories, and smaller organizations. The 1980s brought *wave three* in the form of PCs, and by the end of the decade nearly every white-collar worker in America had a fast and cheap computer on their desk. In the 1990s, *wave four* came in the form of Internet computing; cheap servers and networks made it possible to scatter data around the world at the same time that fast, cheap PCs became mouse-click easy and PC ownership became common in the industrialized world. The following decade saw mobile phones drive what can be considered *computing wave five*. Cheap processors enabled billions of low-end phones, while the march of Moore's Law is driving the smartphone revolution. Today many say this *sixth wave* of computing can be considered the era of *pervasive computing*, where technology is fast and so inexpensive that it is becoming ubiquitously woven into products in ways few imagined years before. Silicon is everywhere! It's in the throwaway radio frequency identification (RFID) tags that track your luggage at the airport. It's the brains inside robot vacuum cleaners, it's built into Legos, it's in the locks that allow Starwood hotel rooms to be opened with a guest's phone, it's in the iBeacon sensors that help you find a hot dog and beer at the ballpark, it's in smart speakers like Echo and HomePod, and it's empowering wearables from smartwatches to in-shirt sensors to Snapchat Spectacles. These digital shifts can rearrange entire industries. Consider that today the firms that sell the most cameras aren't camera companies; they're phone manufacturers offering increasingly sophisticated chip-based digital cameras as a giveaway inside their main product offering. This shift has occurred with such sweeping impact that former photography giants Kodak and the now-merged Konica Minolta have exited the conventional camera business.

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Tech Everywhere: From the Smart Thermostat to a Tweeting Diaper

Former Apple vice president Tony Fadell has been called the "Father of the iPod," and he guided the first three iPhones through production. But his next act after Apple, Nest Labs, was decidedly sixth wave—smartening up the lowly thermostat with high-impact results. The Nest is loaded with Moore's Law smarts: motion sensors to tell if anyone's in a room, a temperature sensor, a Wi-Fi connection to grab weather conditions outside—it even runs Linux. The goal is to pay attention to you and the world around your home and to automatically and efficiently adjust your energy use to best fit your needs—no programming needed (although you can tinker with settings via smartphone app if you'd like). Current "dumb" thermostats control about half of the energy use in a typical US home, so this is a big and important market with a potentially massive payoff for consumers and for the environment.[14] Nest users report shaving their heating and cooling bills by about 20 percent on average, saving a collective 2 billion kilowatt hours in two years.[15] Google believed in the less-than-four-year-old firm enough to buy it for $3.2 billion, at the time Google's second most expensive acquisition ever.[16] Apple apparently also believes in the power of the connected home. The firm's HomeKit iOS extensions can control all sorts of Nest-like smart devices for the home, including thermostats, lighting, locks, home security systems, and more.

Nest is just one example of fast, cheap computing showing up in all sorts of products. Cambridge, Massachusetts–based Ambient Devices manufactures a smart umbrella that regularly receives wireless weather reports and will flash when rain is likely, as if to say, "You will soon require my services!" Smart billboards in Japan peer back at passersby to guess at their demographics and instantly change advertising for on-the-spot targeting.[17] And there are experimental efforts that range from the promising Airbus Bag2Go suitcases, which with RFID, GPS, and phone smarts offer quick check-in and never-lost luggage,[18] to the chuckle-worthy Huggies TweetPee, which can send a text or social media post when a child's diaper "activity" is detected.[19] Robust, low-cost hardware hacking is made easier with products like the Raspberry Pi and Arduino, credit card-sized computers that can run a full PC operating system and cost as little as $5.[20] Hacker magazine *The MagPi* included a Raspberry Pi Zero as a freebee in a newstand issue.[21] Netflix shared plans on how to embed an Arduino in a pair of socks to automatically pause the service if motion detection suggests the viewer has fallen asleep (also shared, knitting instructions for show-themed toe-warmers. *Master of None* taco-socks, anyone?).

Netflix Socks Video

Netflix shared plans for *Netflix Socks* as a holiday gift idea: Arduino-embedded toe warmers that can sense if the wearer has fallen asleep, and can pause streaming video so you won't miss out because you snoozed while you binged.



View the video online at: //www.youtube.com/embed/Fi6RLrJrjLQ?rel=0

Some refer to these devices as the "**Internet of Things**," where low-cost sensors, computing, and communication put embedded smarts in all sorts of mundane devices so that these products can communicate with one another for data collection, analysis, and collective action.[22] We've already learned that buying a product from Zara that has an RFID tag attached to it will trigger

Internet of Things

A vision where low-cost sensors, processors, and communication are embedded into a wide array of products and our environment, allowing a vast network to collect data, analyze input, and automatically coordinate collective action.

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a message to restock shelves, ship more products from a warehouse, and spin up factories for a new order. And there's more to come. Imagine your Nest thermometer coordinating with the rest of your house: closing automated blinds when the sun is hot and high, turning off your water heater when you're away from home, and turning on lights to mimic activity while you're out of town. Smart tags in clothing could communicate with washing machines and dryers and warn the operator if settings could ruin a shirt.

FIGURE 5.2 The Raspberry Pi

The $10 Raspberry Pi Zero W offers impressive specs, including: a 1GHz, single-core CPU, 512MB RAM, Mini-HDMI port, Micro-USB On-The-Go port, Micro-USB power, HAT-compatible 40-pin header, Composite video and reset headers, CSI camera connector, 802.11n Wi-Fi, and Bluetooth 4.0. That's a fairly robust computing platform for less money than most spend on an iPhone cable.



Source: Adafruit Industries.

IBM (you've seen those "Smarter Planet" ads) and General Electric (GE) are among firms pushing to create technology and common languages to turn this vision into a reality. Cities are using smart devices as constant monitors that share information on traffic, available parking spaces, and water quality. GE is outfitting almost everything it builds—from medical equipment to jet engines—with sensors and software so that these devices can share data and coordinate automatically to drive efficiency.[23] GE thinks efficiency gains across multiple sectors—transportation, health care, energy—could boost global GDP by as much as $10 trillion to $15 trillion by 2030[24] (to geek out with video examples like medical imaging, logistics, and 3D printing, see GE's In The Wild series on YouTube). Research group Gartner predicts that there are already some 5 billion connected devices in use today, with an expected 25 billion to be in use by 2020.[25]

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Moore's Law Inside Your Medicine Cabinet... and Your Colon

FIGURE 5.3 The GlowCap
The GlowCap from Vitality, Inc., will flash, beep, call, and text you if you've skipped your meds. It can also send reports to you, your doctor, and your loved ones and even notify your pharmacy when it's time for a refill.



Source: Used with permission from Vitality, Inc.

Moore's Law is coming to your medicine cabinet, and several early-stage efforts show the potential for low-cost computing to improve health care quality while lowering costs. The GlowCap from Vitality, Inc. (now part of NantHealth), is a "smart" pill bottle that will flash when you're supposed to take your medicine. It will play a little tune if you're an hour late for your dose and will also squirt a signal to a nightlight that flashes as a reminder (in case you're out of view of the cap). GlowCaps can also be set to call or send a text if you haven't responded past a set period of time. And the device will send a report to you, your doc, or whomever else you approve. The GlowCap can even alert your pharmacy when it's time for refills. For other kinds of medicines such as inhalers, blister packs, and liquids, Vitality also sells a GlowPack—same concept, different form factor. The bottles sell for as little as $10 but in some cases are likely to be free. The business case for that? The World Health Organization estimates drug adherence at just 50 percent, and analysts estimate that up to $300 billion in increased medical costs and 125,000 annual deaths are due to patients missing their meds.[26] Vitality CEO David Rose (who incidentally also cofounded Ambient Devices) recently cited a test in which GlowCap users reported a 98 percent medication adherence rate.[27]

FIGURE 5.4 PillCam
Swallow the PillCam and the device's twin cameras will relay live video of your insides, helping diagnose gastrointestinal problems.



Source: Medtronic.

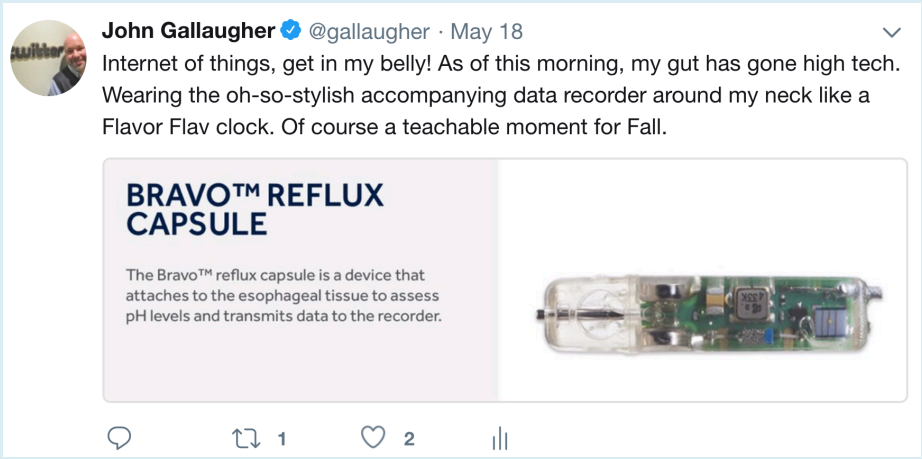
And there might also be a chip inside the pills, too! Proteus, a Novartis-backed venture, has developed a sensor made of food and vitamin materials that can be swallowed in medicine. While there is a lot of talk about "wearable" technology, Proteus is an ingestible tech. The sensor is activated and powered by the body's digestive acids (think of your stomach as a battery). Once inside you, the chip sends out a signal with vitals such as heart rate, body angle, temperature,

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sleep, and more. A waterproof skin patch worn outside the body picks up the signal and can wirelessly relay the pill's findings when the patient walks within twenty feet of their phone. Proteus will then compile a report from the data and send it to their mobile device or e-mail account. The gizmo has already received FDA approval,[28] and Proteus has conducted additional trials for heart disease, hypertension, and tuberculosis, and for monitoring psychiatric illnesses.[29] And a pill with built-in smarts can identify itself to help guard against taking counterfeit drugs, a serious worldwide concern. The CEO of Proteus Health says that soon you may be able to think of your body as "the ultimate game controller."[30]

Pills that chat with mobile phones could help promote telemedicine, bringing health care to hard-to-reach rural populations. The Medtronic PillCam comes with up to two cameras that, once swallowed, can relay images of your innards, used to diagnose intestinal and colon problems[31] (YouTube video of the device in action has been mercifully excluded from this textbook). Your textbook author has ingested a similar device, a Medtronic Bravo Reflux Capsule. No cameras in this one, but it does have sensors and communication smarts to monitor and report on stomach acid. I wore a receiver device around my neck for a weekend, while the heartburn sensor beamed messages through my body from its perch at the end of my esophagus (verdict—no ulcer, but a stomach hernia, ugh). The tweet below shows the lengths I'll go to in capturing a teachable moment for you, dear reader.



One of the most agile surfers of new generations of computing waves is Apple, Inc.—a firm with a product line that grew so broad, it dropped the word "Computer" from its name. Apple's keen insight on where trends in computing power and performance are headed is captured in this statement by the firm's cofounder the late Steve Jobs: "There's an old Wayne Gretzky quote that I love. 'I skate to where the puck is going to be, not where it has been.' And we've always tried to do that at Apple."[32] The curves above aren't perfect, but they can point to where the puck is headed, helping the savvy manager predict the future, plan for the impossible to become possible, and act as the disruptor rather than the disrupted.

Apple's breakout resurgence owes a great deal to the iPod. At launch, the original iPod sported a 5 GB hard drive that Steve Jobs declared would "put 1,000 songs in your pocket." Cost? $399. Less than six years later, Apple's highest-capacity iPod sold for fifty dollars less than the original, yet held *forty times* the songs. By the iPod's tenth birthday, Apple was giving away 5 GB of storage (for music or other media) for free via its iCloud service. Apple's high-end iPod models have morphed into Internet browsing devices capable of showing maps, playing videos, and gulping down songs from Starbucks' Wi-Fi while waiting in line for a latte.

The original iPod has also become the jumping-off point for new business lines including the iPhone, Apple TV, Apple Watch, iPad, iTunes, the App Store, and HomePod. Surfing the ever-evolving waves of computing has turned Apple into the most valuable company in the United States and the most profitable firm on the planet.[33] Ride these waves to riches, but miss the power and promise of Moore's Law and you risk getting swept away in its riptide. Apple's rise occurred while Sony, a

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firm once synonymous with portable music, sat on the sidelines unwilling to get on the surfboard. Sony's stock stagnated, barely moving in six years. The firm has laid off thousands of workers while ceding leadership in digital music (and video) to Apple.

TABLE 5.1 Tech's Price/Performance Trends in Action: Amazon Kindle and Apple Music Storage

Amazon Kindle		Apple	
First Generation	Fourth Generation	iPod	iCloud
250 MB	2 GB	5 GB	5 GB
November 2007	September 2011	October 2001	October 2011
$399	$79	$399	Free

Amazon's Kindle also dramatically demonstrates Moore's Law-fueled evolution. The first Kindle sold for nearly $400. Less than four years later, Amazon was selling an updated version for one-fifth that price. Other factors influence price drops, such as being able to produce products and their components at scale, but Moore's Law and related price/performance trends are clearly behind the price decreases we see across a wide variety of tech products and services. Apple's introduction of the iPad, complete with an iBook store, shows how Moore's Law rewrites the boundaries of competition, bringing a firm that started as a computer manufacturer and a firm that started as an online bookstore in direct competition with one another.

While the change in hard drive prices isn't directly part of Moore's Law (hard drives are magnetic storage, not silicon chips), as noted earlier, the faster and cheaper phenomenon applies to storage, too. Amazon provides another example of creating a once-impossible offering courtesy of the trajectory of price/performance technology curves. The firm's "Search Inside the Book" feature required digitizing the images and text from thousands of books in Amazon's catalog. Not only did making books searchable before purchase help customers; titles supporting "Search Inside the Book" enjoyed a 7 percent sales increase over nonsearchable books. Here's where fast/cheap technology comes in. When the feature launched, the database to support this effort was twenty *times* larger than *any* database used by any commercial firm just eight years earlier. For Amazon, the impossible had not just become possible; it became good business.

Bits and Bytes

Computers express data as bits that are either one or zero. Eight bits form a byte (think of a byte as being a single character you can type from a keyboard). A kilobyte refers to roughly a thousand bytes, or a thousand characters, megabyte = 1 million, gigabyte = 1 billion, terabyte = 1 trillion, petabyte = 1 quadrillion, and exabyte = 1 quintillion bytes.

While storage is most often listed in bytes, telecommunication capacity (bandwidth) is often listed in bits per second (bps). The same prefixes apply (Kbps = kilobits, or one thousand bits, per second, Mbps = megabits per second, Gbps = gigabits per second, and Tbps = terabits per second).

These are managerial definitions, but technically, a kilobyte is 2^{10} or 1,024 bytes, mega = 2^{20}, giga = 2^{30}, tera = 2^{40}, peta = 2^{50}, and exa = 2^{60}. To get a sense for how much data we're talking about, see the following table.[34]

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TABLE 5.2 Bytes Defined

	Managerial Definition	Exact Amount	To Put It in Perspective
1 Byte	One keyboard character	8 bits	1 letter or number = 1 byte
1 Kilobyte (KB)	One thousand bytes	2^{10} bytes	1 typewritten page = 2 KB
			1 digital book (Kindle) = approx. 500–800 KB
1 Megabyte (MB)	One million bytes	2^{20} bytes	1 digital photo (7 megapixels) = 1.3 MB
			1 MP3 song = approx. 3 MB
			1 CD = approx. 700 MB
1 Gigabyte (GB)	One billion bytes	2^{30} bytes	1 DVD movie = approx. 4.7 GB
			1 Blu-ray movie = approx. 25 GB
1 Terabyte (TB)	One trillion bytes	2^{40} bytes	Printed collection of the Library of Congress = 20 TB
1 Petabyte (PB)	One quadrillion bytes	2^{50} bytes	Master copies of the shows and movies available on Netflix (2013) = 3.14 PB[35]
1 Exabyte (EB)	One quintillion bytes	2^{60} bytes	Estimated total data stored in the NSA's Bluffdale, Utah, data center (includes data from hard drives, overseas data centers, cell phones, and more) = 12 EB[36]
1 Zettabyte (ZB)	One sextillion bytes	2^{70} bytes	Estimated total annual amount of data transmitted over the Internet by 2018 = 1.6 ZB[37]

Here's another key implication for the curves shown earlier: if you are producing products subject to radically improving price/performance, then these products will rapidly fall in value over time. That's great when it makes your product cheaper and opens up new markets for your firm, but it can be deadly if you overproduce and have excess inventory sitting on shelves for long periods of time. Dell claims its inventory depreciates as much as a single percentage point in value each week.[38] That's a big incentive to carry as little inventory as possible, and to unload it, fast!

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While the strategic side of tech may be the most glamorous, Moore's Law impacts mundane management tasks, as well. From an accounting and budgeting perspective, as a manager you'll need to consider a number of questions: How long will your computing equipment remain useful? If you keep upgrading computing and software, what does this mean for your capital expense budget? Your training budget? Your ability to make well-reasoned predictions regarding tech's direction will be key to answering these questions.

Tech: A Helping Hand to Escape Poverty

Another tech product containing a microprocessor is transforming the lives of some of the world's most desperate poor—the cell phone. There are three billion people worldwide who don't yet have a phone, but they will, soon. In the ultimate play of Moore's Law opening up new markets, Chinese mobiles priced at $10 have been available for years,[39] while Google hopes its Android Go with its stripped-down, data-light, low-power smartphone experience, will connect a billion of the world's currently unconnected population.[40] It took roughly twenty years to sell a billion mobile phones worldwide; the second billion sold in four years; and the third billion took just two years. Today, some 80 percent of the world's population lives within cellular network range, and the vast majority of mobile subscriptions are in developing countries.[41]

Why such demand? Mobiles change lives for the better. According to economist Jeffrey Sachs, "The cell phone is the single most transformative technology for world economic development."[42] A London Business School study found that for every ten mobile phones per one hundred people, a country's GDP bumps up 0.5 percent.[43] Think about the farmer who can verify prices and locate buyers before harvesting and transporting perishable crops to market; the laborer who was mostly unemployed but with a mobile is now reachable by those who have day-to-day work; the mother who can find out if a doctor is in and has medicine before taking off work to make the costly trek to a remote clinic with her sick child; or the immigrant laborer serving as a housekeeper who was "more or less an indentured servant until she got a cell phone," enabling new customers to call and book her services.[44]

Three-quarters of the world's poorest people get their food and income by farming.[45] But isolated rural farmers often suffer from an information asymmetry problem (see Chapter 2). These farmers traditionally don't have accurate information on what their products are worth, and in many communities, less scrupulous traders will buy up harvests at far-below-market rates, only to resell them and pocket the profits for themselves. Coming to the aid of farmers, the Ghanaian firm Esoko delivers market prices, farming tips, and other key information via text message on even the lowest-end cell phones. In one study, farmers using Esoko reported a 10 percent increase in revenue.[46] Other reports have revenue increases as high as 25 to 40 percent.[47] Esoko offers a breadth of services that range from helping farmers find transport services to helping buyers locate farmers with goods to sell.

Promotional Video of Esoko's Market Information System



View the video online at: //www.youtube.com/embed/tcGuW-Mc48k?rel=0

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The Launch of Safaricom's M-PESA

This TechChange video is narrated by Michael Joseph, managing director of mobile money at Vodafone.



View the video online at: //www.youtube.com/embed/i0dBWaen3aQ?rel=0

When phones can be used as currency for purchases or payments, who needs Visa or, for that matter, a wallet and cash? The M-PESA mobile banking service, run by Kenya's Safaricom, allows customers to transfer cash using text messages. Nearly every Kenyan adult has an M-PESA account, paying for everything from groceries to cab rides to school tuition. The service can also allow family members to quickly and securely send cash across the country. Only 4 million Kenyans have traditional bank accounts, but 25 million use M-PESA, and upwards of 44 percent of Kenya's GDP flows through the service.[48] M-PESA is spreading to other regions and is even used in Afghanistan, while similar schemes are offered by firms such as WIZZIT in South Africa, Zaad in Somaliland, and GCash in the Philippines. The "mobile phone as bank" may bring banking to a billion unserved customers in a few years.

Key Takeaways

- Moore's Law applies to the semiconductor industry. The widely accepted managerial interpretation of Moore's Law states that for the same money, roughly eighteen months from now you should be able to purchase computer chips that are twice as fast or store twice as much information. Or over that same time period, chips with the speed or storage of today's chips should cost half as much as they do now.
- Nonchip-based technology also advances rapidly. Disk drive storage doubles roughly every twelve months, while equipment to speed transmissions over fiberoptic lines has doubled every nine months. While these numbers are rough approximations, the price/performance curve of these technologies continues to advance exponentially.
- These trends influence inventory value, depreciation accounting, employee training, and other managerial functions. They also help improve productivity and keep interest rates low.
- From a strategic perspective, these trends suggest that what is impossible from a cost or performance perspective today may be possible in the future. Fast/cheap computing also feeds a special kind of price elasticity where whole new markets are created. This fact provides an opportunity to those who recognize and can capitalize on the capabilities of new technology. As technology advances, new industries, business models, and products are created, while established firms and ways of doing business can be destroyed.

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- Managers must regularly study trends and trajectory in technology to recognize opportunity and avoid disruption.
- Moore's Law (and related advances in fast/cheap technologies in things like storage and telecommunications) has driven six waves of disruptive, market-transforming computing. The sixth wave involves embedding intelligence and communications in all sorts of mundane devices. Some point to a future "Internet of Things," where objects will collect and share data and automatically coordinate collective action for radical efficiency improvements.

Questions and Exercises

1. What is Moore's Law? What does it apply to?
2. Are other aspects of computing advancing as well? At what approximate rates? What is Kryder's Law?
3. What is a microprocessor? What devices do you or your family own that contain microprocessors (and hence are impacted by Moore's Law)?
4. What is a semiconductor? What is the substance from which most semiconductors are made?
5. How does flash memory differ from the memory in a PC? Are both solid state?
6. Which of the following are solid-state devices: an iPod shuffle, an iPhone, a USB flash drive, a TiVo DVR, a typical laptop PC?
7. Why is Moore's Law important for managers? How does it influence managerial thinking?
8. What is price elasticity? How does Moore's Law relate to this concept? What's special about falling chip prices compared to price drops for products like clothing or food?
9. Give examples of firms that have effectively leveraged the advancement of processing, storage, and networking technology.
10. What are the six waves of computing? Give examples of firms and industries impacted by the sixth wave.
11. As Moore's Law advances, technology becomes increasingly accessible to the poor. Give examples of how tech has benefited those who likely would not have been able to afford the technology of a prior generation.
12. How have cheaper, faster chips impacted the camera industry? Give an example of the leadership shifts that have occurred in this industry.
13. What has been the impact of "faster, cheaper" on Apple's business lines?
14. How did Amazon utilize the steep decline in magnetic storage costs to its advantage?
15. How does Moore's Law impact production and inventory decisions?
16. Research the impact of mobile phones on poor regions of the world. Come to class prepared to discuss examples that demonstrate the potential for fast/cheap technology to improve society, even for individuals with extremely low incomes.
17. The "Internet of Things" makes for compelling commercials, but what needs to happen before a world of interconnected, coordinating devices can become a reality? What implications does this raise for business and society with respect to issues such as privacy and security? If you were GE, would you seek to keep the communication language among smart devices proprietary or open? Why or why not?

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5.2 The Death of Moore's Law?

Learning Objectives

1. Describe why Moore's Law continues to advance and discuss the physical limitations of this advancement.
2. Name and describe various technologies that may extend the life of Moore's Law.
3. Discuss the limitations of each of these approaches.

fabs

Semiconductor fabrication facilities; the multibillion dollar plants used to manufacture semiconductors.

silicon wafer

A thin, circular slice of material used to create semiconductor devices. Hundreds of chips may be etched on a single wafer, where they are eventually cut out for individual packaging.

Moore's Law isn't a precise scientific truth, like Boyle's Law or relativity. Moore simply observed that we're getting better over time at squeezing more stuff into tinier spaces. Moore's Law is possible because the distance between the pathways inside silicon chips gets smaller with each successive generation. While chip factories (semiconductor fabrication facilities, or **fabs**) are incredibly expensive to build, each new generation of fabs can crank out more chips per **silicon wafer**. And since the pathways are closer together, electrons travel shorter distances. If electronics now travel half the distance to make a calculation, that means the chip is twice as fast.

While shrinking silicon pathways creates better chips, packing pathways tightly together creates problems associated with three interrelated forces—*size*, *heat*, and *power*—that together are threatening to slow down Moore's Law's advance. When you make processors smaller, the more tightly packed electrons will heat up a chip—so much so that unless today's most powerful chips are cooled down, they will melt inside their packaging. To keep the fastest computers cool, many PCs, laptops, and video game consoles need fans, and most corporate data centers have elaborate and expensive air conditioning and venting systems to prevent a meltdown. A trip through the Facebook data center during its early growth would have shown that the firm was a "hot" startup in more ways than one. The firm's servers ran at temperatures so high that the Plexiglas sides of the firm's server racks were warped and melting![49] The need to cool modern data centers draws a lot of power and that costs a lot of money.

The chief eco officer at Sun Microsystems has claimed that computers draw 4 to 5 percent of the world's power. Google's chief technology officer has said that the firm spends more to power its servers than the cost of the servers themselves.[50] Apple, Facebook, Microsoft, Yahoo! and Google have all built massive data centers in the Pacific Northwest, away from their corporate headquarters, specifically choosing these locations for access to cheap hydroelectric power. Google's location in The Dalles, Oregon, is charged a cost per kilowatt hour less than one-fifth the rate the firm pays in Silicon Valley.[51] This difference means big savings for a firm that runs more than a million servers.

And while these powerful shrinking chips are getting hotter and more costly to cool, it's also important to realize that chips can't get smaller forever. At some point Moore's Law will run into the unyielding laws of nature. While we're not certain where these limits are, chip pathways certainly can't be shorter than a single molecule, and the actual physical limit is likely larger than that. Get too small and a phenomenon known as quantum tunneling kicks in, and electrons start to slide off their paths. Yikes! While the death of Moore's Law has been predicted for years, scientists continue to squeeze advancement through new manufacturing techniques. Many think that while Moore's Law has celebrated its fiftieth birthday, it may not make it to sixty.[52]

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Buying Time

multicore microprocessors

Microprocessors with two or more (typically lower power) calculating processor cores on the same piece of silicon.

One way to address the problem of densely packed, overheating chip designs is with **multicore microprocessors**, made by putting two or more lower power processor cores (think of a core as the calculating part of a microprocessor) on a single chip. Philip Emma, IBM's manager of systems technology and microarchitecture, offers an analogy. Think of the traditional fast, hot, single-core processors as a 300-pound lineman, and a dual-core processor as two 160-pound guys. Says Emma, "A 300-pound lineman can generate a lot of power, but two 160-pound guys can do the same work with less overall effort."[53] For many applications, the multicore chips will outperform a single speedy chip, while running cooler and drawing less power. Multicore processors are now mainstream.

Today, nearly all smartphones, PCs, and laptops sold have at least a two-core (dual-core) processor. The Microsoft Xbox One and PlayStation 4 both have eight core processors. Intel has even demonstrated chips with upwards of fifty cores.

Multicore processors can run older software written for single-brain chips. But they usually do this by using only one core at a time. To reuse the metaphor above, this is like having one of our 160-pound workers lift away, while the other one stands around watching. Multicore operating systems can help achieve some performance gains. Versions of Windows or the Mac OS that are aware of multicore processors can assign one program to run on one core, while a second application is assigned to the next core. But in order to take full advantage of multicore chips, applications need to be rewritten to split up tasks so that smaller portions of a problem are executed simultaneously inside each core.

Writing code for this "divide and conquer" approach is not trivial. In fact, developing software for multicore systems has been described by Shahrokh Daijavad, software lead for next-generation computing systems at IBM, as "one of the hardest things you learn in computer science."[54] Microsoft's chief research and strategy officer has called coding for these chips "the most conceptually different [change] in the history of modern computing."[55] Despite this challenge, some of the most aggressive adaptors of multicore chips have been video game console manufacturers. Video game applications are particularly well suited for multiple cores since, for example, one core might be used to render the background, another to draw objects, another for the "physics engine" that moves the objects around, and yet another to handle Internet communications for multiplayer games.

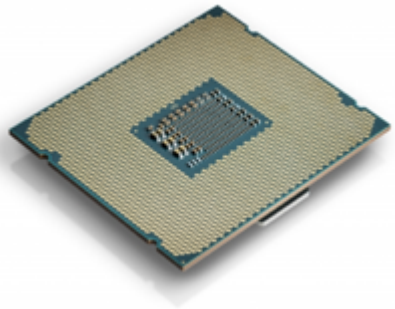
Another way of accelerating processing speed is to use chips that are designed to be really good at a subset of tasks. The graphics chip firms Nvidia (pronounced "en-VID-ee-ah") and AMD were originally designed to do lots of simultaneous calculations necessary for animation and other image work. Many graphics chips have been built with hundreds or in some cases thousands of cores to handle such tasks. And it turns out those multiple, small calculations, while not good for running end-user apps like Word or Excel, are especially well suited for so-called artificial intelligence/machine learning tasks like image and voice recognition. These tasks are usually performed "in the cloud," as opposed to on your smartphone or computer. Speak to Siri, Alexa, Cortana, or say "OK Google," and your voice is sent over the Internet to be decoded by a collection of computers at Apple, Amazon, Microsoft, or Google, which will then work to find the best result for your query, then send the answer back from the cloud to your device.

Google has even begun designing its own chips to handle its specific AI needs. Terms you might hear in this space include ASICs (pronounced "ay-sicks"), which means "application-specific integrated circuits," chips specifically designed to be really good at a specific kind of task; and field-programmable gate arrays (FPGAs), which are chips that can be programmed after purchase, rerouting logical pathways for application-specific efficiency in ways that aren't possible with a general purpose microprocessor like the Intel chip in your laptop (an approach preferred by Microsoft).[56] And while writing "divide and conquer" code to split up tasks to get single, best results is still tricky, new programming environments, such as Nvidia's CUDA, are making this easier.[57]

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TABLE 5.3 Comparison Chart

Microprocessors	ASICs	FPGAs
		
General Purpose Microprocessors: Sometimes called CPUs for central processing units. Can handle most any tasks, so you'll find them as the "main brain" in your PC (Intel-based) and smart phone (ARM-based). **Pros**: Can do just about anything, so they are far better generalists than ASICs or FPGAs. Supported by a large base of existing software. **Cons**: Are slower for many tasks, and chips are power-hungry, requiring more energy. **Players**: Intel (leader in PCs and servers), ARM (designs are the basis of most smartphone microprocessors, including Apple, Samsung, and Qualcomm)	**ASICs**: Application-specific integrated circuits are chips designed to do a subset of tasks very quickly and efficiently. **Pros**: Very fast and power efficient. Great for graphics and AI/machine learning. **Cons**: Can be costly to design and expensive to manufacture a very custom product. **Players**: Nvidia and AMD. Google has built its own AI-specific chip (the Tensor processing unit), but only the biggest firms with a specific need for a massive amount of such chips could justify the expense of doing this.	**FPGAs**: Field programmable gate arrays can have their on-chip logic re-routed to get better performance for a specifi task. **Pros**: Faster and more energy-efficient than general purpose microprocessors. Can be upgraded via software “in th field” after installation. A cheape alternative than designing and manufacturing a custom but unchangeable ASIC. **Cons**: ASICs designed from scratch for specific tasks can b faster/more efficient. **Players**: Intel-owned Altera, Xilinx. Microsoft uses FPGAs fo Bing and other cloud tasks.

Source: https://newsroom.intel.com/press-kits/intel-core-x-series-processors/ and https://www.altera.com/about/news_room.html

Another approach that's breathing more life into Moore's Law moves chips from being paper-flat devices to built-up 3-D affairs. By building up as well as out, firms are radically boosting speed and efficiency of chips. Intel has flipped upward the basic component of chips—the transistor. Transistors are the supertiny on-off switches in a chip that work collectively to calculate or store things in memory (a high-end microprocessor might include over two billion transistors). While you won't notice that chips are much thicker, Intel says that on the miniscule scale of modern chip manufacturing, the new designs are 37 percent faster and half as power hungry as conventional chips.[58]

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New Materials and Quantum Leaps? Thinking Beyond Moore's Law—Constraining Silicon

Think about it—the triple threat of size, heat, and power means that Moore's Law, perhaps the greatest economic gravy train in history, will likely come to a grinding halt in your lifetime. Multicore and 3-D transistors are here today, but what else is happening to help stave off the death of Moore's Law?

Every once in a while a material breakthrough comes along that improves chip performance. A few years back researchers discovered that replacing a chip's aluminum components with copper could increase speeds up to 30 percent. Now scientists are concentrating on improving the very semiconductor material that chips are made of. While the silicon used in chips is wonderfully abundant (it has pretty much the same chemistry found in sand), researchers are investigating other materials that might allow for chips with even tighter component densities. New processors made with silicon germanium, germanium, or grapheme have all been mentioned as next-gen candidates.[59] Hyperefficient chips of the future may also be made out of carbon nanotubes, once the technology to assemble the tiny structures becomes commercially viable.

Other designs move away from electricity over silicon. Optical computing, where signals are sent via light rather than electricity, promises to be faster than conventional chips, if lasers can be mass produced in miniature (silicon laser experiments show promise). Others are experimenting by crafting computing components using biological material (think a DNA-based storage device).

One yet-to-be-proven technology that could blow the lid off what's possible today is quantum computing. Conventional computing stores data as a combination of bits, where a bit is either a one or a zero. Quantum computers, leveraging principles of quantum physics, employ qubits that can be both one *and* zero at the same time. Add a bit to a conventional computer's memory and you double its capacity. Add a bit to a quantum computer and its capacity increases exponentially. For comparison, consider that a computer model of serotonin, a molecule vital to regulating the human central nervous system, would require 10^{94} bytes of information. Unfortunately there's not enough matter in the universe to build a computer that big. But modeling a serotonin molecule using quantum computing would take just 424 qubits.[60]

Some speculate that quantum computers could one day allow pharmaceutical companies to create hyperdetailed representations of the human body that reveal drug side effects before they're even tested on humans. Quantum computing might also accurately predict the weather months in advance or offer unbreakable computer security. Opportunities abound. Of course, before quantum computing can be commercialized, researchers need to harness the freaky properties of quantum physics wherein your answer may reside in another universe, or could disappear if observed (Einstein himself referred to certain behaviors in quantum physics as "spooky action at a distance").

Pioneers in quantum computing include IBM, HP, NEC, and a Canadian startup named D-Wave, which has sold early-stage quantum computers to Google, NASA, and Lockheed Martin.[61] If or when the full promise of quantum computing will become a reality is still unknown, but scientists and engineers are hoping that by the time Moore's Law runs into Mother Nature's limits, a new way of computing may blow past anything we can do with silicon, continuing to make possible the once impossible.

Key Takeaways

- As chips get smaller and more powerful, they get hotter and present power-management challenges. And at some point, Moore's Law will stop because we will no longer be able to shrink the spaces between components on a chip.
- Multicore chips use two or more low-power calculating "cores" to work together in unison, but to take optimal advantage of multicore chips, software must be rewritten to "divide" a task among multiple cores.

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- 3-D transistors are also helping extend Moore's Law by producing chips that require less power and run faster.
- New materials may extend the life of Moore's Law, allowing chips to get smaller. Entirely new methods for calculating, such as quantum computing, may also dramatically increase computing capabilities far beyond what is available today.

Questions and Exercises

1. What three interrelated forces threaten to slow the advancement of Moore's Law?
2. Which commercial solutions, described in the previous section, are currently being used to counteract the forces mentioned? How do these solutions work? What are the limitations of each?
3. Will multicore chips run software designed for single-core processors?
4. As chips grow smaller they generate increasing amounts of heat that needs to be dissipated. Why is keeping systems cool such a challenge? What are the implications for a firm like Yahoo! or Google? For a firm like Apple or Dell?
5. What are some of the materials that may replace the silicon that current chips are made of?
6. Search online to assess the current state of quantum computing. What kinds of problems might be solved if the promise of quantum computing is achieved? How might individuals and organizations leverage quantum computing? What sorts of challenges could arise from the widespread availability of such powerful computing technology?

5.3 The Power of Parallel: Supercomputing, Grids, Clusters, and Putting Smarts in the Cloud

Learning Objectives

1. Understand the differences between supercomputing, grid computing, cluster computing, and cloud computing.
2. Describe how grid computing can transform the economics of supercomputing.
3. Recognize that these technologies provide the backbone of remote computing resources used in cloud computing.
4. Understand the characteristics of problems that are and are not well suited for parallel processing found in modern supercomputing, grid computing, cluster computing, and multicore processors. Also be able to discuss how network latency places limits on offloading computing to the cloud.

supercomputers

Computers that are among the fastest of any in the world at the time of their introduction.

As Moore's Law makes possible the once impossible, businesses have begun to demand access to the world's most powerful computing technology. **Supercomputers** are computers that are among the fastest of any in the world at the time of their introduction.[62] Supercomputing was once the domain of governments and high-end research labs, performing tasks such as simulating the explosion of nuclear devices, or analyzing large-scale weather and climate phenomena. But it turns out with a bit of tweaking, the algorithms used in this work are profoundly useful to business.

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Corporate use of supercomputing varies widely. United Airlines used supercomputing to increase the number of flight-path combinations for scheduling systems from 3,000 to 350,000. Estimated savings through better yield management? Over $50 million! CIBC (the Canadian Imperial Bank of Commerce), one of the largest banks in North America, uses supercomputing to run its portfolio through Monte Carlo simulations that aren't all that different from the math used to simulate nuclear explosions. The muscular mathematics CIBC performs allows the firm to lower capital on hand by hundreds of millions of dollars, a substantial percentage of the bank's capital, saving millions a year in funding costs. Also noteworthy: the supercomputer-enabled, risk-savvy CIBC was relatively unscathed by the subprime crisis.

Modern supercomputing is typically done via a technique called **massively parallel** processing (computers designed with many microprocessors that work together, simultaneously, to solve problems). The fastest of these supercomputers are built using hundreds or even thousands of microprocessors, all programmed to work in unison as one big brain. While supercomputers use special electronics and software to handle the massive load, the processors themselves are often of the off-the-shelf variety that you'd find in a computer at BestBuy. For example, the recent speed champ, China's Tianhe (or "Milky Way") 2, uses 32,000 Intel Xeon chips, 48,000 co-processing chips, and sports a total of 3.1 million cores.[63]

massively parallel

Computers designed with many microprocessors that work together, simultaneously, to solve problems.

Another technology, known as **grid computing**, is further transforming the economics of high performance. With grid computing, firms place special software on its existing PCs or servers that enables these computers to work together on a common problem. While many firms set up grids in data centers from servers they've bought specifically to work together on corporate tasks, large organizations have also created grids by harnessing excess capacity from staff PCs when these computers aren't being used or aren't used to full capacity. With grid software installed, idle devices can be marshaled to attack portions of a complex task as if they collectively were one massively parallel supercomputer. *BusinessWeek* reports that while a middle-of-the-road supercomputer could run as much as $30 million, grid computing software and services to perform comparable tasks can cost as little as $25,000, assuming an organization already has PCs and servers in place.

grid computing

A type of computing that uses special software to enable several computers to work together on a common problem, as if they were a massively parallel supercomputer.

The biotech firm Monsanto uses this technology to explore ways to manipulate genes to create crop strains that are resistant to cold, drought, bugs, and pesticides, or that are more nutritious. The fiftyfold time savings the firm achieved through grid computing lets Monsanto consider thousands of genetic combinations in a year.[64] Lower R&D time means faster time to market—critical to both the firm and its customers. Movie studios use grids for animation and special effects; Procter & Gamble used the technology to redesign manufacturing for Pringles potato chips; Pratt & Whitney tests aircraft engine designs by employing grid technology; GM and Ford use grids to simulate crash tests; and JP Morgan Chase launched a grid effort that mimics CIBC's supercomputer, but at a fraction of the latter's cost. By the second year of operation, the JP Morgan Chase grid was saving the firm $5 million per year.

Another term you might hear is **cluster computing**. Computing clusters are also built with commodity servers, but they usually take advantage of special software and networking hardware to more tightly link them together to function as one. The geeky details of how tightly or loosely coupled devices are—and whether this classifies as a grid or cluster—are less important, but as a manager you should be able to recognize these terms and think critically about their potential use and limitations.

cluster computing

Connecting server computers via software and networking so that their resources can be used to collectively solve computing tasks.

Multicore, massively parallel, grid, and cluster computing are all related in that each attempts to lash together multiple computing devices so that they can work together to solve problems. Think of multicore chips as having several processors in a single chip. Think of massively parallel supercomputers as having several chips in one computer, and think of grid and cluster computing as using existing computers to work together on a single task (essentially a computer made up of multiple computers), with clusters being more "tightly coupled" with additional software and networking hardware to facilitate their coordination. While these technologies offer great promise, they're all subject to the same limitation: software must be written to divide existing problems into smaller pieces that can be handled by each core, processor, or computer, respectively. Some problems, such as simulations, are easy to split up, but for problems that are linear (where, for example,

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step two can't be started until the results from step one are known), the multiple-brain approach doesn't offer much help.

Massive collections of computers running software that allows them to operate as a unified service also enable new service-based computing models, such as **software as a service (SaaS)** and **cloud computing**. In these models, organizations replace traditional software and hardware that they would run in-house with services that are delivered online. Google, Microsoft, Salesforce.com, and Amazon are among the firms that have sunk billions into these Moore's Law-enabled **server farms**, creating entirely new businesses that promise to radically redraw the software and hardware landscape while bringing gargantuan computing power to the little guy (see Chapter 14). Technology such as the IBM Watson cloud act like a supercomputer for hire. Researchers have leveraged the technology to, as *New Scientist* states "make discoveries scientists can't" by scanning massive databases of research and hunting for patterns humans have missed.[65] Moving "brains" to the cloud can help increase calculating performance even when we can't pack more processing brawn into our devices, but the cloud requires a long-distance connection that's a lot slower and perhaps less reliable than the quick hop from storage to processor that occurs inside most consumer electronics. In tech circles, delay is sometimes referred to as **latency**—and low latency is good. It means communications are speedy. As an example of how latency limits what the cloud can do, consider the new generation of Xbox: the Xbox One. Microsoft has designed the gaming system so that it can offload some tasks to its massive 300,000-server gaming data centers if they don't require an immediate response. Latency-sensitive tasks that can't be shipped to the cloud might include reactions to bumping collisions in a racing game, or crossfire in a shooter. But the cloud could easily handle complex calculations to load as needed, such as rendering a scene's background and lighting.[66]

software as a service (SaaS)

A form of cloud computing where a firm subscribes to a third-party software and receives a service that is delivered online.

cloud computing

Replacing computing resources—either an organization's or individual's hardware or software—with services provided over the Internet.

server farms

A massive network of computer servers running software to coordinate their collective use. Server farms provide the infrastructure backbone to SaaS and hardware cloud efforts, as well as many large-scale Internet services.

latency

A term often used in computing that refers to delay, especially when discussing networking and data transfer speeds. Low-latency systems are faster systems.

Paging Doctor Watson... And Teacher Watson... And Trader Watson... And...

If there were a Supercomputer Hall of Fame, it would almost certainly include the IBM-created, Jeopardy-playing Watson. However, while initially billed as a "supercomputer," Watson today is a robust, cloud-based computing platform that allows any organization to tap into all sorts of services, including natural language processing (to easily create interactive query systems and chat bots), image recognition, data analysis, machine learning to uncover new insights and identify unseen patterns, and more.

Originally built to quickly answer questions posed in natural language, by the end of a televised three-day tournament Watson had put the hurt on prior Jeopardy champs Ken Jennings and Brad Rutter, trouncing the human rivals and winning one million dollars (donated to a children's charity). Watson's accomplishment represented a four-year project that involved some twenty-five people across eight IBM research labs, creating algorithms, in a system with ninety servers, "many, many" processors, terabytes of storage, and "tens of millions of dollars" in investment.[67] Winning Jeopardy makes for a few nights of interesting TV, but what else can it do? Well, the "Deep QA" technology behind Watson is already being used by health care professionals as a kind of "exobrain." On average, "primary care physicians spend less than twenty minutes face-to-face with each patient per visit, and average little more than an hour each week reading medical journals."[68] Now imagine a physician assistant Watson that could leverage massive diagnosis databases while scanning hundreds of pages in a person's medical history, surfacing a best guess at what docs should be paying attention to. A *JAMA* study suggested that medical errors may be the third leading cause of death in the United States,[69] so there's apparently an enormous and mighty troubling opportunity in health care alone. IBM is partnering with Massachusetts voice-recognition leader Nuance Communications (the tech that originally made Apple's Siri such a good listener) to bring Watson to the doc's office. Med schools at Columbia and the University of Maryland are helping with the research effort. Manipal Hospitals in India are using Watson to bring global insights from research and practice worldwide for use creating individual cancer treatment programs.[70] Of course, you wouldn't want to completely trust a Watson recommendation. While Watson was good enough to be tournament champ, IBM's baby missed a final Jeopardy answer of "Chicago" because it answered that Toronto was a US city.

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FIGURE 5.5 Watson Competes on Jeopardy



Source: http://www.ibm.com/press.

IBM is aggressively encouraging others to take advantage of Watson technology. Today, Watson tech has been applied to over 75 industries in 17 nations, with tens of thousands of people leveraging Watson-smarts to assist their own work.[71] Pfizer is using Watson to speed drug discovery research by leveraging IBM technology to dig insights from a vast library that ranges from medical publications to patent applications.[72] In finance, IBM offers Watson services to comply with banking regulation (some 20,000 new regulatory requirements were introduced in a single year, and regulatory compliance eats up more than 10 percent of operation spending at major banks).[73] A suite of Watson marketing tools helps firms from Kia Motors to The North Face analyze and mine social media, identify audiences, predict behavior, and build targeted marketing plans.[74] And Sesame Workshop (the firm behind Grover and Big Bird), have used Watson to develop software that delivers kid-specific vocabulary learning.[75] The group's swanky Manhattan digs provide a base for showcasing the tech to clients, and provide resources to third parties looking to bake Watson smarts into their own offerings using the "Watson Cloud," and other resources. The suite of tools for using Watson range from no-code platforms for any manager to highly technical products that allow programmers and data analysts to deeply customize help sought through the Watson cloud. IBM will even provide seed capital to efforts it deems most promising. A recent Watson Mobile App Challenge winner, the firm Elemental Path, is launching a dinosaur-shaped child's toy that uses Watson's Q&A smarts to answer kid questions, tell jokes and stories, and quiz kids as a learning buddy. The toy learns a child's interests and comprehension level, and tailors interaction as its understanding of its owner develops. A Kickstarter campaign for the product zoomed past its initial goal, and underscores how a few bright researchers can leverage cloud resources and plummeting costs to build something that was not just cost-prohibitive, it was impossible just a few years back.[76]

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Cognitoys Dinosaur with Watson Smarts

Kickstarter video for Elemental Path's CogniToys Dinosaur, which interacts with children using Watson smarts accessed over the cloud. Moore's Law combined with savvy networking brings supercomputing-class technology into a sub-$90 child's toy.



View the video online at: //www.youtube.com/embed/o1tm5Xs5vlw?rel=0

Moore's Law will likely hit its physical limit in your lifetime, but no one really knows if this "Moore's Wall" is a decade away or more. What lies ahead is anyone's guess. Some technologies, such as still-experimental quantum computing, could make computers that are more powerful than all the world's conventional computers combined. Think strategically—new waves of innovation might soon be shouting "surf's up!"

Key Takeaways

- Most modern supercomputers use massive sets of microprocessors working in parallel.
- The microprocessors used in most modern supercomputers are often the same commodity chips that can be found in conventional PCs and servers.
- Moore's Law means that businesses as diverse as financial services firms, industrial manufacturers, consumer goods firms, and film studios can now afford access to supercomputers.
- Grid computing software uses existing computer hardware to work together and mimic a massively parallel supercomputer. Using existing hardware for a grid can save a firm the millions of dollars it might otherwise cost to buy a conventional supercomputer, further bringing massive computing capabilities to organizations that would otherwise never benefit from this kind of power.
- Cluster computing refers to collections of server computers that are linked together via software and networking hardware so that they can function as a single computing resource.
- Massively parallel computing also enables the vast server farms that power online businesses like Google and Facebook, and creates new computing models, like software as a service (SaaS) and cloud computing.
- The characteristics of problems best suited for solving via multicore systems, parallel supercomputers, grid, or cluster computing are those that can be divided up so that multiple calculating components can simultaneously work on a portion of the problem. Problems that are linear—where one part must be solved before moving to the next and the next—may have difficulty benefiting from these kinds of "divide and conquer" computing. Fortunately,

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many problems such as financial risk modeling, animation, manufacturing simulation, and gene analysis are all suited for parallel systems.

- Many computer tasks can be offloaded to the cloud, but networking speeds (latency)—that is, the time needed to send results back and forth—can limit instances where collections of off-site computing hardware can replace or augment local computing.

Questions and Exercises

1. Show your familiarity with key terms: What are the differences between supercomputing, grid computing, and cluster computing? How are these phenomena empowered by Moore's Law?
2. How does grid computing using slack or excess computing resources change the economics of supercomputing?
3. Name businesses that are using supercomputing and grid computing. Describe these uses and the advantages they offer their adopting firms. Are they a source of competitive advantage? Why or why not?
4. What are the characteristics of problems that are most easily solved using the types of parallel computing found in grids, clusters, and modern-day supercomputers? What are the characteristics of the sorts of problems not well suited for this type of computing?
5. You can join a grid, too! Visit the SETI@home website (http://setiathome.ssl.berkeley.edu/). What is the purpose of the SETI@Home project? How do you participate? Is there any possible danger to your computer if you choose to participate? (Read their rules and policies.) Do some additional research on the Internet. Are there other interesting grid efforts that you can load onto your laptop or even game console?
6. Search online to identify the five fastest supercomputers currently in operation. Who sponsors these machines? What are they used for? How many processors do they have?
7. What is "Moore's Wall"?
8. What is the advantage of using computing to simulate an automobile crash test as opposed to actually staging a crash?
9. Moore's Law may limit the amount of computing done on the PC, smartphone, or gaming console in front of you. How can cloud computing make these devices seem more powerful? Give examples of when using a powerful, remote, cloud computing resource might work well to enhance computing on a local device, and mention when the cloud might be less effective. What is the main constraint in your example?

5.4 e-waste: The Dark Side of Moore's Law

Learning Objectives

1. Understand the magnitude of the environmental issues caused by rapidly obsolete, faster and cheaper computing.
2. Explain the limitations of approaches attempting to tackle e-waste.

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3. Understand the risks firms are exposed to when not fully considering the life cycle of the products they sell or consume.
4. Ask questions that expose concerning ethical issues in a firm's or partner's products and processes, and that help the manager behave more responsibly.

e-waste

Discarded, often obsolete technology; also known as electronic waste.

We should celebrate the great bounty Moore's Law and the tech industry bestow on our lives. Costs fall, workers become more productive, innovations flourish, and we gorge at a buffet of digital entertainment that includes music, movies, and games. But there is a dark side to this faster and cheaper advancement. A laptop has an expected lifetime of around two to four years. A cell phone? Eighteen months or less.[77] Rapid obsolescence means the creation of ever-growing mountains of discarded tech junk, known as electronic waste or **e-waste**, and represents the fastest growing waste stream on the planet.[78] Each year the planet generates over 50 million tons tons of e-waste[79] and the results aren't pretty. Consumer electronics and computing equipment can be a toxic cocktail that includes cadmium, mercury, lead, and other hazardous materials. Once called the "effluent of the affluent," e-waste will only increase with the rise of living standards worldwide.

The quick answer would be to recycle this stuff. Not only does e-waste contain mainstream recyclable materials we're all familiar with, like plastics and aluminum, it also contains small bits of increasingly valuable metals such as silver, platinum, and copper. In fact, there's more gold in one pound of discarded tech equipment than in one pound of mined ore,[80] and it's 13x cheaper to extract precious and rare earth metals from discarded electronics than it is to mine it from the earth.[81] But as the sordid record of e-waste management shows, there's often a disconnect between consumers and managers who *want* to do good and those efforts that are *actually* doing good. The complexities of the modern value chain, the vagaries of international law, and the nefarious actions of those willing to put profits above principle show how difficult addressing this problem will be.

The process of separating out the densely packed materials inside tech products so that the value in e-waste can be effectively harvested is extremely labor intensive, more akin to reverse manufacturing than any sort of curbside recycling efforts. Sending e-waste abroad can be ten times cheaper than dealing with it at home,[82] so it's not surprising that up to 80 percent of the material dropped off for recycling is eventually exported.[83] Much of this waste ends up in China, South Asia, or sub-Saharan Africa, where it is processed in dreadful conditions.

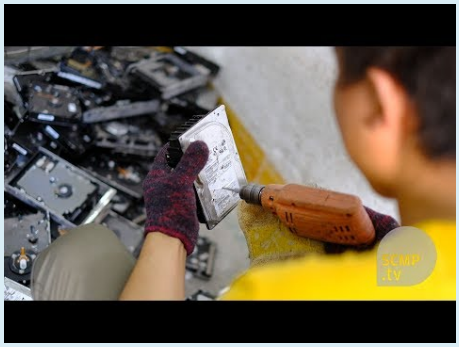
Consider examples extensively chronicled by organizations such as the Silicon Valley Toxics Coalition, the Basel Action Network (BAN), and Greenpeace. Their research has documented workers without protective equipment, breathing clouds of toxins generated as they burn the plastic skins off of wires to get at the copper inside. Others use buckets, pots, or wok-like pans (in many cases the same implements used for cooking) to sluice components in acid baths to release precious metals—recovery processes that create even more toxins. The area around one site had lead and heavy metal contamination levels some four hundred to six hundred times greater than what international standards deem safe.[84] That area was so polluted that drinking water had to be trucked in from eighteen miles away. Pregnancies were six times more likely to end in miscarriage, and 70 percent of the kids in the region had too much lead in their blood.[85] China has recently moved to block large amounts of recycling importing, including e-waste, and is moving to change practices in its most notorious recycling regions. However much of what once went to China is now migrating to other parts of Southeast Asia or Africa.[86] The world's largest e-dump is in Accra, the capital of the West African nation of Ghana. Known as Agbogbloshie, roughly 700 people, including children as young as 12, eke out a living as electronics scavengers.

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Conditions in the e-Waste Capital of the World

This video from Hong Kong's *South China Morning Post* documents the horrible conditions found at a recycling endpoint in Guiyu, China. While, as the report mentions, China has curtailed imports of goods for recycling, and is moving to migrate recyclers to higher-standard practices, much of what was once recycled here has moved to other facilities in Southeast and South Asia, and sub-Saharan Africa.



View the video online at: http://www.youtube.com/embed/RJ6VX3pC02s?rel=0

The trade is often brokered by unscrupulous middlemen who mask the eventual destination and fate of the products purchased. Each year BAN exposes the e-waste flow overseas by hiding GPS tracking devices inside equipment dropped off at various recyclers and charity drives.[87] BAN investigators in Lagos, Nigeria, documented mountains of e-waste with labels from schools, US government agencies, and even some of the world's largest corporations. And despite Europe's prohibition on exporting e-waste, many products originally labeled for repair and reuse end up in toxic recycling efforts. Even among those products that gain a second or third life by being refurbished and resold in developing nations, the inevitable is simply postponed, with e-waste almost certain to end up in landfills that lack the protective groundwater barriers and environmental engineering of their industrialized counterparts. The reality is that e-waste management is extraordinarily difficult to monitor and track, and loopholes are rampant.

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Uncovering Fraudulent Recyclers

Watch the Basel Action Network track e-waste to global locations where they are processed under hazardous and environmentally damaging conditions. Organizations including Dell and Goodwill have been fleeced into thinking they were dealing with reputable providers.



View the video online at: http://www.youtube.com/embed/n6FJJ29k8uc?rel=0

Thinking deeply about the ethical consequences of a firm's business is an imperative for the modern manager. A slipup (intentional or not) can, in seconds, be captured by someone with a cell phone, uploaded to YouTube, or offered in a blog posting for the world to see. Big firms are big targets, and environmentalists have been quick to push the best-known tech firms and retailers to take back their products for responsible recycling and to eliminate the worst toxins from their offerings. Consider that even Apple (where Al Gore sits on the firm's board of directors), has been pushed by a coalition of environmental groups on all of these fronts. Critics have shot back that singling out Apple is unfair. The firm was one of the first computer companies to eliminate lead-lined glass monitors from its product line, and has been a pioneer of reduced-sized packaging that leverages recyclable materials. And Apple eventually claimed the top in Greenpeace's "Greener Electronics" rankings.[88] Apple has even worked to automate responsible recycling by creating robots that can disassemble, repurpose, and recycle components in returned iPhones (see video below).[89] Despite the good works, if the firm that counts Al Gore among its advisors can get tripped up on green issues, all firms are vulnerable.

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Apple's Daisy—The Robot That Recycles iPhones

Apple's Daisy recycling robot can disassemble any of nine models of iPhone, processing 200 iPhones in an hour.



View the video online at: http://www.youtube.com/embed/2Bu-gl7v-P8?rel=0

Environmentalists see this pressure to deal with e-waste as yielding results: Most tech firms have continually moved to eliminate major toxins from their manufacturing processes. All this demonstrates that today's business leaders have to be far more attuned to the impact not only of their own actions, but also to those of their suppliers and partners. How were products manufactured? Using which materials? Under what conditions? What happens to items when they're discarded? Who provides collection and disposal? It also shows the futility of legislative efforts that don't fully consider and address the problems they are meant to target.

Finding Responsible e-Waste Disposers

A recent sting operation led by the US Government Accountability Office (US GAO) found that forty-three American recyclers were willing to sell e-waste illegally to foreign countries, without gaining EPA or foreign country approval. Appallingly, at least three of them held Earth Day electronics-recycling events.[90]

So how can firms and individuals choose proper disposal partners? Several certification mechanisms can help shed light on whether the partner you're dealing with is a responsible player. The Basel Action Network e-Stewards program certifies firms via a third-party audit, with compliant participants committing to eliminating e-waste export, land dumping, incineration, and toxic recycling via prison labor. The International Association of Electronics Recyclers (IAER) also offers audited electronics recycler certification. And firms certified as ISO 9001 and ISO 14001 compliant attest to quality management and environmental processes. Standards, techniques, and auditing practices are constantly in flux, so consult these organizations for the latest partner lists, guidelines, and audit practices.[91] http://www.e-stewards.org/certification-overview/; International Standards Organization accessed via http://www.iso.org/iso/home.htm; AER Worldwide accessed via https://www.aerworldwide.com/; and G. MacDonald, "Don't Recycle 'E-waste' with Haste, Activists Warn," *USA Today*, July 6, 2008.

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FIGURE 5.6 e-Stewards
The e-Stewards program can help you find a vetted, responsible recycler.



Source: e-Stewards.org; http://e-stewards.org/find-a-recycler/.

Which brings us back to Gordon Moore. To his credit, Moore is not just the founder of the world's largest microprocessor firm and first to identify the properties we've come to know as Moore's Law, he has also emerged as one of the world's leading supporters of environmental causes. The generosity of the Gordon and Betty Moore foundation includes, among other major contributions, the largest single gift to a private conservation organization. Indeed, Silicon Valley, while the birthplace of products that become e-waste, also promises to be at the forefront of finding solutions to modern environmental challenges. The Valley's leading venture capitalists, including Sequoia and Kleiner Perkins (where Al Gore is now a partner), have started multimillion-dollar green investment funds, targeted at funding the next generation of sustainable environmental initiatives.

Key Takeaways

- e-waste may be particularly toxic since many components contain harmful materials such as lead, cadmium, and mercury.
- Managers must consider and plan for the waste created by their products, services, and technology used by the organization. Consumers and governments are increasingly demanding that firms offer responsible methods for the disposal of their manufactured goods and the technology used in their operations.
- Managers must audit disposal and recycling partners with the same vigor as their suppliers and other corporate partners. If not, an organization's equipment may end up in environmentally harmful disposal operations.

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Questions and Exercises

1. What is e-waste? What is so dangerous about e-waste?
2. What sorts of materials might be harvested from e-waste recycling?
3. Many well-meaning individuals thought that recycling was the answer to the e-waste problem. But why hasn't e-waste recycling yielded the results hoped for?
4. What lessons do the challenges of e-waste offer the manager? What issues will your firm need to consider as it consumes or offers products that contain computing components?
5. Why is it difficult to recycle e-waste?
6. Why is e-waste exported abroad for recycling rather than processed domestically?
7. What part does corruption play in the recycling and disposal of e-waste?
8. What part might product design and production engineering play in the reduction of the impact of technology waste on the environment?
9. What are the possible consequences should a US firm be deemed "environmentally irresponsible"?
10. Name two companies that have incurred the wrath of environmental advocates. What might these firms have done to avoid such criticism?

5.5 Mickey's Wearable: Disney's Magic Band

Learning Objectives

1. Illustrate the value that Disney accrued from embedding technology in otherwise manual experiences.
2. Recognize how the experience improved the value of the customer's Disney World experience.
3. Understand some of the issues involved in deploying large-scale information systems in a corporate environment.

Plan a trip to Disney World in Orlando, Florida, and the park is armed to leverage tech to streamline your experience, delight you at every turn, and keep you spending money. The centerpiece is the MagicBand, a stylish, rubberized, waterproof wristband mailed in advance to guests' homes. Bands can be used for park and attraction admission, for keyless entry into your Disney hotel room, to pay for rides, and to locate your group to deliver restaurant meals, personalized greetings, match you to photos taken by park photographers and attraction cameras, and more. And of course, the tech is tied to your credit card, so you can pay for everything, from an in-park Starbucks fix to gourmet restaurant meals to mouse ears and *Frozen* dolls, all with a wave of your wrist. Magic Band is now on its v. 2 iteration—a slimmer model where the tech at the center can be popped out to be mounted on a carabiner or lanyard. In roughly two years since launch, Disney has distributed over 30 million magic bands, making Disney the fourth largest provider of wearable technology.[92]

Family members choose the color of their individual band from a rainbow of options, and a band box arrives for the family with each guest's names etched inside their custom wearable. Each band is packed with low-cost, high-powered tech, courtesy of Moore's Law. Bands have both an

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RFID chip and a 2.4 GHz radio, akin to what you'd find in many cordless phones. MagicBands can transmit in a radius of 40 feet. Embedded batteries last two years.[93]

Disney's MagicBand

A video by Orlando Attractions Magazine shows the MagicBand in action in a variety of settings.



View the video online at: http://www.youtube.com/embed/l3ojftUvWWU?rel=0

MagicBands are part of a broader set of technologies that Disney calls MyMagic+ that link together various systems that include the Web and mobile MyDisneyExperience to plan and share your vacation itinerary, manage your schedule, and deliver GPS-park maps and schedules to smartphone apps; the FastPass+ ride reservation system; and the Disney PhotoPass that stitches together a custom media album gathered from your visit (with an option to purchase prints, of course).[94] The mandate from Meg Crofton, previous president of Walt Disney World Resort, was to remove the friction in the Disney World experience. Says another Disney exec, "If we can get out of the way, our guests can create more memories."[95]

A band that tracks users and contains payment information can lead to privacy concerns, but Disney seems to have this covered. Any data collected is anonymized and encrypted. The band itself doesn't store any personal information; instead, it contains a code that identifies users within Disney's internal encrypted databases. Lose a band and it can be disabled and replaced. Purchases also require a PIN, and parents concerned with free-spending children can disable purchasing on their bands, or set a spending limit.[96]

Experience Examples

Band up as soon as you arrive in Orlando, then just hop a shuttle and head to your hotel or directly to the park. No need to even check in at the front desk—your band is your room key, as well as your park admission ticket, the pass to zip into any rides you've reserved in advance, and your payment method. No need to delay the fun waiting for baggage claim carousels; Disney's systems will also make sure your luggage is delivered to your room.

The MagicBand rollout in Disney World's *Be Our Guest* restaurant, inspired by the fairy-tale dining experience in *Beauty and the Beast*, launched to glowing reviews. Guests arriving at the restaurant are greeted by name by a hostess that gets a heads-up on her modified iOS device. The welcome is followed by a suggestion to sit wherever you want. The kitchen already has the order you've made online. Wireless receivers on the table and in the walls know where you are, so your

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food is whisked right to you, as if you were Belle herself. All in all, a seamless experience that won top innovation honors from the National Restaurant Association.[97]

MagicBand can also turn a long ride wait into a time-filling interactive experience. Photos taken by park photographers and other in-experience cameras are linked to your band's ID and will feed images to your My Disney Experience smartphone app, ready for saving or social sharing—a nice way to kill time while waiting in line.[98] The popular Epcot Test Track ride is notorious for its lines, but clever design fills the wait with a touch-screen auto-design session where users create their own car for integration into the attraction when they're ready to roll. Guests can also create a custom car commercial. Disney survey data suggests a 35-minute wait time for Test Track feels like it's only been 15 to 20 minutes.[99]

Big Data and Big Benefits

Disney World is really more of a city than a resort. It occupies twice as much land as Manhattan, contains four major theme parks, some 140 attractions, 300 dining locations, and 36 hotels. The 15-mile monorail alone hosts an average of 150,000 rides each day.[100] Driving far-reaching delight alongside efficiency at scale is the major goal of the MyMagic+ system that contains the magic band plus trip planning and operations technology.

Guests use the park's website and apps before they show up in Orlando so that they can reserve their favorite rides for priority seating. They can also select shows and parades, choose to attend fireworks displays, and set up character greetings. Information from these systems, when coupled with real-time data collected from MagicBand wearing guests, delivers more insight to tailor many more service improvements, than if guests were free-ranging around Disney World without prior planning.[101] Disney analysts saw that some guests were traversing the park upwards of 20 times a day to see all the rides they were most interested in, but with MyMagic+, park systems crunch data so the Mouse House can craft a custom guest itinerary that eliminates a frustrating zigzag across the many realms of the Magic Kingdom. MyMagic+ books ride reservations to minimize wait and spread out guests to further cut line time. With an average of 8,000 to 10,000 guests flowing through the park's main entrance every hour, big data analytics and efficient scheduling algorithms keep everyone happier.[102]

Data helps Disney know when to add more staff at rides and restaurants; how to stock restaurants, snack bars, and souvenir stands; and how many costumed cast members should be roaming in various areas of the park. If a snafu arises, such as an unexpectedly long line or a restaurant menu change, a custom-crafted alert with alternative suggestions can go out via text or e-mail.[103] At some point, systems might be able to detect when guests have waited too long or otherwise had an unexpectedly frustrating experience, offering a treat coupon or a pass to another ride. These kinds of systems have allowed casinos to turn negative experiences (losing big in slots) into positive ones.[104]

Disney says the MagicBand and supporting systems have cut turnstile transaction time by 30 percent, guests are spending more money, and systems have increased efficiency to the point where Disney World can serve 3,000 to 5,000 additional guests per day.[105] Another benefit to satisfied customers? They're less likely to decamp for nearby rival parks such as Universal Studios, Sea World, and Legoland.[106]

Magical Experiences Cost Serious Coin

These systems don't come cheap. It's estimated that Disney spent $1 billion on MyMagic+. Over 100 systems needed to be integrated to make the park function in a unified, guest-delighting way.[107]

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The cost just to redesign and integrate the DisneyWorld.com website with MyMagic+ is said to have cost about $80 million.[108]

Moore's Law turns embedded technology at scale, a once impossible proposition, into a now justifiable business-enhancing expense (albeit a big one). More than 28,000 hotel doors needed replacement locks to work with MagicBand. Two dozen workers spent eight months upgrading 120 doors per day, trying to be unobtrusive in properties that boast an 80 percent average guest occupancy rate. Two hundred eighty-three park-entry points also had to be upgraded. More than 6,000 mobile devices (mostly iPod Touch and iPads with custom apps) were deployed to support new park systems. Disney World also needed to install more than 30 million square feet of Wi-Fi coverage.[109] According to a source in a *Fast Company* article, "It was a huge effort to wire a communications infrastructure that was basically the same size as San Francisco."[110] And you can't roll out a major tech initiative without making sure your staff knows how to use it. Over 70,000 "cast members" (Disney's name for its employees) received MyMagic+ training, with 15,000 skilled-up in specifics such as the FastPass+ ride reservation system and MagicBand merchandising.[111]

Putting tech on the wrist of every guest also adds a marginal cost to everyone coming through the door. The firm spent only four cents each to print paper tickets, but the early prototype for MagicBand came in at $35. Fortunately[112] Moore's Law, savvy engineering, and buying at scale kicked in, and manufacturing costs for bands are now below $5,[113] a much more tolerable price when tallied against the myriad of benefits delivered to each visiting guest.

Magical Experiences can Require Magical Coordination

A *Fast Company* article on the development of MyMagic+ also underscores political challenges when designing and deploying large-scale systems. Lots of groups had a stake in the outcome, and coordinating differing ideas, opinions, and agendas can be taxing. The systems impacted park operations, infrastructure, hotels, and marketing, among many other areas. Disney's IT group would be heavily involved in systems development and operation, and would need to lead integration with many existing systems and the replacement of others. The powerful Imagineering team, the group that designs much of the theme park wizardry that puts the magic in the Magic Kingdom, was also deep into the decision-making. Add to this additional work from third parties, including Frog Design, a renown high-end global design consultancy whose prior clients include Apple, Lufthansa, and UNICEF; and tech consulting from Accenture, HP, and Synapse among others.[114] In such a disparate group, conflict, even among the well-intended, was inevitable.

Fortunately, the project benefited from strong executive leadership—a key to many successful transformative projects. The effort had the full support and backing of Disney CEO Bob Iger, who regularly discussed the project with the firm's board of directors. Iger's involvement sent a clear message: we're doing this, and the resources will be there to support the effort. The exploratory team for the Next Generation Experience project, or NGE (the early name for what would develop into MyMagic+ and MagicBand), included some of the firm's most senior execs in theme[115] park and Disney World management. The core team for project included senior execs in technology, Imagineering, theme parks, and business development.[116] Disney's COO has stated the project actually came in a bit under budget, although delays and a staged rollout had left many of originally envisioned features to be introduced over time.[117]

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Look to the Future

Additional services on deck include sharing data so that hosts and costumed cast members can issue birthday greetings, and rollout of even more interaction, such as animatronics that call you by name as you walk up to them.[118] Look for even deeper integration as new Disney World areas Pandora, World of Avatar, and Star Wars Land come online. Disney's theme park and resort destinations are, collectively, a $14.1 billion business.[119] Full rollout at other parks is less clear, but the Disney attractions empire is massive and includes theme parks in Anaheim, Paris, Shanghai, Tokyo, and Hong Kong; cruise lines; adventure travel; arcades; and ESPN properties. It's suspected that MagicBand wouldn't roll out in Disneyland in Anaheim, because the restructuring costs for a much smaller park wouldn't be efficient. Shanghai users may opt for a mobile phone experience, given the higher penetration and usage pattern of smartphones.[120] However, learning and various system components are expected to show up worldwide, with the firm stating it plans to roll out "variations on MyMagic+."[121] Disney parks have an annual admission of over 120 million guests a year. At that scale, innovations and bar-setting experiences have a massive influence on overall customer expectations.[122] Universal has already introduced its TapuTapu wearable, which will vibrate with alerts and includes a screen notifying users when it's time for their ride—no long queue needed![123] Expect players in other hospitality and entertainment markets to study Disney's magic in hopes of creating a bit of sorcery of their own.

Universal's Wristband

See the Universal Orlando TapuTapu wearable, complete with vibrating alerts and a message screen, in action at the Volcano Bay theme park.



View the video online at: http://www.youtube.com/embed/Hb0T1ZjzCPY?rel=0

Key Takeaways

- The Disney MagicBand handles many tasks, including park and attraction admission, payment, staff notification for improved service, and security such as hotel room admission.
- Deploying a project like MagicBand involves integrating over one hundred existing and new systems in a broader effort called MyMagic+. Infrastructure needed to be upgraded, and employees trained. The experience cost roughly $1 billion to deploy.
- Many internal and external groups were involved. Differing opinions and agendas often make large projects politically challenging to coordinate. Having the CEO champion the effort, and

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senior executives from various groups lead development, helped reduce debilitating infighting and helped the project come in under budget.

Questions and Exercises

1. What is the MagicBand? What technology is inside it and what does it do? How do the bands benefit the customer experience? What benefits does Disney realize from the system?
2. In addition to designing and creating bands, what else did Disney need to do to pull off this effort? How many systems were involved? What infrastructure needed to be upgraded?
3. There's a lot you can do with technology, but Disney is also crafting a very special, branded experience. Do you think Disney got it right, or does the technology seem like it would interfere with the experience? Why or why not?
4. What more can and should Disney do with this technology?
5. Large technical projects can be a challenge to design and deploy. Why? How did Disney cut through some of these challenges and eventually deliver a project within goals and within budget?
6. How does Disney deal with security and privacy concerns? Do you think these precautions are enough? Why or why not?

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CHAPTER 6

Disruptive Technologies: Understanding Giant Killers and Tactics to Avoid Extinction

6.1 Introduction

Learning Objectives

1. Identify the two characteristics of disruptive innovations.
2. Understand why dominant firms often fail to capitalize on disruptive innovations.
3. Suggest techniques to identify potentially disruptive technologies and to effectively nurture their experimentation and development.

Kodak once had 145,000 employees, a market share near 90 percent,[1] and profit margins so good an executive once bragged that any products more lucrative than film were likely illegal.[2] No firm was closer to photographers. No brand was more synonymous with photographs. Emotionally moving images were known as "Kodak moments." And yet a firm with so much going for it was crushed by the shift that occurred when photography went from being based on chemistry to being based on bits. Today Kodak is bankrupt, it's selling off assets to stay alive, and its workforce is about one-fourteenth what it used to be.[3]

The fall of Kodak isn't unique. Many once-large firms fail to make the transition as new technologies emerge to redefine markets. And while these patterns are seen in everything from earthmoving equipment to mini-mills, the tech industry is perhaps the most fertile ground for disruptive innovation. The market-creating price elasticity of fast/cheap technologies acts as a catalyst for the fall of giants.

The Characteristics of Disruptive Technologies

The term *disruptive technologies* is a tricky one, because so many technologies create market shocks and catalyze growth. Lots of press reports refer to firms and technologies as disruptive. But there is a very precise theory of disruptive technologies (also referred to as *disruptive innovation*—we'll use both terms here) offered by Harvard professor Clayton Christensen that illustrates giant-killing market shocks, allows us to see why so many once-dominant firms have failed, and can shed light on practices that may help firms recognize and respond to threats.

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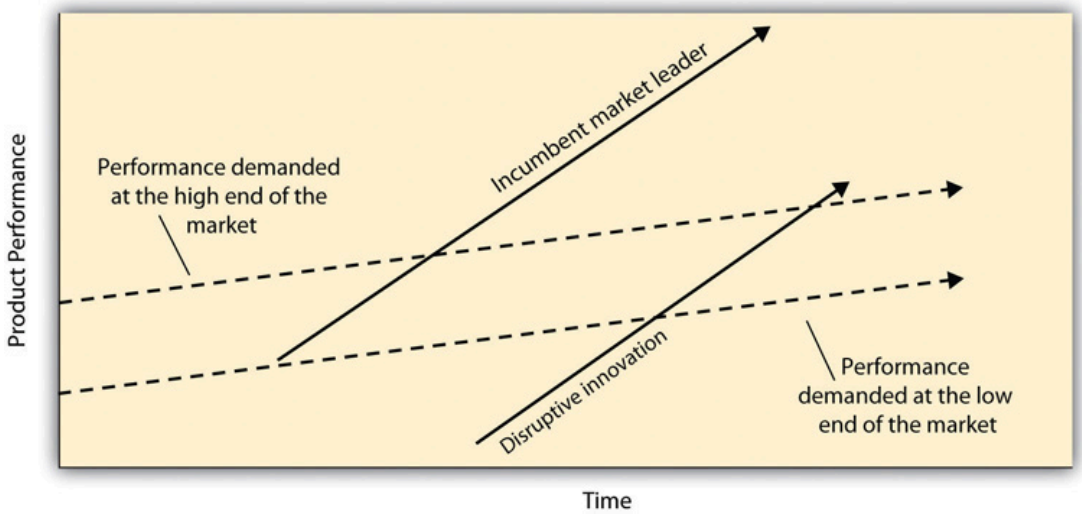
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In Christensen's view, true disruptive technologies have two characteristics that make them so threatening. First, they come to market with a set of performance attributes that existing customers don't value. Second, over time the performance attributes improve to the point where they invade established markets.[4] (See Figure 6.1.)

These attributes are found in many innovations that have brought about the shift from analog to digital. The first digital cameras were terrible: photo quality was laughably bad (the first were only black and white), they could only store a few images and did so very slowly, they were bulky, and they had poor battery life. It's not like most customers were lined up saying "Hey, give me more of that!" Much the same could be said about the poor performance of early digital music, digital video, mobile phones, tablet computing, and Internet telephony (Voice over IP, or VoIP), just to name a few examples. But today all of these digital products are having a market-disrupting impact. Digital cameras have all but wiped out film use, the record store is dead, mobile phones for many are their only phone, in many living in emerging markets the smartphone is one's only personal computer, Internet phone service is often indistinguishable from conventional calls, and Skype can be considered the world's largest long-distance phone company.[5] All of these changes were enabled by fast/cheap technologies, largely by the trends we see in the chart from the prior chapter labeled Figure 5.1.

FIGURE 6.1 The Giant Killer

Incumbent technologies satisfy a sweet spot of consumer needs. Incumbent technologies often improve over time, occasionally even overshooting the performance needs of the market. Disruptive technologies come to market with performance attributes not demanded by existing customers, but they improve over time until the innovation can invade established markets. Disruptive innovations don't need to perform *better* than incumbents; they simply need to perform *well enough* to appeal to the customers of the incumbents (and often do so at a lower price).



Source: Adapted from C. Christensen, *The Innovator's Dilemma* (Boston, MA: Harvard Business School Press, 2013).

Why Big Firms Fail

Those running big firms fail to see disruptive innovations as a threat not because they are dumb but, in many ways, because they do what executives at large, shareholder-dependent firms should do: they listen to their customers and focus on the bottom line. And because of the first characteristic mentioned, the majority of a firm's current customers don't want the initially poor-performing new technology. The most disruptive technologies also often have worse margins than the initially dominant incumbent offerings. Since these markets don't look attractive, big firms don't dedicate resources to developing the potential technology or nurturing the needs of a new customer base. Your best engineers are likely going to be assigned to work on cash-cow offerings, not questionable

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new stuff. This results in a sort of blindness created by an otherwise rational focus on customer demands and financial performance.

Those early customers for a disruptive technology are part of a different "value network" than anything addressed by incumbent market leaders.[6] These customers care about different features and attributes than incumbent customers (e.g., a free call over a quality call; portable music over high-fidelity music). But over time, the disruptive technology becomes good enough to appeal to customers of incumbent products and invades these markets. By the time the new market demonstrates itself, startups have been at it for quite some time. They have amassed expertise and often benefit from increasing scale and a growing customer base. The brands of firms leading in developing disruptive innovations may also now be synonymous with the new tech. If this happens, big firms are forced to play catch-up, and few ever close the gap with the new leaders.

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Don't Fly Blind: Improve Your Radar

So how can a firm recognize potentially disruptive innovations? Paying attention to the trajectory of fast/cheap technology advancement and new and emerging technologies is critical. Seeing the future involves removing shortsighted, customer-focused, and bottom-line-obsessed blinders. Having conversations with those on the experimental edge of advancements is key. Top-tier scientific researchers and venture capitalists can be particularly good sources for information on new trends.

Increasing conversations across product groups and between managers and technologists can also be helpful. It's common for many firms to regularly rotate staff (both management and engineering) to improve idea sharing and innovation. Facebook, for example, requires employees to leave their teams for new assignments at least once every eighteen months.[7]

Note that many disruptive firms were started by former employees of the disrupted giants. The founders of Adobe, for example, came from Xerox; Apple's founders worked for Hewlett-Packard; Marc Benioff worked for Oracle before founding software-as-a-service giant Salesforce.com. Employees who feel so passionate about a trajectory for future technology that they are willing to leave the firm and risk it all on a new endeavor may be a signal that a development is worth paying attention to.

Yahoo! and the Squandered Mobile Opportunity

A *BusinessWeek* cover story on former Yahoo! CEO Marissa Mayer's challenges stated that at the time Mayer took over, Yahoo! was a particularly weak player in mobile because it "ran into a classic Innovator's Dilemma"[8] (the name sometimes is ascribed to disruptive innovation theory, which is the title of one of Clayton Christensen's books). Yahoo!'s success had been built on the desktop, browser-based Web. While the firm had built a mobile team, the mobile group was disbanded by a former CEO who struggled to justify keeping talented engineers on underperforming projects. The mobile team leader left the company, while other members of the pioneering mobile unit were scattered to other teams and had trouble convincing browser-centric managers that mobile was the future. In many ways, Yahoo!'s mobile team was premature, but more importantly, it didn't have an executive champion to protect and nurture the team during the pioneering phase when financial results couldn't be realized. It couldn't show substantial results, so managers were reassigned while upstarts built multibillion-dollar businesses on increasingly powerful computers we carried in our pockets. Imagine if Yahoo!'s mobile team had been protected and allowed to experiment and grow. Could Flickr have morphed into Instagram? Could Yahoo! Messenger have become WhatsApp?

Potential Disruptor Spotted: Now What?

All these conversations will simply expand a manager's radar—they don't necessarily offer insight on how to deal with *potentially* disruptive innovations once spotted. Navigating this next step is really tough. There's no guarantee that a potentially disruptive innovation will in fact become dominant. Trying to nurture new technology in-house is also a challenge. Top tech talent will often never be assigned to experimental products, or they may be pulled off emerging efforts to work on the firm's most lucrative offerings if the next version of a major product is delayed or in need of staff. And as disruptive technologies emerge, by definition they will eventually take market share away from a firm's higher-margin incumbent offerings. The result of the transition could contract corporate revenues, lower profits, and incur losses—a tough thing for many shareholders to swallow.

Christensen suggests a few tactics to navigate the challenges. One is that a firm can build a portfolio of options on emerging technologies, investing in firms, startups, or internal efforts that

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can focus solely on what may or may not turn out to be the next big thing. An *option* is a right, but not the obligation, to make an investment, so if a firm has a stake in a startup, it may consider acquiring the firm, or if it supports a separate division, it can invest more resources if that division shows promise. It's also important that these experimental efforts are nurtured in a way that is sufficiently separate from the parent—geographical distance helps, and it's critical to offer staff working on the innovation a high degree of autonomy. Christensen uses the analogy of the creosote bush to explain what often happens to new efforts in big firms that don't break out potentially disruptive innovations. The desert-dwelling creosote bush excretes and drops a toxin that kills nearby rival plants that might otherwise siphon away resources like water or soil nutrients. Threatened managers can act just like the bush—they'll pull high-quality engineers off emerging projects if a firm's top offerings need staff to grow. Lucrative old tech has a credible case for big budget allocations and is first in line when planning corporate priorities. But by nurturing potentially disruptive innovations in protected units (or even as separate firms), engineers and managers focusing on new markets can operate without distraction or interference from resource-coveting or threatened staff on other projects. This kind of separation can be vital for startups, but some firms maintain arms-length autonomy even as their investments in potential disruptors grow quite large. When East Coast storage giant EMC (now part of Dell) acquired a majority ownership in Silicon Valley's multi-billion-dollar VMware, it left the latter largely free to innovate, nurture its customer base, and grow its own brands, even as some of the firm's products and partners threaten parent core products. VMware even has its own publicly traded stock, despite the fact that shares are majority held by the now-private Dell.

While these techniques are easy to mention in a management textbook, they are extraordinarily difficult to get right. Facebook was famously late to the mobile revolution and felt forced to make billion- and multibillion-dollar purchases for Instagram and WhatsApp. And Google News exec Richard Gingras has stated, "We're just as subject as anyone else to missing key trends. The speed of mobile, we missed that. We also missed the powerful trends in social, where frankly we're catching up. That's an ongoing challenge."[9] Sometimes consulted experts get it wrong, too. At the dawn of commercial mobile phone technology AT&T hired storied consulting firm McKinsey & Company to forecast US cellphone use. The McKinsey prediction of 900,000 subscribers was less than 1 percent of the actual figure of 109 million (worldwide mobile subscribers would balloon to roughly 5 billion a decade later). Despite having invented the cell phone in its Bell Labs unit, AT&T cut future investment in the technology based on McKinsey's wildly incorrect prediction. In order to make up for the mistake, AT&T eventually acquired McCaw Cellular for $12.6 billion.[10] The need to further expand into mobile was also credited with AT&T's $67 billion merger with Bell South.[11] Buyer beware: many times firms can't acquire themselves out of missing a market. Microsoft bought Nokia after its continued attempts at mobile missed the mark, deeply lagging behind Apple and Google. Just two years after making the purchase, Microsoft wrote down the Nokia acquisition by over $7.6 billion dollars (a loss that was more than its purchase price).[12] Identifying and nurturing potentially disruptive technologies requires constant vigilance and relentless and broad environmental scanning.

Intuit Pilots a Course through Disruption

One firm that appears to be successfully navigating the rough waters of disruptive innovation is Intuit. The highly profitable, multibillion-dollar firm is the leader in several packaged software categories, including personal finance (Quicken), small business (QuickBooks), and tax prep (TurboTax) software. But the future is in the cloud, and for conventional packaged software firms, this could be threatening. Acquisitions are one way Intuit has dealt with disruption. Mint.com is a personal finance offering delivered over the Web and in an app that wasn't just cheaper than Intuit's Quicken product—it was offered for free. (Mint makes money by making recommendations of ways to improve your finances—and takes a cut from these promotions.) Intuit decided to buy the upstart rival even though it was clearly cannibalizing Intuit's efforts. It even killed an internally developed but less successful rival product following the acquisition. Mint today remains as a separate brand and is helping inform the rest of the firm on how to succeed with alternatives

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to packaged software. The firm's TurboTax now has cloud-based offerings and a free SnapTax app—take a photo of your W2 and the app fills out your taxes for you automatically (you pay to electronically file). And engineers are able to use 10 percent of their work time to explore new, experimental ideas.[13] While so many firms have been thwarted by listening to existing customers and clinging to old models that are about to become obsolete, Intuit has managed to find growth through disruption. So-called connected services that either run in the cloud or enhance existing offerings make up over 65 percent of the firm's revenues.[14]

Intel's Cash Cow: Increasingly Threatened by Chip Designs Originally Used in Phones and Graphics Cards

One firm threatened by disruptive innovation brought about by the advent of new fast and cheap technology is, ironically, processor giant Intel. The firm's most lucrative chips are the ones in servers—they cost a lot and have great margins. But a market in which Intel never had much success is now threatening to invade the server space. Chips based on Intel rival ARM power nearly all of the smartphones on the planet. Samsung, Apple, Motorola, Xiaomi, and LG all use chips with ARM smarts. Unlike Intel, ARM doesn't manufacture chips itself—instead, it licenses its hyperefficient designs to rivals who tweak them in their own offerings. ARM designs are especially attractive to smartphone manufacturers because they are far more power-efficient than the chips Intel sells for PCs, laptops, and servers. The Intel chips were never designed for power efficiency; they evolved from markets where computers were always plugged in. As Moore's Law advances, ARM chips (once computational weaklings) are now fast enough to invade the established market for server chips. This has left Intel scrambling to create low-power chip offerings in an attempt to attack ARM in smartphones and satisfy the needs of its traditional customer base. ARM chips can't run software that conforms to the Intel x86 standard used in most PCs and servers, so all of a firm's old code would need to be rewritten and compiled[15] (turned into patterns of ones and zeros that can be executed by a chip's instruction set) to work on any ARM-powered servers, laptops, or desktops (a potentially big switching cost). But the chips are also cheaper, threatening Intel margins.

HP offers a line of servers that use ARM logic, and AMD, an Intel rival that has long made chips compatible with Intel's x86 standard, has a new line of server chips based on the incompatible but power-stingy ARM logic. Microsoft has committed to using ARM chips in its data center, it offers an ARM-compatible version of Windows Server, and it is working with a consortium of firms to provide a better translation of programs that run on Intel's x86 standard, so that this software could be translated on-the-fly to run on ARM-based chips[16] (Intel threatens to sue over patent violations).[17] Also, as was mentioned in the prior chapter, technologies such as ASICs and FPGA-based chips are being used by data centers with heavy artificial intelligence and machine learning needs, further eating into a market that was once dominated by the Intel x86 standard. Google has built its own AI-focused chips. It could do this because it buys on such a massive scale that customization made sense—and by selling access to these chips via its cloud computing services, Google aims to make the market for its own chips even bigger. In fact, Amazon, Apple, and Facebook are all working on their own chip designs—all firms are among the biggest buyers of technology and each is a customer of Intel.[18]

Meanwhile, Intel has developed lower-power chips to attack the smartphone market where ARM dominates. Intel's Quark and Curie chips aim even lower, targeting the Internet of Things. To demonstrate possibilities, Intel's CEO has been wearing a "smart shirt" embedded with sensors that monitor heartbeat and other vitals.[19] And Intel's acquisition of Altera was meant to give it a strong offering in FPGA chips popular with the data center machine learning crowd. Who wins remains to be seen, but Intel's battle cry comes from the title of a book written by former Intel CEO, the late Andy Grove—*Only the Paranoid Survive*. An adherent to the power of the Disruptive Innovation framework (Grove and Christensen once appeared together on the cover of *Forbes* magazine), Grove stated, "[The] models didn't give us any answers, but they gave us a common language and a common way to frame the problem so that we could reach consensus around a counterintuitive course of action."[20]

Sometimes there aren't any easy answers for transitioning a firm that lies in the path of disruptive innovation. The newspaper industry has been gutted by Internet alternatives to key products,

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and online ad revenue for newspapers isn't enough to offset the loss of traditional sources of income. As an example of how bad things have been for newspapers, consider the *San Jose Mercury News*, the paper of record in Silicon Valley. In a span of five years, the *Merc* saw revenue from classified ads drop from $118 million to $18 million. Says Scott Herhold, a *Mercury News* columnist, "Craigslist has disemboweled us."[21] We can relate this chapter to the five forces model covered previously: Fast/cheap technology fueled the Internet and created a superior substitute for newspaper classifieds—ads that were unlimited in length, could sport photos, link to an e-mail address, and be modified or taken down at a moment's notice, and were, in many cases, free. There aren't any easy answers for saving an industry when massive chunks of revenue evaporate overnight.

For every Kodak that suffers collapse, new wealth can be created for those who ride the wave of disruptive innovation. Consider the thirteen guys behind Instagram. In about eighteen months, they built a billion-dollar business, and that now has over 500 million users worldwide.[22] Word to the wise: for your best bet at being a tech victor and not a tech victim, keep your disruption-detecting radar dialed up high and watch the trajectory of fast/cheap technology curves.

Key Takeaways

- Many dominant firms have seen their market share evaporate due to the rise of a phenomenon known as disruptive technologies (also known as disruptive innovations). While this phenomenon occurs in a wide variety of industries, it often occurs when the forces of fast/cheap technology enable new offerings from new competitors.
- Disruptive technologies (also called disruptive innovations) come to market with a set of performance attributes that existing customers do not demand; however, performance improves over time to the point where these new innovations can invade established markets.
- Managers fail to respond to the threat of disruptive technologies, because existing customers aren't requesting these innovations and the new innovations would often deliver worse financial performance (lower margins, smaller revenues).
- Several techniques can help a firm improve its monitoring ability to recognize and surface potentially disruptive technologies. These include seeking external conversations with pioneers on the frontier of innovation (researchers and venture capitalists) and internal conversations with the firm's engineers and strategists who have a keen and creative eye on technical developments that the firm has not yet exploited.
- Once identified, the firm can invest in a portfolio of technology options—startups or in-house efforts otherwise isolated from the firm's core business and management distraction. Options give the firm the right (but not the obligation) to continue and increase funding as a technology shows promise.
- Having innovation separated from core businesses is key to encourage new market and technology development focus, while isolating the firm from a "creosote bush" type of resource sapping from potentially competing cash-cow efforts.
- Piloting a firm through disruptive innovation is extremely difficult, as the new effort will cannibalize existing markets, may arrive with lower margins, and can compress revenues.

Questions and Exercises

1. What are the two characteristics of disruptive innovations?
2. Make a list of recent disruptive innovations. List firms that dominated the old regime and firms that capitalized after disruption. Are any of the dominant firms from the previous era the same as those in the postdisruptive era? For those firms that failed to make the transition, why do you think they failed?
3. Why do leading firms fail to recognize and react to potentially disruptive innovations? How can a firm avoid the kind of blindness that leads to disruption?

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4. Once a firm can detect disruptive technologies, what techniques can it use to nurture and develop these technologies?
5. Intuit seems to have successfully transitioned from a world of packaged software to one based in the cloud and in apps, and that includes some free products. Are there other firms that have failed to make this transition? Others that haven't? Discuss the reasons for their success or failure.
6. Some say university education is about to be disrupted. Do you agree? Why or why not? What suggestions do you have for university administrators at your school for dealing with potential disruptions?
7. Research the role of 3D printers. Is this a disruptive technology? Which firms will be hurt as 3D printers advance? Which organizations will benefit from this transition? What advice do you have for firms that operate on a path that will be impacted by 3D printing?

6.2 From Bitcoin to Blockchain and Beyond: A Disruptive Innovation for Money and More?

Learning Objectives

1. Understand what bitcoin is, to whom it appeals and why, its strengths, and its limitations.
2. Understand Blockchain technologies—their potential benefit, current weaknesses, and areas of promising and impactful use.
3. Gain additional insights into evaluating the trajectory of technology and its disruptive capacity.

bitcoin

An open source, decentralized payment system (sometimes controversially referred to as a digital, virtual, or cryptocurrency) that operates in a peer-to-peer environment, without bank or central authority.

Bitcoin is the transaction method favored by cybercriminals and illegal trade networks like the now shuttered Silk Road drugs bazaar.[23] It's not backed by gold or government and appeared seemingly out of thin air as the result of mathematics performed by so-called "miners." It's been a wildly volatile currency, where an amount that could purchase a couple of pizzas would, in three years, appreciate to be worth over $6 million.[24] Its one-time largest exchange handled hundreds of millions in digital value, yet it was originally conceived as the "Magic: The Gathering Online card eXchange" (Mt. Gox), and that service suffered a massive breach where the digital equivalent of roughly $450 million disappeared.[25] Many don't even know what to call bitcoin. Is it a cryptocurrency, a digital currency, digital money, or a virtual currency?[26] The US government has ruled that bitcoin is property (US marshals have auctioned off bitcoins seized from crooks).[27]

FIGURE 6.2
The B symbol with two bars is used to refer to bitcoin.



Source: https://en.bitcoin.it/wiki/Promotional_graphics

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Despite this checkered start, many think bitcoin and similar schemes (often referred to as **cryptocurrencies**) could upend money as we know it. And bitcoin isn't the only player in town. Other cryptocurrencies, such as Ethereum, Ripple, and Litecoin, have all grown to the point where the value of tokens in circulation is well into the billions of dollars for each. Deloitte has written that the negative hype surrounding bitcoin and related technologies has underestimated its potential to revolutionize not just payments but all sorts of asset transactions.[28] The Bank of England has issued a report describing bitcoin as a "significant innovation" that could have "far-reaching implications."[29]

Others look beyond crypto as a money substitute, instead focusing on an enabling technologies known as the **blockchain**, a highly secure, decentralized, distributed transaction recording and verification mechanism that has been adapted for all sorts of uses, including stock sales and digital document signing.[30] The government of Singapore has worked with several large banks in a test of its own digital currency, used in a trial of a blockchain-driven system for interbank payments.[31] The National Bank of Australia and the Canadian Imperial Bank of Commerce have tested international currency transfer using the Ripple.[32] The Central Bank of Kazakhstan has developed a blockchain system to sell short-term bonds directly to retail customers without commissions or transaction fees.[33] These technologies have demonstrated enough promise that venture capitalists have poured over $1.3 billion into crypto and blockchain startups in the fourteen months from January 2017 through February 2018 and this does not include ICOs (initial coin offerings) described later.[34]

cryptocurrencies

A digital asset where a secure form of mathematics (cryptography) is used to handle transactions, control the creation of additional units, and verify the transfer of assets. Cryptocurrencies usually take advantage of a technology known as a blockchain.

blockchain

A distributed and decentralized ledger that records and verifies transactions and ownership, making it difficult to tamper with or shut down.

How It Works

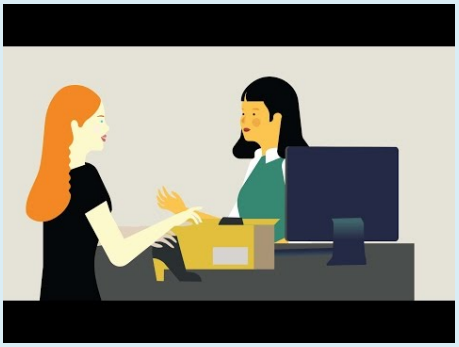
Although you might see news reports that include a graphic of a bitcoin token, that's all just the graphic arts department. In reality there is no such physical representation of bitcoin—it exists only and entirely online. Bitcoins and other cryptocurrencies are transferred from person to person like cash. Instead of using a bank as a middleman, transactions are recorded in a distributed, decentralized public ledger (known as a *blockchain*). Verification and time-stamping of transactions in the blockchain is performed across the network by a pool of users known as *miners*. The miners get an incentive for being involved: they can donate their computer power in exchange for the opportunity to earn additional tokens in the cryptocurrency—for example, fractions of bitcoin—and sometimes miners earn modest transaction fees. This means bitcoin and other crypto is a *peer-produced* financial instrument (for more on peer production, see Chapter 10). While the ledger records transactions, no one can transfer the asset without a special password (called a *private key*, which is often stored in what is referred to as a cryptocurrency *wallet*, which is really just an encrypted holding place). The technology behind most crypto and blockchain technologies is open source and considered rock solid. Passwords are virtually impossible to guess, and verification makes sure no one spends the same currency in two places at once. And the decentralized nature of the system makes it extremely unlikely that the system can be directly tampered with or altered.

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Introduction to Blockchain Technology

A video introduction to blockchain technology offered by IBM, a firm with a thriving practice offering blockchain technology and consulting to organizational clients.



View the video online at: http://www.youtube.com/embed/ID9KAnkZUjU?rel=0

Also note that there is no single blockchain software used by all efforts. While bitcoin has its own blockchain, other cryptocurrencies have their own versions, often involving different software. Many firms have also developed their own technologies or created solutions built on existing open source efforts.

Benefits

Much of the blockchain's appeal comes from the fact that asset ownership records are transferred from person to person like cash, rather than using an intermediary like banks or credit card companies if a cryptocurrency is used as a cash replacement. Getting rid of card companies *cuts out transaction fees*, which can top 3 percent. Overstock.com was one of the first large online retailers to accept bitcoin. Its profit margins? Just 2 percent. Needless to say, Overstock's CEO is a bitcoin enthusiast.[35] Crypto also opens up the possibility of *micropayments* (or small digital payments) that are now impractical because of fees (think of everything from gum to bus fare to small donations).

It's often thought that cryptocurrencies could be a boon for *international commerce*, especially for *cross-border remittance* and in *expanding e-commerce in emerging markets*. Family members working abroad often send funds home via services like Western Union or MoneyGram, but these can cost $10 to $17 for a $200 transfer and take up to five days to clear in some countries.[36] A blockchain-based transfer would be immediate and could theoretically eliminate all transaction fees, although several firms are charging small fees to ease transactions and quickly get money moved from national currency to a cryptocurrency and back. In such a case, the bitcoin or other cryptocurrencies used are less about the currency itself and more about transfer of ownership. For example, if someone in the US wishes to send dollars to Nigeria, a service could buy bitcoin in the US for dollars, then immediately sell these bitcoin in Nigeria in the local naira currency. Firms looking at cross-border funds transfer are going after a big market: global remittances total over half a trillion dollars.[37] Cryptocurrencies might also lubricate the wheels of commerce between nations where credit card companies and firms like PayPal don't operate, and where internationally accepted cards are tough to obtain. Less than one-third of the population in emerging markets has any sort of credit card, but bitcoin could provide a vehicle to open this market up to online purchases. Remember, credit cards aren't just about cash, they're also about credit, and currently credit

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works for most people in highly industrialized economies. But unique, albeit limited use, cases are often the first step in the march taken by eventually disruptive technologies.

Civil libertarians like the idea of transactions happening without the prying eyes of data miners inside card companies, having their transaction history shared by others, or the government. As *Wired* points out, blockchain technologies *straddle the line between transparency and privacy*. All transactions are recorded in the open, via the blockchain, but individuals can be anonymous. You can create your anonymous private key and have someone transfer funds to you, or earn cryptocurrency via mining, and no one can see who you are. This also means that these distributed, decentralized blockchains have *no single controlling entity where fraud, corruption, damage, hacking, or government shutdown could occur*. While governments can try to shut down or legislate blockchain activity within their borders, there's no single "bitcoin" company, no "blockchain" organization to take to court and force their servers to be unplugged. It's been noted that following the revelations in WikiLeaks, Visa, Mastercard, and PayPal refused donations to WikiLeaks. In that aftermath, bitcoin became the go-to vehicle for those supporting WikiLeaks' efforts.[38] If a bitcoin transaction is not permitted in your country, go abroad and you've got full access to everything in your wallet.

A paper by Deloitte University sees the blockchain as far more than a replacement for money—it could make all sorts of financial transactions better by (potentially) making them cheaper, faster, and more secure. At its core, blockchains are *a standard for securely exchanging value and recording ownership over a network without an intermediary*. Most new blockchain technologies use software that exists outside of bitcoin (network effects are at work here—success will depend on the widespread adoption of any new blockchain standard). Blockchain technology has the potential to disrupt all sorts of systems that rely on intermediaries, including the transfer of property, execution of contracts, and identity management. The paper's authors envision using the blockchain as a sort of ownership stamp that is attached to things like vehicles, where repair history and accidents can be referenced to an ownership-representing bitcoin fragment in the way registry paperwork happens now, and where vehicle titles can be transferred by passing the ownership token from one person to another—no lawyers, no notaries, no vehicle registration required—and hence the predictions of *less expensive, faster, and more secure transactions*.[39] As the *Wall Street Journal* points out, "almost any document can be digitized, codified, and inserted into the blockchain, a record that is indelible, cannot be tampered with, and whose authenticity is verified by the consensus of a community of computer users rather than by the discretionary order of a centralized authority."[40] It's important to recognize that while bitcoin uses a blockchain ledger, not all blockchain technologies use the bitcoin blockchain. If blockchain transactions are to emerge as mainstream, governments would likely want to link to such systems when ownership needs to be verified, but all this is technically possible to build, and if it works, the disruption across industries would be massive.[41]

Examples of Blockchains in Action

Real world examples of blockchain technology can be found across industries—from banking to entertainment—practical examples and experiments that point to disruptive possibilities.

- The Nasdaq stock exchange has tested blockchain technology for transactions in its private market subsidiary, stating the exchange could eventually use the technology for Nasdaq trades in the public market.[42] Nasdaq is also using the technology to allow private companies to issue stock and stockholders of public companies to vote their shares.[43]
- A collection of over forty-five of the world's leading financial institutions, including Bank of America, Citigroup, HSBC, and ING have formed R3CEV to build infrastructure based on blockchain technology, and have engaged several national central banks, including the government of Singapore and the Bank of Canada in participation.[44]

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- IBM has a growing blockchain practice, including efforts focused on managing products in the firm's supply chain, tracking items location and ownership from sourced raw materials through distribution to customers. IBM is also creating a whole new firm with shipping giant Maersk (look for their name along the side of container ships) to commercialize blockchain use in shipping.[45]
- Insurer Nationwide wants to put the blockchain on your side with a solution to help verify insurance coverage in real time, benefiting the insured, insurers, and even law enforcement.[46]
- Overstock.com has used blockchain to issue corporate bonds, and was one of the first well-known Internet retailers to accept bitcoin as payment. The firm has since created its own subsidiary tZero, to work on blockchain innovations.[47]
- De Beers, a firm that mines, trades, and markets about one-third of the world's diamonds, is developing blockchain technology for tracing diamonds from the mine to the customer purchase, a practice that should reduce fraud and help ensure that gems in the age of "Blood Diamonds" are indeed conflict free.[48]
- Spotify acquired the blockchain startup Mediachain Labs to help the firm build attribution systems, so that music rights holders are tracked and paid.[49]
- Kodak, the poster child for the disrupted market leader, is developing blockchain system for tracking rights and payments for photographers.[50]
- Facebook has a blockchain division run by the former head of PayPal.[51]

The availability of tools and services from mainstream suppliers are likely to spread blockchain use. Blockchain services, which might include do-it-yourself software and cloud services or consulting and setup for creating a functioning market using blockchain, are now offered by mainstream tech firms like Amazon, Google, IBM, and Microsoft.

Tastes Like Blockchain

Food-borne illness and a tainted food supply can be a terrifying problem with serious financial and societal implications. The US romaine lettuce e-coli epidemic sickened people across 25 states and estimates of impact run into the hundreds of millions of dollars.[52] In China, a compound used in plastics production had tainted milk, sickening some 300,000 dairy customers and killing at least six infants. Other recent examples of food foul play include wood pulp blended with Parmesan cheese, horse meat passed off as beef, and plastic found in chicken nuggets.[53] While RFID tags are being used throughout the agricultural industry to track items, another method of following food from farm to fork is the blockchain.

One firm experimenting with the technology is French department store giant Carrefour. The retailer sells over a million chickens under its house brand,[54] and now the life story of those birds is available by scanning a QR code on the package. Carrefour's supply chain is set up so that each step along the way, from hatchery to producer to store, is tracked via a blockchain entry. And the blockchain isn't just for the birds. The World Wildlife Fund is using an RFID plus blockchain solution to track tuna from boat to processing plant, potentially keeping your sushi ocean friendly and healthy. IBM is bringing together major players worldwide, including food suppliers Dole, Nestlé, Unilever, and Tyson Foods, plus retailers Walmart, Kroger, and China's JD.com, in a similar scheme to track items through the food supply.[55]

Of course, blockchain is just software, so procedures and auditing need to be put in place to ensure that the data that goes into the system is, in fact, valid, but the societal impact may be massive. Insurance lowered, supplier and restaurant bankruptcy avoided, jobs saved, illness avoided, and of course, lives saved. One study estimates that for every 1 percent reduction in food-borne diseases in the US, would prevent half a million people from getting sick,[56] resulting in a net $700 million benefit from reduced sick days and work interruptions.[57]

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Concerns

Blockchain technology's future could be bright, or it could fizzle as another overhyped, underperforming technology. There are several challenges faced by cryptocurrencies, blockchain technologies, or both, that need to be overcome before it makes it in the mainstream.

For cryptocurrencies, *consumer benefit needs to be stronger*. While international remittance customers and those otherwise left out of the banking and credit card system can see immediate benefit from crypto cash replacements, most of the population isn't impacted by this market. For most, cryptocurrency is a *difficult to understand* and often *difficult to use* technology that offers little benefit. Slick apps and firms offering streamlining support services that allow, for example, the easy and quick conversion from dollars (or other currencies) to cryptocurrencies and back will help, but unless this offers consumer value beyond the credit card, few will bother to switch from plastic.

Cryptocurrencies have a *reputation problem*. Being embraced by drug dealers, extortion hackers, tax evaders, and fringe libertarians doesn't instill a lot of confidence. And it doesn't help that bitcoin was created by a mysterious, unknown entity referred to as Satoshi Nakamoto.[58]

Security concerns also pose a problem. While bitcoin software is considered to be solid, it's not a guarantee that other entities are as secure. The multimillion-dollar theft from Mt. Gox is a prime example.[59] The wallets that hold your private key are also potentially vulnerable. If your computer is wiped out by a virus and you haven't written down your password or saved a backup copy in another secure and accessible location, you're hosed; it's like money burned up in a fire. Hackers that steal passwords—whether they're on your computer or the cloud—effectively have access to anything in your crypto wallet; they can walk away with all your cash and it's unlikely that there'll be a way to recover the loot. And for all of the security and anonymity promised by the blockchain, if the sender or receiver of any data is compromised, information could escape into the wild or be captured by the nefarious.

Many firms that hope to strengthen cryptocurrency and blockchain technologies (including rival currencies, wallet builders, exchanges, and payment processors) have struggled under an *ambiguous cloud of not knowing how they will be regulated* and what legal issues apply to them.[60] China has banned bitcoin,[61] but California has moved forward to legalize the use of alternative currencies.[62] New York has announced bitcoin-friendly initiatives.[63] The government of Japan now recognizes bitcoin as a legal payment method, Russia has reversed its initial anti-bitcoin stance, and Australia has eliminated a double-taxation penalty impacting bitcoin.[64] The US government has also created regulations around bitcoin that make it less amorphous and safer for investors, while the IRS ruled that bitcoins are property.[65] Trends seem to be moving in the right direction, but financial institutions don't work well in environments of uncertainty, and clear operating guidelines and legal protections will be vital for bitcoin to thrive.

Volatility is also an issue. The chart below shows bitcoin's wild ride, over a less than 18-month period, swinging from a low of $368 to nearly $20,000. The world's second largest cryptocurrency, Ethereum, saw its value increase fifty-fold during the first half of 2017, but lost 20 percent of its value shortly after an erroneous report that its founder had died in a car crash.[66] This kind of volatility makes bitcoin and other cryptocurrencies less useful as dollar-like currencies, limiting its appeal to speculators, who often seem like get-rich-quick schemers, or the much smaller legitimate market that is looking for in-and-out transactions such as cross-border payments. Some also worry about a crypto valuation bubble.[67]

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FIGURE 6.3 Bitcoin Price Fluctuation from January 1, 2016 through May 25, 2018
From 2016 through mid-2018, the price of one bitcoin fluctuated wildly, from a low of $368 to a high of nearly $20,000.



Source: Data from "Bitcoin USD (BTC-USD)." Yahoo Finance website, https://finance.yahoo.com/quote/BTC-USD/history?p=BTC-USD.

Increased *transaction volume* should help stabilize the market, increase liquidity, and bring some stability to the currency. Substantial volume means a network effect is present—the technology becomes valuable and useful because so many others are using it. But while volume will be vital for any cryptocurrency or blockchain standard, bitcoin has a long way to go. As of mid-2018, bitcoin's highest daily transaction volume was about 440,000[68] compared with the 150 million daily transactions that Visa processes.[69] And to get to that kind of volume, bitcoin will need more infrastructure support. Visa currently has the capability to handle 56,000 transactions a second, while the entire bitcoin miner network could only handle seven. That's not seven thousand, that's one hand plus two fingers.[70]

Perhaps most troubling, early bitcoin technology couldn't handle increasing transaction volume. A limitation in the structure of underlying bitcoin software limits transaction processing, and processing times ballooned to the point where several firms that once accepted bitcoin have stopped doing so. Fixes for the *scalability problem* (which has also hampered other cryptocurrencies like Ethereum) are possible, and several have been proposed, but issuing a fix involves a massive upgrade of software, and certain factions of the community (including many in the large network of small-time bitcoin miners) are wary of the impact of any change.[71] A controversial 2017 proposal to improve scalability and reduce steadily increasing bitcoin transaction costs resulted in a "hard fork" of bitcoin into an adjacent currency known as bitcoin cash.[72] Your old bitcoin could work on the new network, but there were effectively two ledgers at that point. Confused? It gets worse. Less than a year after bitcoin cash appeared, there were no less than 44 additional "forks" of bitcoin, new software ledgers that TNW referred to as "useless."[73] Blockchain technology is hurt by a *lack of standards*, and while there may be successes if a single standard emerges around, say, food safety or music licensing, we're not there yet. As crypto continues to get repeatedly "forked up," bitcoin *balkanization* and other software schisms will reinforce a perception that these technologies are not yet ready for widespread use.

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ICOs: Initial Coin Offerings as a New Way for Startups to Raise Cash

Some firms are engaging in a new type of fundraising, widely referred to as an ICO or initial coin offering. Firms raising money via an ICO issue a coin or other token that represents some form of value. While some ICO tokens represent an ownership stake in the firm that can even be matched to voting rights and future dividend distributions like a stock, others simply issue an amount of a new cryptocurrency (e.g., a bitcoin rival), or offer usage credits or loyalty points for a given service—usually something they plan on building.[74] In this respect, ICOs can be a sort of crowd sale and share something in common with crowdfunding sites like Kickstarter.[75] The advantage of an ICO for issuing firms is that they can *raise capital with limited to no regulation*. The advantage for consumers is that *a token can be instantly traded with anyone*, provided the coin or token received is linked to some publicly available blockchain used by both buyer and seller. An investor that owns shares in a public company can trade those shares in the stock market for cash. But an investor that makes a private investment in a pre-IPO company has private shares that are less **liquid** (i.e., harder to turn into cash). In theory, the owner of ICO tokens (even those that aren't tied to any sort of equity or ownership stake in a firm) can trade them at any time, if they can find a buyer; no need to own publicly traded shares or even a stock market.

ICOs got a lot of press in early 2017. The startup Golem, described as a sort of Airbnb where organizations can sell excess computing power, raised $8.6M in twenty-nine minutes. Brave, a browser startup from a former Mozilla CEO, raised $35M in thirty seconds. Another firm, Gnosis, a decentralized predictive market platform, raised $12.5M in twelve minutes. These firms needed to create awareness so that there were buyers for the tokens offered in the ICO, but buyer beware—neither firm had a product that had passed its beta-testing phase at the time of the offering.[76] TechCrunch reports that according to its own data, over the fourteen months from the start of 2017 through the first two months of 2018, blockchain and related startups raised nearly $1.3 billion in traditional venture capital rounds worldwide, but nearly $4.5 billion was raised via ICOs.[77] That's about 3.5x more money from the crowd than from the VC! ICOs have downsides for firms raising capital, too. Startups raising money via an ICO token sale might hit their fundraising goals, but professional investors such as venture capitalists and angel investors that are the traditional source of capital for startups, typically come with professional networks that can offer advice, mentorship, and important contacts for recruiting, sales, legal advice, and more (some describe ICOs as "dumb money" as opposed to "smart money"). Right now, ICOs are pretty much an unregulated dice roll. In the early days of this model of fundraising, 35 percent of ICOs failed completely but 45 percent showed returns in excess of 500 percent.[78] And there's no guarantee that government entities won't try to step in—a good thing if that helps curtail the possibility of sham ICOs used by scammers. Efforts including Ethereum and Storj (an online marketplace for cloud storage) were careful to call their fundraising "token crowdsales," both to helps investors understand that they aren't purchasing equity or a security, and to try to make it clear to the SEC that they aren't offering something akin to stock.[79]

liquid

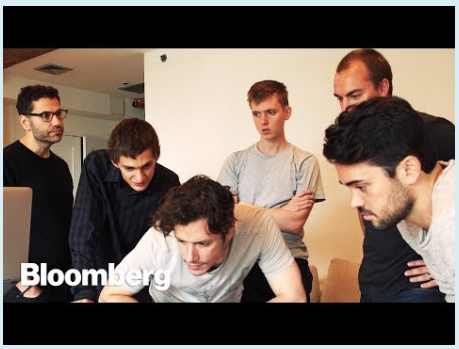
An asset which is liquid can be easily turned into cash. Stocks of public companies traded on major exchanges are highly liquid. Private shares in a company that has not yet gone public are illiquid since there is not a readily available public market.

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A Look Inside an Initial Coin Offering

Bloomberg offers a look inside an initial coin offering. The ICO of Brooklyn-bsaed AirSwap shows fundraising through phishing attempts, eventually raising $50 million.



View the video online at: //www.youtube.com/embed/T2uJ6cCwqh0?rel=0

What Do You Think?

If all this sounds sketchy to you, consider how currencies have evolved. We've moved from precious materials (gold, silver, etc.) to a currency backed by precious materials (the gold standard), to one based largely on laws and governmental trust, to one allowing physical cash to be replaced by hand-signed paper receipts (checks), and then to bits—that is, credit cards and money transfers. Now, many of us use smartphone apps to snap photos of checks and have them electronically deposited into banks. Rip up the check when you're done, because the transaction was completed by sending its digital image. With this evolution as context, does cryptocurrency seem like such an unlikely next step?

Bitcoin used its early mover status to jumpstart network effects value from a larger number of buyers and sellers. However, there are quite a few alternatives to bitcoin. *The Guardian* says nearly 800 cryptocurrencies are in existence, with some of the larger efforts being Ethereum, Ripple, and Litecoin.[80] You might even have seen a NASCAR sponsored by Dogecoin (the fact that this bitcoin rival was named after an Internet meme dog doesn't help credibility among the financially conservative). As of this writing, Ethereum is getting the most traction. Its market cap had, at one point, come within 80 percent of the total value of all bitcoin. Larger firms, including Microsoft and JP Morgan Chase, are working together on Ethereum-based technologies, which from the start have been designed to be a transaction-recording platform as well as a cryptocurrency.[81] To get a look at the current value of leading cryptocurrencies, check out https://coinmarketcap.com/.

And remember that cryptocurrencies are just an element of what the blockchain can do. This revolution may be less about monetary exchange and more about using technologies to redefine processes. What's your take? Do you see credible opportunity here? Disruptive threat? Or flash-in-the-pan hype that'll fizzle and go nowhere?

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Key Takeaways

- Bitcoin is an open source, decentralized payment system (sometimes controversially referred to as a digital, virtual, or cryptocurrency) that operates in a peer-to-peer environment without bank or central authority.
- Cryptocurrencies are entirely digital—there are no physical "coins". Cryptocurrencies are created and can be earned by miners who participate in verifying and permanently recording transactions in a secure, distributed public ledger (the blockchain).
- While bitcoin was the first cryptocurrency to gain transaction, hundreds of rivals have emerged. Some, such as Ethereum and Ripple, have currencies that are, in total, valued in multibillions of dollars.
- Various exchanges have been developed to make it easier for consumers to trade conventional currency for bitcoin or other cryptocurrencies, and vice versa. An increasingly long list of retailers and other providers have begun accepting bitcoin as cash.
- Since blockchain technologies provide a mechanism to instantly exchange value over the Internet without an intermediary, techniques are being developed that use the concept of a blockchain to move beyond cash-substitute uses, facilitating the exchange and ownership record of other types of assets (autos, real estate, diamonds and hard assets, and intellectual property), providing digital signatures, and more. If widely adopted, this technology has the potential to disrupt and improve operations among not only financial institutions but also aspects of the legal system, government regulation, health care, and other sectors.
- Many governments, financial institutions, and startups have launched blockchain initiatives targeted at bond issues, capital raising, and financial settlement.
- Lower or no transaction costs appeal to retailers, and those wishing to exchange currency across borders. Bitcoin could lower retailer transaction costs, create an opportunity for the digital purchase of goods with small value (micropayments), and open up markets where credit card access is limited.
- Civil libertarians also like the fact that bitcoin transactions can happen without revealing the sorts of personal data that credit card companies and other financial institutions are gathering. Since it's a peer-to-peer transaction, there is no central authority that can freeze accounts or impose other policies on users.
- Limited consumer benefit, difficulty of use, reputation problems, security concerns, ambiguous regulation, volatility, transaction volume, and the scalability of current infrastructure are all concerns that may limit bitcoin's mainstream appeal.

Questions and Exercises

1. Bitcoin's technology is in flux. Investigate how to get dollars into bitcoin, where you can pay for things using bitcoin, and how to get money out. Did you try this out? Why or why not?
2. Based on your experience in number 1, what will need to happen with bitcoin for it to gain mainstream consumer acceptance?
3. What's the status of bitcoin vs. the bitcoin cash fork? Who favored the fork and who opposed it? Why?
4. To whom do cryptocurrencies appeal? Why? Do some exploring online. Where are bitcoin or other cryptocurrencies accepted? Have any of these firms commented on results (positive or negative) of accepting crypto? Share your findings with your class and discuss likely resulting market trends.
5. What can retailers do to encourage more customers to use cryptocurrencies?
6. Members of the MIT bitcoin club each received $100 to experiment with the technology. Perform some additional research. What have they done? Come to class prepared to discuss their results and the value of this initiative.

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7. Conduct a search online and investigate the total currency value (market capitalization or market cap) for current leading cryptocurrencies. Which firms are the most widely used and most valuable? Why?
8. Investigate current uses of blockchain technology. Which seem successful? Have any failed? Build a list of industries that you think have a high likelihood of disruption by blockchain. If you were a manager in this industry, what would you do to deal with the potential for a blockchain revolution? Report your results to the class and share what you, as a manager, can take away from these experiments.

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CHAPTER 7

Amazon: An Empire Stretching from Cardboard Box to Kindle to Cloud

7.1 Introduction

Learning Objectives

1. Appreciate the breadth of businesses in which Amazon competes.
2. Understand that Amazon's financial performance has not been consistent.
3. Begin to recognize the reasons for this performance inconsistency and set the stage for the examination unfolding in subsequent sections.

As CEO of tech industry research firm Forrester Research, George Colony is paid to predict the future. Firms spend big bucks for Forrester reports that cover trends and insight across the world of computing. So when, in the early years of Amazon's expansion, Colony turned his attention to the Internet retailer founded by Jeff Bezos, there were a lot of people paying attention. Colony proclaimed that the recently public firm would soon be "Amazon.toast" as larger traditional retailers arrived to compete online.[1] Colony wasn't the only Bezos-basher. *Fortune*, the *Guardian*, and *Barron's* were among the publications to have labeled the firm "Amazon.bomb." Bezos's personal favorite came from a pundit who suggested the firm should be renamed "Amazon.org," adopting the domain of a nonprofit since it'll never make any money.[2]

Amazon went seven whole years without turning a profit, losing over $3 billion during that time. The firm's stock price had fallen from a high of $100 a share to below $6. Conventional wisdom suggested that struggling dot-coms were doomed, as retail giants were poised to bring their strong offline brands and logistics prowess to the Internet, establishing themselves as multichannel dominators standing athwart the bloodied remains of the foolish early movers.

But during those seven years and through to this day, Bezos (pronounced "bay-zose") steadfastly refused to concentrate on the quarterly results Wall Street frets over. Instead, the Amazon founder has followed his best reckoning on where markets and technology were headed, postponing profit harvesting by plowing cash into expanding warehousing capacity, building e-commerce operations worldwide, growing one of the Internet's most widely used cloud computing platforms, leading the pack in e-readers, developing the first credible threat to Apple's dominant iPad in tablets, launching video streaming/gaming devices for television, and defining a successful new product category with Echo, a voice-response speaker platform. The company's logistics and shipping efforts include a leased fleet of cargo jets (Prime Air), hundreds of tractor trailers, an expanding local delivery infrastructure, a forray into trans-oceanic shipping, and a much-publicized commit-

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ment to delivery by unmanned drone. Today, Amazon is clearly more than an online store and has even begun to aggressively invest beyond "clicks" into "bricks." The firm had begun operating campus bookstores (a once lucrative business for Barnes & Noble[3]), opened a handful of "Amazon Books" physical retailers, developed a no-checkout convenience store concept store (Amazon Go), and announced the gargantuan $13.7 billion acquisition of Whole Foods—giving the once Internet-only player a 42-state collection of over 430 grocery stores.[4] Not all forays are successful—the firm's attempt at creating a smartphone competitor to iOS and Android, the Fire Phone, was a multimillion dollar disaster—but the firm's recent batting average in new product introductions has been impressive.

Amazon-Owned Businesses

CNNMoney offers a look at some of the businesses Amazon owns, including Zappos, IMDb, Whole Foods, Audible, and Good Reads. Some of Bezos's personal investments are also mentioned. Oh—and there are images of that 10,000-year clock being built.



View the video online at: http://www.youtube.com/embed/lQIsBBJmBD8?rel=0

Tellingly, Amazon's first profit was posted the week one-time brick-and-mortar Goliath Kmart went bankrupt. Kmart was also the former parent of another giant of the offline world, Borders, a firm that completely shuttered in the wake of Amazon's dominance. Kmart was eventually purchased by Sears, a reeling retailer that lost $10 billion in six years.[5] As for Amazon, profits continued. In a three-year period following the introduction of the Kindle, Amazon's net income climbed from $476 million to $1.15 billion. Barnes & Noble's fell from $150 million to $37 million before dipping into the red. Punditry is a dangerous business, but *Barron's* made up for the dot-bomb comment, putting Amazon on its cover under a headline proclaiming the firm the world's best retailer. *Fortune* atoned by naming Bezos the "Businessperson of the Year,"[6] and Amazon was recently named as having the "Best Reputation of any US corporation."[7]

Amazon's future continues to be hotly debated as the firm's profitability swings wildly. The firm has been called both the "unstoppable monster of the tech industry" and a "charitable organization run by elements of the investment community for the benefit of customers."[8] Massive investments had, for years, cratered Amazon profits even as Amazon marched to became the fastest firm in history to reach $100 billion in sales. Yet by April 2018, Amazon had posted its twelfth consecutive profitable quarter, trouncing estimates with $1.6 billion in profits on over $51 billion in sales in the first three months of the year.[9] The cloud business, AWS, has been growing "even faster than Amazon['s retail business]"[10] and brought in over $5.4 billion in those same three months.[11]

Fortune has declared that Amazon is "outperforming everyone's wildest expectations."[12] To be clear, those expectations have been sky-high, and Amazon's highly valued stock with its nosebleed P/E ratio suggests that Wall Street continues to anticipate a huge upside. Let's dive in and look at how technology and strategy have come together in one of the most innovative firms in history.

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Jeff Bezos and the Long Term

"Our first shareholder letter, in 1997, was called 'It's all about the long term.' If everything you do needs to work on a three-year time horizon, then you're competing against a lot of people. But if you're willing to invest on a seven-year time horizon, you're now competing against a fraction of those people, because very few companies are willing to do that. Just by lengthening the time horizon, you can engage in endeavors that you could never otherwise pursue. At Amazon we like things to work in five to seven years. We're willing to plant seeds, let them grow—and we're very stubborn. We say we're stubborn on vision and flexible on details."[13]

Bezos's big thinking isn't limited to Amazon. He has struck an unusual partnership with JPMorgan Chase and Warren Buffet's Berkshire Hathaway to explore new technologies and solutions to serve their US employees. The deal may have implications for broader society—think telemedicine, early-detection devices, tackling drug pricing and distribution, offering combined care and insurance alternatives, and devices that promote and reward healthy living.[14] Just how far ahead is Bezos's time horizon? His personal investments (conducted as Bezos Expeditions) include Blue Origin, a commercial rocketry and aviation firm that intends to send humans into space and has already secured payload delivery contracts with NASA.[15] Other investments include Twitter and Uber. In 2013, Bezos (not Amazon[16]) went old school and bought the *Washington Post*.[17] Bezos has also built a 10,000-year clock deep inside a mountain on his ranch in West Texas. The timepiece plays an elaborate cuckoo-like sequence, composed by musician Brian Eno, to mark every year, decade, century, millennium, and ten millennia. How's that for a symbol of long-term thinking?[18]

Why Study Amazon?

Amazon isn't just the Internet's biggest superstore, it's the world's most valuable retailer and the largest, most profitable provider of cloud computing services, by far. While sales are still a fraction of Walmart's, Bezos's firm is worth twice as much as the world's largest physical retailer, and is growing far faster.[19] Examining Amazon's various businesses provides a context for introducing several critical management concepts, such as cash efficiency, logistics advantages, and channel conflict. We see ways in which tech-fueled operations can yield above-average profits far greater than offline players. We can illustrate advantages related to scale, the data asset, and the brand-building benefits of personalization and other customer service enhancements. Amazon's Kindle business and its expanding forays into the tablet, set-top box, and the voice-powered personal assistant markets allow us to look into the importance of mobile, multiscreen, and diverse-interface computing as a vehicle for media consumption, a distribution channel for increased sales and advertising, a creator of switching costs, a gathering point for powerful data, and a competitor for platform dominance. And the firm's AWS (Amazon Web Services) business allows us to see how the firm is building a powerhouse cloud provider, generating new competitive assets while engaging in competition where it sells services to firms that can also be considered rivals.

Key Takeaways

- Amazon is the largest online retailer and has expanded to dozens of categories beyond books. As much of the firm's media business (books, music, video) becomes digital, the Kindle business (which has expanded to tablet, set-top box, and smartphone) is a conduit for retaining existing businesses and for growing additional advantages. And the firm's AWS cloud computing business is the largest player in that category. The firm has even begun investing in physical retail locations, including opening Amazon Books stores, pioneering the no-checkout Amazon Go concept, and buying Whole Foods and gaining over 430 grocery stores.

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- Amazon takes a relatively long view with respect to investing in initiatives and its commitment to growing profitable businesses. The roughly seven-year timeline is a difficult one for public companies to maintain amid the pressure for consistent quarterly profits.
- Amazon's profitability has varied widely, and analysts continue to struggle to interpret the firm's future. However, after years of investing in new businesses and in building scale advantage, Amazon is now solidly and reliably profitable. Studying Amazon will reveal important concepts and issues related to business and technology.

Questions and Exercises

1. Which firms does Amazon compete with?
2. Investigate Amazon's performance over the last decade. How has the firm done with respect to revenue, net income, and share price? How does this compare with competitors mentioned?
3. What are some of the advantages in having a longer time horizon? What are some of the challenges? What needs to happen to enable Amazon to continue to "think long term"? What could derail this approach?

7.2 The Emperor of e-Commerce

Learning Objectives

1. Recognize how Amazon's warehouse technology and systems are designed to quickly and cost-effectively get products from suppliers to customers with a minimum of error.
2. Understand how high inventory turns and longer accounts payable periods help fuel a negative cash conversion cycle at Amazon, and why this is a good thing.
3. Gain insight into various advantages that result from the firm's scale and cost structure.
4. Appreciate how data can drive advantages not fully available to offline firms, ranging from increased personalization to innovation and service improvements.
5. Identify the two sides in Amazon Marketplace network effects, and why this is important in strengthening the firm's brand. Understand the financial advantages of goods sold through marketplace versus those that Amazon takes possession of and sells itself.
6. Appreciate how mobile access is influencing opportunities through additional changes in how, where, and when consumers shop.

Everybody starts small, even Bezos. At first the firm focused exclusively on selling books over the Internet. An early office was in a modest space boasting a then-appealing 400-square-foot basement warehouse in a low-rent area of Seattle, where neighboring establishments included the local needle exchange, a pawn shop, and "WigLand."[20] Today, the firm is decidedly larger. Amazon is now the world's largest online retailer, by far, and operates over 400 facilities worldwide dedicated to the warehousing, distribution, and delivery of products, sometimes guaranteeing delivery within the hour.[21] The stylized smile in the Amazon logo doubles as an arrow pointing from A to Z (as in "we carry everything from A to Z"). A new downtown Seattle headquarters will take up three full city blocks anchored by three signature office towers. While Amazon's revenues are still smaller than Walmart, the firm is growing far faster and has a market cap not just bigger than Walmart, but bigger than Walmart, Target, Best Buy, Macy's, Nordstrom, Kohl's, JCPenney, and Sears—*combined*.[22]

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How does a firm that sells products that pretty much any other retailer can provide, grow and create competitive advantages that keep rivals at bay? Look to the napkin! The lobby of Amazon's headquarters sports the framed vision scribbled out by Amazon's chief, allegedly penned on the nearest writing surface while Bezos was noshing (see Figure 7.1).

FIGURE 7.1 Amazon's "Wheel of Growth"



Source: Adapted from a Jeff Bezos Napkin Scribble.

At the heart are three pillars of Amazon's business: large selection, customer experience (sometimes referred to simply as "convenience"), and lower prices. Says Bezos, "I always get the question, what's going to change in ten years? I almost never get asked, what's NOT going to change in the next ten years? That's the more important question, because you can build a business around things that are stable. [Things like] low prices…faster delivery [offering customer convenience]…vast selection."[23]

The three pillars of selection, customer experience, and low prices reinforce one another and work together to create several additional assets for competitive advantage. Exceptional customer experience fuels a strong *brand* that makes Amazon the first place most consumers shop online. Having more customers allows the firm to provide more products, creating *scale*. The larger the business, the easier it is for Amazon to justify vertically integrating to become its own shipper in some circumstances—keeping prices and other costs down while speeding delivery. Amazon also opens its website up to third-party sellers—a dynamic where more customers attract more sellers, which attracts still more customers (and so on). That virtuous cycle of buyer-seller growth is a two-sided *network effect*, yet another source of competitive advantage. And all this activity allows Bezos and Company to further sharpen the business battle sword by gathering an immensely valuable *data asset*. Each digital movement is logged, and the firm is constantly analyzing what users respond to in order to further fine-tune the customer experience, fine-tune demand predictions, squeeze out costs, and drive cash flow. Let's look at each of these items and see how Amazon's bold tech-based strategy is realizing additional advantages in the domain of marketing, accounting, and operations.

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Fulfillment Operations—Driving Selection, Customer Convenience, and Low Price

Amazon has always sold direct to consumers, but it didn't always do this well. The firm's early warehousing was a shambles of inefficient, money-burning processes. Amazon hired operations experts from leading retailers, but raiding Walmart's talent pool wasn't enough. Amazon's warehouse and technology infrastructure are radically different than those of any conventional retailer. While Walmart warehouses that support its superstores ship large pallets of identical items in a single shipment (think crates of diapers or toothpaste) to thousands of its retail locations, Amazon warehouses pack boxes of disparate individual items, sending packages to millions of homes. To build a system that worked, Amazon focused on costs, data, and processes so that it could figure out what was wrong and how it could improve, applying technology for the biggest impact.

One effort, "Get the C.R.A.P. out," focused on products that "can't realize any profits." The firm's senior vice president of North American operations recalls visiting a Kentucky warehouse and watching a staffer spend twenty minutes packaging up a folding chair—a process way too inefficient for a firm with razor-thin margins. To fix the situation, Amazon worked with the vendor to get chairs in prepackaged, ready-to-ship boxes, keeping the product available to customers while cleaving costs.[24]

To automate profit-pushing hyperefficiency, Amazon warehouses are powered by at least as much code as the firm's website[25]—nearly all of it homegrown.[26] Shipments during the holiday rush can top 65 million a day, all without elves or flying reindeer.[27] The firm's larger warehouses are upwards of a quarter-mile in length, packed with aisles of shelves. Technology choreographs thousands of workers and robots in what seems part symphony, part sprint.

When suppliers ship new products to Amazon, items are scanned and prepped so inventory is ready to fulfill customer orders as soon as possible. Dozens of workers examine the incoming shipments for defects. If a problem is spotted in the receiving area, the staffer flips an adjacent warning light from green to red, signaling a warehouse "problem solver" to swoop in, deal with the issue, and make sure additional items in the rest of the product supply can keep flowing in.[28] Amazon is always looking to cut errors and identify areas for potential process improvement. Other groups of problem solvers scuttle about the warehouse with wheel-mounted laptops, observing operations and offering coaching on how staff can do things better.[29] To foster improvement, warehouse movements are continuously logged and productivity is tracked and plotted. High-performing workers are praised throughout the day, with management calling out the names of workers who hit or exceeded goals.[30] Says one Amazon exec, "If we discover a better way of doing something, we can roll it out across the world."[31]

While problem solvers can pick up quick-to-implement process improvements, there are also massive tech-fueled changes under way. Amazon previously relied exclusively on human beings rushing around maze-like warehouse shelves to stock products and pick orders.[32] The worker runabout was good for personal cardio, but it required wide lanes between shelving, and technology to coordinate path-crossing, occasionally crash-prone, cart-pushing humans. Today, a new robot army is being rolled out to turbocharge fulfillment operations and spare the worker sprint.

Robots powering redesigned fulfillment centers come from Kiva Systems, a Massachusetts-based firm that Amazon bought for over three-quarters of a billion dollars.[33] Kiva robots don't look like C-3PO. They're squat, 320 lb, orange colored, rounded-rectangles on wheels, about the size of a living room ottoman. Now, instead of workers running to shelves, robots bring shelves to workers. Robots don't yet handle the bulkiest items such as flat-screen TVs or lawnmowers, but Kiva robots carry shelves stacked with upwards of 750 lb of goods, making them capable of handling the majority of what you're likely ordering from Amazon.[34]

In robot-automated fulfillment centers, those items that are handled by Kivas are sent to one of four floors where the robots roam. A massive robot arm known as the "Robo-Stow" might be used

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to hoist pallets of products from one floor to another.[35] Shelvers stand on platforms while Kiva robots line up for restocking, bearing shelf towers with open bins stacked nine-or-more slots high along on all four sides. Robots position shelves to expose the correct side for inventory placement. Shelvers scan products that are added to inventory, placing each in a specific location on a specific shelf that is also scanned. This tells Amazon's software exactly where a given item is stored. Next, the shelf is whisked away by a robot until one of the items on the shelf is needed for a customer order. The same items might be stored on dozens of different shelves throughout the warehouse. This allows different robots to simultaneously fulfill different orders for the same items. Amazon software enforces an additional rule when stocking shelves, known internally as "random stow": No two similar products sit next to each other. While this makes Amazon's shelves look like an unorganized hodgepodge, when a product is the only one of its type on a given shelf, this actually reduces the chances that a picker will confuse a size or color or otherwise grab the wrong thing.[36] Reducing mistakes keeps customers happy in brand-building ways, and it reduces errors that can crush profits.

When an online order is sent to a fulfillment center, pickers wait for shelf-carrying robots to line up with precisely those items that the customer has requested. A monitor near the picker indicates the item that's needed and where it can be found on the robot-conveyed shelf.[37] Humans are still needed to grab an item off the shelf, do a second quality check, electronically scan items and shelves to record the item as moving out of inventory, and place items into yellow plastic order fulfillment bins. Once all items for a given order are picked, the bins containing orders are placed on conveyor belts where they're whisked away for packing. Software identifies the optimal size of smile-logoed Amazon cardboard box to use for a given order and how many air pillows to protect packed items, and even dispenses the right amount of packing tape. The entire order process involves only about a minute, total, of human contact.[38]

In a set of steps called SLAM (scan, label, apply, manifest), and taking only about a second,[39] packed boxes are weighed, and the software does an additional check to see if the weight is what's expected. If an order is too light, that's a sign that a box is missing an item, too heavy and the wrong item may be in the order.[40] Boxes are scanned, and shipping labels are printed and blown on with a puff of air. Systems only stamp names and addresses on boxes after orders are complete and boxes are sealed. No floor workers know who you are or what you've ordered. Packed boxes are then loaded onto separate trays that ride into another conveyor belt system, where they are scanned and tipped down the correct chute among dozens of choices so that the box is routed onto the appropriate truck for that order's shipping provider and destination. Some warehouses ship products so quickly that outbound trucks are dispatched with a less-than-three-minute window between them.[41]

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Robots at Amazon Fulfillment

Follow the entire process as items enter an Amazon Fulfillment Center, get stacked on robot-mounted shelves, get called back for order assembly, and get boxed and sorted for shipping.



View the video online at: http://www.youtube.com/embed/M5xvCGGDISk?rel=0

Amazon is now using over 100,000 robots,[42] and a single warehouse, like the massive Tracy, California facility (which is about as large as fifty-nine football fields) can have over 5,000 Kiva robots,[43] helping the firm ship as many as 21 million distinct products.[44] Motion sensors and floor-mounted guides help robots find their way. Shelf-carrying Kivas travel around 3 to 4 mph and never collide. The wireless, electric robots will run a couple hours on a charge, and they'll return for a recharge when needed.[45] Robots can't repair themselves, but repair staff are on site in the event of failure, with no more than ten robots in the fleet expected to be out of commission at any point in time.[46] Kivas keep getting better, too. Amazon claims the current generation is 50 percent more efficient at moving inventory than models that were produced at the time of acquisition.[47]

As for benefits, Kiva robots allow shelves to be slotted closer together and can be queued up for rapid, never-colliding, constant round trips. This helps Amazon store as much as 50 percent more product in Kiva-equipped warehouses (greater selection at lower cost), it has reduced unload time for inbound inventory from "hours" to as little as 30 minutes,[48] and it has cut average order fulfillment time from about an hour and a half to as little as fifteen minutes.[49] While robot workers are cheaper than people, Kiva isn't a job-killer; in fact, Amazon has actually increased staff since deploying the robots. Says the firm's VP of worldwide operations, "Kiva's doing the part that's not that complicated. It's just moving inventory around. The person is doing the complicated work, which is reaching in, identifying the right product, making sure it's the right quality, and making sure it's good enough to be a holiday gift for somebody."[50]

Deploying robots isn't cheap. It's estimated that Amazon spends over $26 million on equipment and $46 million total getting a large warehouse on board with Kiva robots,[51] but systems also help the firm position itself for even more customer satisfaction. Faster delivery times through speedy fulfillment centers helped Amazon expand same-day delivery to twenty-seven cities in Spring 2016.[52]

Keeping customers happy stems in part from setting expectations, so Amazon's systems receive weather reports as well. Order a product during a pre-Christmas snowstorm, and expect to see a message on the website indicating that "adverse weather conditions are impacting deliveries." A nice touch on the few times when a snag might cause problems. Those are quite rare: Amazon boasts on-time package delivery rates of up to 99.9 percent or more.[53]

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Amazon's Cash Conversion Cycle—Realizing Financial Benefits from Speed

Quickly moving products out of warehouses is good for customers, but Amazon's speed also offers another critical advantage over most brick-and-mortar retailers: The firm is astonishingly efficient at managing cash. Here's how.

When incoming inventory shows up at most retailers—and this is certainly true for Amazon, Barnes & Noble, and Best Buy—those firms don't pay their suppliers right away. Instead, they log payment due for these goods as an **account payable**, a bill that says when payment is due some time in the future. Accounts payable periods vary, but it's not uncommon for a big retailer to be able to hold products for a month or longer without having to pay for them. However, when customers buy from a retailer, they pay right away. Cash is collected immediately, and funds from credit cards and checks clear in no more than a few days. The firm's period between shelling out cash and collecting funds associated with a given operation is referred to as the **cash conversion cycle** (CCC). There are other factors that influence the CCC, but right now we'll concentrate on the hugely important time difference between paying for inventory and selling those goods. A retailer wants this number to be as small as possible; otherwise, unsold inventory is sitting on shelves and doesn't generate any cash until it's sold. Especially cash-crunched firms may even require short-term loans to pay suppliers, and those firms that can't generate cash quickly enough are referred to as having **liquidity problems**.

While a firm's CCC varies from quarter to quarter, Barnes & Noble has reported that its inventory has sat on shelves sixty-eight days on average before being purchased.[54] BestBuy has held inventory for as many as seventy days before a sale.[55] Costco and Walmart sell goods more quickly, but they also pay for inventory before it is sold.[56] When compared with these peers, however, Amazon alone consistently reports a negative CCC—it actually sells goods and collects money from customers weeks before it has to pay its suppliers. This gives the firm a special advantage since it has an additional pool of cash that it can put to work on things like expanding operations, making interest-bearing investments, and more.

account payable

Money owed for products and services purchased on credit.

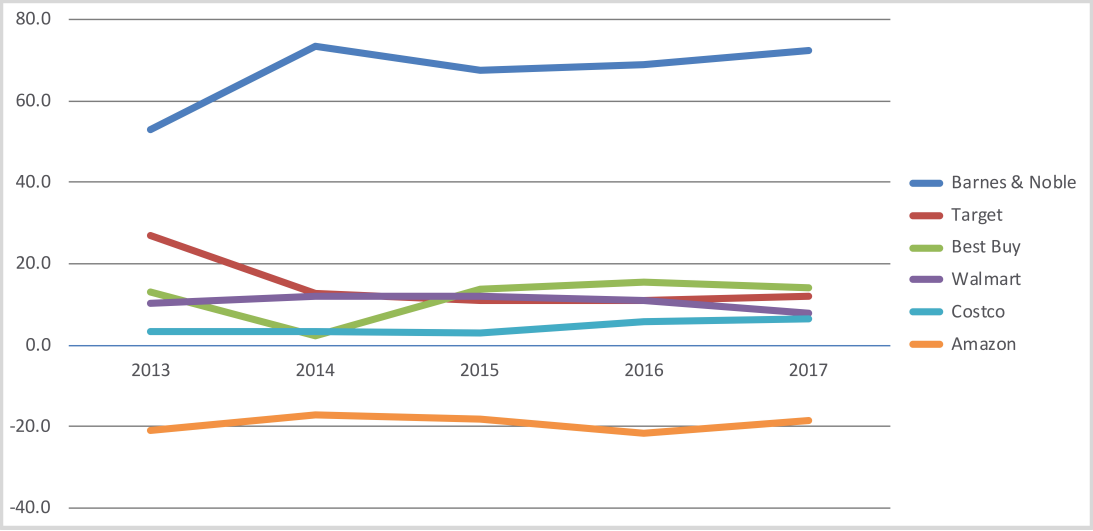
cash conversion cycle

Period between distributing cash and collecting funds associated with a given operation (e.g., sales).

liquidity problems

Problems that arise when organizations cannot easily convert assets to cash. Cash is considered the most *liquid* asset—that is, the most widely accepted with a value understood by all.

FIGURE 7.2 Cash Conversion Cycle (in Days) among Select Major Retailers



Source: Data from firm-published financial reports.

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inventory turns

The number of times inventory is sold or used during a specific period (such as a year or quarter). A higher figure means a firm is selling products quickly.

The efficiency of a firm's cash cycle will vary over time. And numbers reported are an average for all products—some products are slow movers while others are sold very quickly. But the negative cash conversion cycle is another powerful benefit that Amazon's fast-fulfillment model offers over rivals. The goal for Amazon? Keep **inventory turns** high (e.g., sell quickly) and pay suppliers later.

Internet Economics, Scale, and Pricing Power

Selling more goods often gives Amazon bargaining power with suppliers. And the size (scale) of Amazon's business provides the firm with negotiating leverage to secure lower prices and longer payment terms. Walmart's sales dwarf Amazon's. Walmart's 2016 revenues were $485 billion. Amazon's 2016 revenue was about $136 billion, but at least $12.2 billion should be subtracted out as non-retail revenue for cloud-computing.[57] But Walmart has over 11,500 stores worldwide[58] and Target (with only $69 billion in 2016 revenue) has 1,807 stores.[59] Amazon has about 400 logistics facilities worldwide, including fulfillment centers, sortation centers, delivery stations, and Prime Now hubs.[60] Putting aside the Whole Foods acquisition (which Amazon says it will, in the short term, run as a separate business, retaining its current CEO[61]), and its opening a modest number of Amazon Books and other retail outlets, Amazon still has a massive economic advantage over traditional retail. While Amazon spends significantly on software, automation, and expansion of its warehouses, its overall costs for things like real estate, energy, inventory, and security are far lower than costs experienced by brick-and-mortar rivals. And employee efficiency should be greater as well, since Amazon shift workers are working at fairly constant rates throughout the day while retailer activity fluctuates with the ebb and flow of customer visitation hours.

The Advantage of Being Big: Realizing Scale Advantages as the Retail e-Commerce Leader

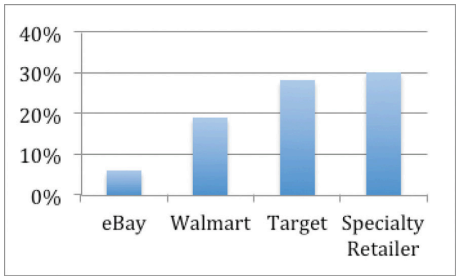
Retail can be a cutthroat business. Competition often boils down to whoever has the lowest price. Amazon's sales volume scale enables it to operate with thin margins and low prices. As former Amazon employee Eugene Wei puts it, this allows Amazon "to thin the oxygen" of competitors.[62] Amazon's breadth of operations brings in cash from other businesses, giving the firm the stamina to endure the challenge of an unprofitable price war. After vanquishing a category rival following a price war, Wei put it this way: "Our leading opponent had challenged us to a game of who can hold your breath longer," and Amazon had "bigger lungs."[63] The lesson is clear: A smaller firm looking to pick a price fight with Amazon might not survive.

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Amazon's retail prices aren't just cheaper than other e-commerce firms; they're usually cheaper than larger rival Walmart, too. Wells Fargo compared a diverse basket of products available at both firms and found that Walmart prices were actually 19 percent more expensive than Amazon prices. Target was 28 percent more expensive, while products purchased at specialty retailers cost 30 percent more. Even more impressive, Amazon seems to be monitoring the availability of products at competitor websites and using stockouts as an opportunity to earn more. The *Wall Street Journal* reports that "where rivals sold out of items, Amazon responded by raising its prices an average of 10 percent."[64] Firms should be careful—consumers have been known to react angrily to so-called **dynamic pricing** if they feel they are being taken advantage of.[65] But the insight does show how data can drive a nimble response to shifts in the competitive landscape.

FIGURE 7.3 Key Retailer Average Price Difference above Amazon.com



Source: Adapted from J. Jannarone, "Retailers Struggle in Amazon's Jungle," Wall Street Journal, February 22, 2011; and S. Distinguin, "Amazon.com: The Hidden Empire (2013 Update)," faberNovel, February 2013.

dynamic pricing

Pricing that shifts over time, usually based on conditions that change demand (e.g., charging more for scarce items).

While Walmart, through Jet.com, has made some strides in narrowing price differences,[66] analysts point with concern that Amazon may go after Walmart's category-leading grocery business by continuing to lower prices at Whole Foods, all while offering discounts to those who sign up for Amazon Prime.[67] Amazon generates a lot of cash, and for years it has been plowing nearly every penny back into the firm, mostly via investments in fulfillment center infrastructure and (as we'll see later in this chapter) capacity for the firm's dominant, higher-margin cloud computing business (visible in accounting statements by analyzing the sizable gap between the firm's operating cash flow, which eliminates capital expenditures, and free cash flow, which includes them).[68] Now the firm is harvesting profits from that infrastructure investment. Larger warehouses, more warehouses closer to big cities, and more efficient warehouses all build a moat around the firm's existing businesses, making it less likely that any firm will be able to attack Amazon's three-pronged value trident of selection, service, and price.[69]

While not well known for its own brands beyond Kindle, Amazon's scale has allowed it to create several of its own branded product lines. Amazon's private-label brands include AmazonBasics (cables, batteries, and other consumer electronics accessories), Mama Bear (diapers and other baby products), Happy Belly (foodstuffs, including nuts and trail mixes), Presto! (home cleaning products), Pinzon (bedding and bath), Strathwood (outdoor furniture), Pike Street (bath and home products), Denali (tools),[70] and at least seven private-label clothing brands.[71]

Putting its own brand on high-volume products should allow Amazon to cut out some of the costs that would otherwise go to a branded supplier, lowering prices and improving margins over conventional brands. The willingness to sell its own brands can also give Amazon even more negotiating leverage with suppliers. Firms unwilling to provide Amazon with the price breaks, payment terms, or complete product-line access it demands may see Amazon compete directly with them via a private-label product. And a scale-reinforced brand that screams "best price" in a space crowded with me-too retailers selling the exact same thing is a powerful asset and enormous barrier for competitors to try to overcome. Amazon can keep advertising spending down, as customers see the firm as the first and often only stop needed when moving from product research to purchase. Consider that Target (with billions less in sales than Amazon) spends over $400 million more on advertising than Amazon[72] (with most of Amazon's spending on non-retail offerings like Kindle and Amazon Video). And once customers show up on its website, Amazon can use customer data to surface its brands to those it thinks will be most likely to buy.

Amazon also sees growth beyond consumers. Amazon Business is going after the corporate procurement market, which Forbes generously estimates as being valued at $7.2 trillion.[73] Amazon's selection, selling everything from paper to IT products to break room snacks to lab equipment, may make the firm a first-choice destination for buying in many categories, especially given that the average business products wholesaler offers only about 50,000 products online.[74] Special features are targeted at business customers, including the ability to create multiple user accounts, integrate with corporate procurement systems, set up a purchase approval workflow, work with purchase orders, and even negotiate bulk discounts. A pass-through link will allow a visitor to Amazon to chat with experts from firms selling technical products.[75] In 2017, Amazon announced it had over

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1 million business customers, double the amount a year earlier. Amazon's entry into the market is thought to have contributed to the sale of office supplier retailer Staples at a bargain basement price, and the category of Amazon Business competitors that includes big firms you may not have heard of (Grainger, Fastenal, and MSC Industrial) lost some $8 billion in market value in just one year. Getting most products in and out of a warehouse is the same regardless of category, so Amazon can quickly expand in any area where it thinks the model will work.[76]

Amazon Business

Amazon is building a gargantuan business selling supplies to business customers, challenging everyone from Staples to parts supplier Grainger.



View the video online at: http://www.youtube.com/embed/Ma552DYyQXM?rel=0

Customer Obsession

For a firm that does so much, Amazon's moves are largely motivated by one thing: relentless customer focus. Sure, every firm says they care about their customers. But consider this: In meetings, Bezos is known to insist that one seat be left open at the conference table as a symbol representing "the most important person in the room," the Amazon customer.[77] To keep even the most senior executives empathetic to the customer experience, every two years every employee, from Bezos on down, must spend two days on the service desk answering customer calls.[78]

It's an eye on improving the customer experience that has motivated so many of Amazon's pioneering efforts, among which include one-click ordering (which the firm patented), customer reviews, recommendations, bundles, look and search inside the book, where's my stuff, and free supersaver shipping. While pioneered by Amazon, many of these efforts are now accepted as must-have features across e-commerce categories.[79]

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Amazon is also using the Amazon Prime subscription service to make customers happy, and along the way, to create habit-changing behaviors that fuel sales growth. Subscribers to Amazon Prime get free two-day shipping for unlimited qualifying purchases, so users don't have to bundle products in a shopping cart before they can qualify for free shipping. It also loads up Prime members with additional perks like a selection of thousands of videos and hundreds of thousands of songs that subscribers can stream for free. Show your loyalty with an Amazon Prime Visa card? You'll get 5 percent cash back, not only from Amazon, but also at Whole Foods. Prime members will get another 10 percent off Whole Foods sales items—a welcome discount for customers that used to refer to the high-priced grocery chain as "Whole Paycheck." And when Amazon expanded same-day delivery to fourteen US cities, it waived fees for Prime subscribers (cementing a same-day Amazon habit may be important as firms that include Google, Macy's, and Nordstrom all experiment with same-day service for a fee).[80] In 2018 Amazon, for the first time, announced how many Prime customers it had—100 million[81]—that's about half of all US households. Many estimates have Prime customers spending twice as much as non-Prime. Many on Wall Street have been critical of free shipping, but it's yet another way that Amazon improves the customer experience. Free shipping can cost Amazon upwards of $600 million in a single quarter,[82] and shipping costs have been rising as much as 25 percent a year since 2004. The firm's recent increase in Prime's subscription price (from $99 to $119 in the United States) coupled with increased volume and loyalty seem to be making the program worthwhile.

FIGURE 7.4
Letter posted to Amazon’s home page following the firm’s second record-breaking ACSI score


amazon.com.

Dear Customers,

The American Customer Satisfaction Index is, by far, the most authoritative and widely followed survey of customer satisfaction. Last year, Amazon.com received an ACSI score of 84, the highest ever recorded -- not just online, not just in retailing -- but the highest score ever recorded in any service industry. This year, Amazon.com scored an 88 -- again the highest score ever recorded in any service industry.

In ACSI's words:

"Amazon.com continues to show remarkably high levels of customer satisfaction. With a score of 88 (up 5%), it is generating satisfaction at a level unheard of in the service industry...Can customer satisfaction for Amazon climb more? The latest ACSI data suggest that it is indeed possible. Both service and the value proposition offered by Amazon have increased at a steep rate".

Thank you very much for being a customer, and we'll work even harder for you in the future. (We already have lots of customer experience improvements planned for 2003.)

On behalf of everyone at Amazon.com,

Sincerely,

Jeff Bezos
Founder & CEO

Source: Amazon Press Room; http://media.corporate-ir.net/media_files/irol/17/176060/images/letters/letter_acsi.jpg.

As we've mentioned earlier, strong brands are built largely through customer experience. As evidence of the strength of customer experience, Amazon has repeatedly scored the highest rating on the University of Michigan's American Customer Service Index (ACSI). Not only was it a rating that bested all other Internet retailers; it was the highest score of any firm in any service industry.

Leveraging the Data Asset—A/B Testing, Personalization, and Even an Ad Business

Moving early and having scale allow Amazon to amass that profoundly valuable tech-derived competitive resource—data. The more customers a firm has, the more accurately the firm can understand various patterns related to recommendations, preferences, customer segments, price tolerance, and more.

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A/B test

A randomized group of experiments used to collect data and compare performance among two options studied (A and B). A/B testing is often used in refining the design of technology products, and A/B tests are particularly easy to run over the Internet on a firm's website. Amazon, Google, and Facebook are among the firms that aggressively leverage hundreds of A/B tests a year in order to improve their product offerings.

At Amazon, data wins arguments, and the corporate culture gives employees the freedom to challenge even the most senior managers, all the way up to Bezos himself. When Amazon coder Greg Linden proposed that Amazon present "impulse buy" recommendations that match patterns associated with the consumer's shopping carts (e.g., customers who bought that also bought this), he was originally shot down by a senior vice president. Linden was undeterred; he ran an **A/B test**—capturing customer response for those who saw option "A" (recommendations) versus option "B" (no recommendations). The result overwhelmingly demonstrated that recommendations would drive revenue.[83]

Two-Pizza Teams: Keeping an Entrepreneurial Culture in a Big Firm

One challenge growing firms often face is that they become slow and less innovative as they expand.[84] In order to keep Amazon nimble and innovative, Bezos has mandated a rule known as "two-pizza teams," stating that any individual project team should be small enough that it can be fed by no more than two pizzas.[85] This helps ideas flourish, discourages the kind of "groupthink" that diminishes the consideration of alternative approaches, and even provides a mechanism where several efforts can compete to identify the best solution.

While the "abandoned shopping cart" problem plagues many Web retailers, Amazon is considered one of the best "converting" e-commerce sites, moving customers from product evaluation through completing checkout.[86] A/B tests drive this; the firm has relentlessly experimented with tests that modify and compare all sorts of variables, including the wording associated with images and buttons, screen placement, size, color, and more. Constantly measuring customer activity also helps the firm direct its investment in infrastructure. One test, for example, revealed that a tenth of a second's delay in page loading equaled a 1 percent drop in customer activity, pointing to a clear ROI (return on investment) for keeping server capacity scalable.[87]

While you're shopping on Amazon, you're likely part of some sort of experiment—perhaps several. While Amazon doesn't say how many A/B tests it runs, Google runs over seven thousand annually. Amazon has gotten so good at A/B testing that it launched a service offering scalable options for running simultaneous tests and gathering measured results for developers that use the Amazon app store. A/B testing is yet another advantage e-commerce firms have over conventional retailers. Constant experimentation, refinement, and retesting are far easier in the digital world when every user's click, delay, and backtrack can be measured and compared.

cookie

A line of identifying text assigned and retrieved by a given Web server and stored by your browser.

collaborative filtering

A classification of software that monitors trends among customers and uses this data to personalize an individual customer's experience.

Amazon's data trove on you individually, and users collectively, fuels the firm's personalization effort (efficiently referred to internally as p13n, since there are thirteen letters between the p and the n in the word personalization). When visiting the Amazon home page, it's more accurate to say that you're visiting *your* Amazon home page at a given point in time. Your page may vary not only based on any ongoing A/B tests but also based on Amazon's best guess of what you'll want to see as well as any myriad of other sales and promotion goals. Behind the scenes, your Web browser receives a unique tracking string called a **cookie**, and Amazon tracks your surfing behavior as well as your buying history. Rate products? Even better! Amazon knows what you liked and what you didn't. The firm's proprietary **collaborative filtering** software compares a user's data with others' data, mapping a best guess of what you'll like to see each time you visit. A parent who has searched for and bought items for young children will likely see recommendations for other age-appropriate kid products—maybe even guessing at your kid's gender and likes. Athletes, gamers, and romance novel fans should also expect interest revealed by surfing and purchasing to create a custom experience. Amazon has claimed that as much as 35 percent of product sales have come from the firm's recommendations.[88] Scale means the firm has more users doing more things, allowing the firm to collect more observations that fuel greater accuracy in tailoring the user experience. And this fuels that oh-so-important, brand-building positive customer experience.

All of this customer insight data also positions Amazon to grow a massive, Google-competing ad business. Amazon initially sold ads as a way to generate more sales through its website, but Amazon now offers advertisers the ability to advertise on Kindles, on other Amazon-owned sites like

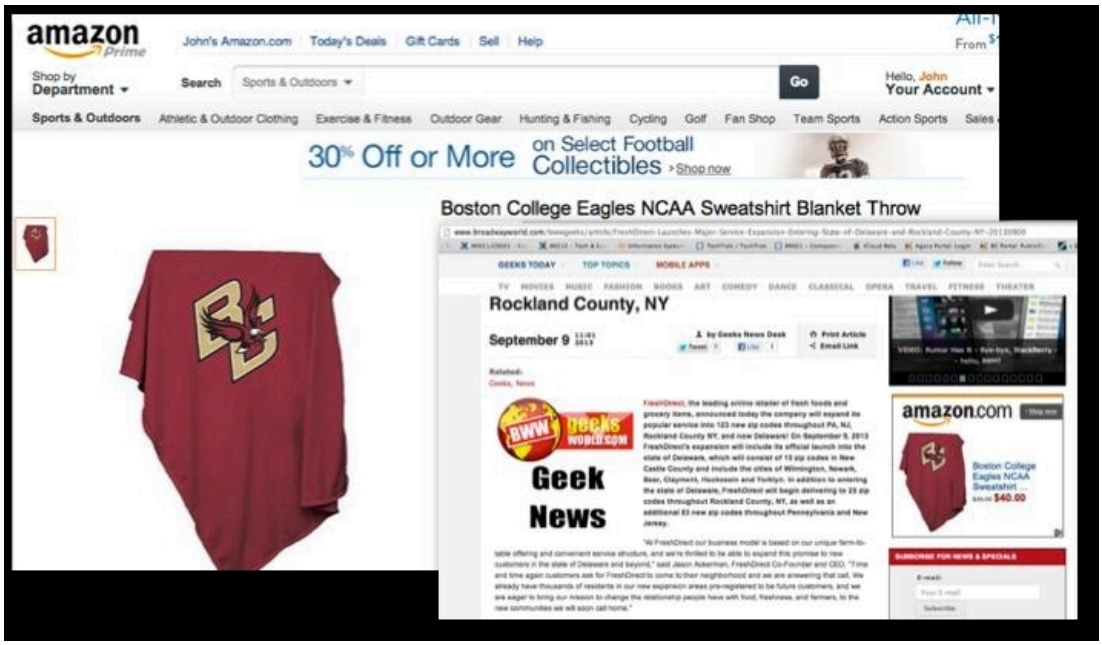
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IMDb, within mobile apps, and via Amazon-targeted ads on third-party websites. Amazon made $1.7 billion selling ads in 2017, up 60 percent from the previous year,[89] yet another business Walmart is unlikely to be able to replicate. Amazon ad offerings are feature rich, including things like the ability to play a movie trailer in an ad or embedding a discount coupon in a click-to-purchase offering. Amazon reportedly charges up to $1 million for ads placed on the welcome screen of the new Kindle Fire.[90] Don't like ads? You can pay $20 more for a Kindle without the "special offers." Have you also ever looked at a product on Amazon, didn't buy it, but then started seeing the product pop up in ads as you surfed the Web? That's called *retargeting*, and Amazon is building this business as well. Retargeting is especially attractive to suppliers since a click through brings you right to Amazon's cash register, a place where you've likely already got all of your account information online and where buying is just "1-Click" away.

FIGURE 7.5

In this retargeting example, a user visiting the Amazon page for a college-themed blanket (background) was tracked using a cookie, and the user's interest in this product was recorded. Advertisements for this product were shown when this same user visited other websites (foreground).



Selection and Network Effects

Amazon's radical focus on customer experience also caused it to take what many would consider a contrarian move—offering products provided by others alongside its own listings. Third-party products are referred to as being part of the Amazon Marketplace. Amazon doesn't own inventory of marketplace items. Sellers can warehouse and ship products themselves, or they can opt to use Amazon's warehouses as part of the Fulfilled by Amazon program. The latter lets Amazon handle logistics, storage, packaging, shipping, and customer service, while customers get Amazon shipping prices—including supersaver discounts and free shipping for customers enrolled in the Amazon Prime program. Customers also benefit if they already have credit card and other information on file with Amazon (a switching cost potentially deterring users from going to a new site).

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two-sided network effect

Products or services that get more valuable as two distinct categories of participants expand (e.g., buyers and sellers).

Nearly half of all units sold by Amazon are from the firm's 2 million participating Amazon Marketplace sellers worldwide.[91] Marketplace allows Amazon to build a *long tail* of product offerings without the costly risk of having to take ownership of unproven or slow-moving inventory, while the firm gets fat and happy in the middle of a **two-sided network effect** (i.e., more buyers attract more sellers, and more sellers attract more buyers). Some Marketplace products compete directly with Amazon's own offerings, but the firm doesn't shy away from allowing competitive listings, new or used, even if they're cheaper. Competition among sellers reinforces low price and lowers the chance that customers will look first to sites like PriceGrabber, Shopping.com, Google, or eBay. Even if a rival wins a sale, all products sold through Amazon allow Bezos's firm to collect a fee. Third-party sellers may send a signal to Amazon that a certain product category may be worth entering itself, all while sellers pick up the initial risk of inventory ownership. And when Amazon sells third-party goods through its site, it continues to "own" much of the customer relationship for that sale, gathering data that would have otherwise been lost if customers went elsewhere. Amazon also won't hesitate to kick out sellers with bad ratings to ensure quality and protect the Amazon brand.

Scale from Selection: The Long Tail

More than half of shoppers start their product search on Amazon—making the firm the leader in product-oriented search (sorry, Google).[92] Much of Amazon's appeal as a first-choice shopping destination comes from the firm's selection. Internet businesses are free of what former *Wired* editor Chris Anderson calls the limitations of shelf space and geography, which trouble traditional retailers.[93] Traditional retailers stock their limited shelves with the most popular items, and consumers are limited to the selection available in the stores that they are willing to travel to. Amazon's warehouses and third-party seller selection offer the equivalent of virtually limitless shelf stock, something you'd never find in a store. This selection is delivered by US mail or package shippers, so geography is no longer a concern. This allows the firm to leverage what is often called the long tail (as introduced in Chapter 4, the tail refers to the large number of products unavailable through conventional retail stores, see Figure 7.6, and also shown in Chapter 4). The cost to house and ship a popular book, or a more obscure one, should be the same. While popular items make up traditional retailer inventory (the area on the left-hand side of the curve in Figure 7.6 "The Long Tail"), it turns out there's actually *more money* to be made selling obscure stuff (the stretched-out but larger area on the right-hand side of the curve) if you can reach a greater customer base over the Internet. As evidence, consider that at Amazon, roughly 60 percent of books sold are titles that aren't available in even the biggest Barnes & Noble Superstores.[94] Amazon is also moving from distribution of the "atoms" of books and video to digital distribution of media products via the Kindle. This eliminates the cost to warehouse and ship the atoms of physical goods.

FIGURE 7.6 The Long Tail



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Not only does Amazon allow others to sell products through its site, it allows others to market for the firm. The Amazon Associates program is the world's largest **affiliate marketing program**, offering a sort of "finder's fee" for generating sales. Website operators can recommend Amazon products on their site, and Amazon gives the affiliate a percentage of sales generated from these promotions. For Amazon, fees paid are pay for performance—associates get a commission only if their promotions generate sales.

affiliate marketing program

Marketing practice where a firm rewards partners (affiliates) who bring in new business, often with a percentage of any resulting sales.

Acquisitions and Category Expansion: Fewer Rivals, More Markets, and More Customer Choice

Acquisitions of other firms and the growth of new internal businesses has allowed Amazon to accomplish several things, including broadening the firm's product offerings to underscore Amazon as the "first choice" shopping destination; absorbing potentially threatening competitors before they get too big; experimenting with new product offerings and services; and integrating value-added businesses and technologies into the Amazon empire. *BusinessWeek* once ran a cover story titled "What Amazon Fears Most," featuring a diaper-clad toddler. The implication was that New Jersey-based Quidsi, operator of Diapers.com, could grow brand and scale in staple products, drawing customers away from Amazon. Amazon bought the firm for over half a billion dollars, and even though Quidsi never turned a profit and Diapers.com, Wag.com, and other Quidsi brands were eventually shuttered,[95] Amazon took out what was once regarded as one of the biggest threats to grabbing high-growth markets that Amazon didn't dominate, and prevented Walmart (a rival bidder for Quidsi) from gaining that expertise (Quidsi's founders went on to start Jet.com, selling that firm to Walmart for $3 billion a short time later).[96] Amazon's $1 billion purchase of Zappos (which continues to operate as a separate firm) also took out a fast-growing Amazon rival before it became a threat.[97] Other acquired firms include Alexa, a Web analytics and tools provider; Audible, the leading provider of digital audio books; Goodreads and Shelfari, social networking sites for book readers; Woot, a **flash sales** site; Lovefilm, often described as the "Netflix of Europe"; and Souq, often described as the "Amazon of the Middle East."[98] Some experiments fail, such as the now shuttered flash-sale site MyHabit, but Amazon's deep pockets and relentless experimentation make it one of the most threatening competitors in retail and services.

flash sales

Offering deep discounts of a limited quantity of inventory. Flash sales often run for a fixed period or until inventory is completely depleted. Players include Gilt Groupe and Amazon's MyHabit in fashion, and One Kings Lane in home décor.

Amazon is also growing its own brands in new categories. Amazon Instant Video offers streaming television and movie titles for rental or purchase, and some are included free with an Amazon Prime subscription. Amazon Fresh is a FreshDirect-like competitor, offering same-day or next-day delivery of groceries and more.

Key Takeaways

- Amazon's sophisticated fulfillment operations speed products into and out of inventory, reinforcing brand strength through speed, selection, and low prices.
- Rapid inventory turnover and long payment terms enable Amazon to consistently post a negative cash conversion cycle. The firm sells products and collects money from customers in most cases before it has paid suppliers for these products.
- The cost structure for online retailers can be far less than that of offline counterparts that service similarly sized markets. Savings can come from employee costs, inventory, energy usage, land, and other facilities-related expenses.
- Amazon's scale is a significant asset. Scale gives Amazon additional bargaining leverage with suppliers, and it allows the firm to offer cheaper prices in many categories than nearly every other firm, online or off. Scale through multiple warehouses allows Amazon to offer more

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products, a greater product selection, and same-day delivery for urban areas near warehouses. Amazon financials suggest that the firm is deferring profitability due to its increased investment in capital expenditures such as its warehouse and data center buildout.

- Around 40 percent of products sold on Amazon are offerings sold through Amazon Marketplace by third parties. Amazon gets a cut of each sale, maintains its control of the customer interface, and retains the opportunity to collect customer data that would be lost if users went elsewhere for a purchase.
- Amazon takes advantage of the *long tail*, a concept where firms can profitably offer a selection of less popular products. Amazon's enormous product selection—with offerings from the firm and from third parties—reinforces its position as the first-choice shopping destination.
- Amazon's ability to acquire and leverage data further allows the firm to enhance customer experience and drive sales. Internet retailers have a greater ability to gather personal data on consumers than do offline counterparts. Data is used in personalization and in innovation fueled by the result of A/B experiments.

Questions and Exercises

1. When you walk into a conventional retailer, similar items are stacked next to each other. But Amazon tries not to do this in its warehouses. Why?
2. How do Amazon warehouse staff know where to find items? How does technology help make the process most efficient?
3. How have robots changed the way Amazon warehouses operate? What are the benefits these robots bring to Amazon? Which firm supplies Amazon's shelving robots and why might this be important for Amazon?
4. Does Amazon buy most of its warehouse automation software from others, or is most of the software written in house? Why do you suppose this is the case?
5. In what other ways do Amazon's information systems reduce errors? Why is error reduction so critical to firm performance?
6. Which requires more code—the firm's customer-facing website or warehouse automation?
7. Although Amazon is investing in robotics, human beings still do most of the product picking. How does Amazon ensure that customer privacy is protected despite heavy human involvement? Do you think it needs to go to such great lengths? Why or why not?
8. What is the cash conversion cycle (CCC)? What factors enable Amazon to have a CCC that is negative? Why are offline rivals unable to match these efficiencies? What advantage does this give Amazon over rivals?
9. How do Amazon's prices compare with rivals' prices? What gives Amazon such advantages? What other pricing advantages does Amazon have that a conventional retailer might not be able to take advantage of?
10. What is dynamic pricing, and why might this be risky?
11. What are private-label products, and what advantages do they offer Amazon?
12. Log into Amazon (or pull up a page if you "remain" logged in). Compare it to a classmate's page. What similarities do you notice? What differences? Why do you think Amazon made the choice to show you the things that it did? Do you think it guessed accurately regarding your interests? Why or why not?
13. Amazon's unique customer data have allowed the firm to enter the advertising business. Which firms does this bring Amazon into competition with? Research Amazon's role in matching advertisers to consumers. How big a player is Amazon? How do you feel about a firm using your personal data on purchases, product browsing, and recommendations for advertising? Under what circumstances (if any) are you comfortable with such targeting, and under what circumstances are you concerned?
14. How does Amazon keep management focused on customer issues and "putting the customer first"?
15. Describe how Amazon Marketplace offers two-sided network effects.

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16. Besides network effects, what additional benefits does Amazon gain by allowing other retailers to sell potentially competing products on Amazon?
17. What is the long tail? How does the long tail change retail economics? How does it influence shoppers' choice of where to look for products? What firms, other than Amazon, are taking advantage of the long tail in their industries?
18. How is scale important to Amazon? What advantages does scale offer Amazon over its smaller rivals?
19. Amazon's operations are a marvel of automation and procedural efficiency, but the firm has also been subject to criticism regarding its warehouse work environment. Investigate these criticisms on your own. Do you feel they are valid? Are any of the critics also worthy of criticism? If so, how? Do you feel Amazon has responded appropriately to this criticism? How would you have responded if you were CEO of the firm? What takeaways from your own investigation will inform your own actions as a manager?

7.3 The Lord of Logistics

Learning Objectives

1. Understand how and why Amazon is increasingly taking over aspects of its own logistics business.
2. Understand Amazon's various delivery options and why it would choose one vs. the other.
3. Explore how scale is enabling the firm to vertically integrate several aspects of delivery, from air freight and ocean freight to long and mid-haul trucking, to last mile delivery.
4. Learn how Amazon is using technology to provide more delivery convenience to consumers, and potentially set itself up as a better alternative for consumer delivery than UPS, FedEx, or the USPS.

Building a Delivery and Logistics Business Inside the Business

Amazon has also been rapidly building out its own shipping and delivery infrastructure, which now includes a fleet of Prime Air cargo jets, long-haul trailers, local trucks, trans-oceanic shipping operations, and plans for automated delivery-by-drone. Cost and control drive Amazon's interest in logistics.

Amazon spent $21.7 billion on shipping costs in 2017; that's nearly twice what it spent just two years earlier.[99] Keeping packages under its own control on just the long-haul portion of routes could save Amazon around $3 or more on a typical delivery (average per-package shipping costs from FedEx and UPS is estimated at $7.81).[100]

A delivery network also gives Amazon more control over the customer experience. Interest in taking control of logistics increased after December 2013, when UPS couldn't handle the massive volume of Amazon's holiday package delivery, costing Amazon millions in refunds, and damaging the firm's reputation for delivery reliability among those who were left with empty spaces under the tree.[101]

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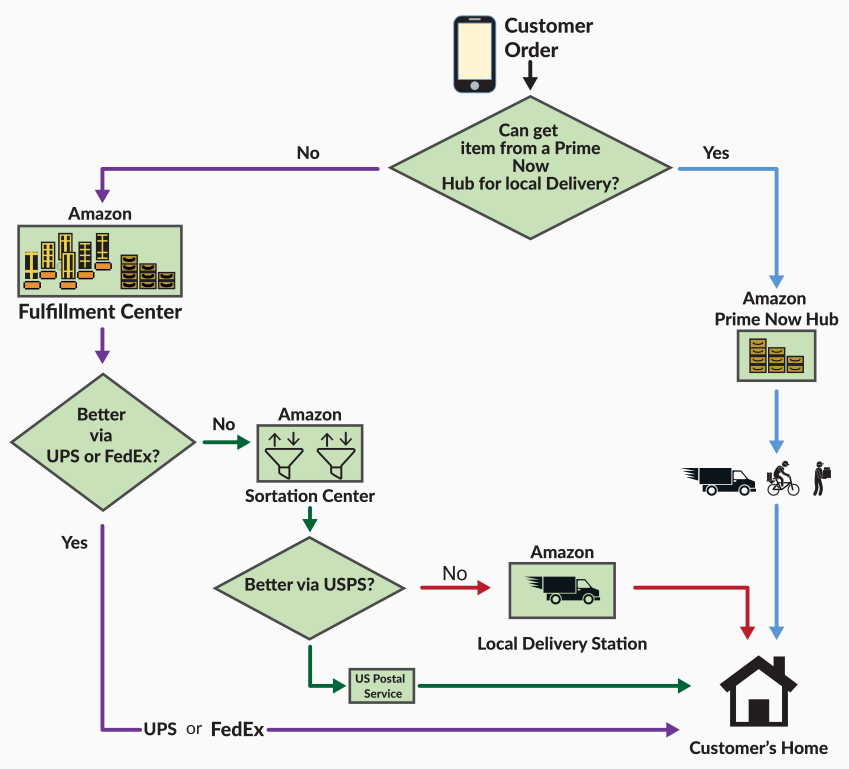
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Controlling parts of its distribution channel means FedEx and UPS will be increasingly disintermediated from a larger percentage of Amazon orders. The worldwide delivery market brings in about $400 billion in annual revenue. Amazon is allegedly piloting its own rival shipping service, offering deliveries for other businesses.[102] This could lead to the firm selling a wide assortment of delivery and logistics services to others, not unlike how the firm turned its computing infrastructure expertise into a multibillion-dollar cloud computing business.

Cost savings, happier customers, plus a new revenue stream are all sweet incentives for Bezos to go after shipping, and Amazon has been aggressively poaching executives and other experienced workers from Uber, FedEx, and UPS to bring in the brains needed for a best-in-class operation.[103]

FIGURE 7.7 Choosing the Right Shipping Partner

Crunching data and creating infrastructure lets Amazon choose the right shipping partner (including itself) to optimize on factors such as speed and cost. Prime Now customers ordering in areas served by a Prime Now hub can get goods fulfilled within an hour or two (and packages may arrive via van, bike, or on foot). Products outside of Prime Now are sourced at fulfillment centers and may be handed off to UPS, or FedEx, or moved to a sortation center where sorted products are passed to the US Postal Service, or go out for delivery in Amazon trucks or by private citizen drivers contracting with Amazon.



Amazon already cherry-picks the optimal way to get packages to consumers, crunching data that considers cost, fuel prices, routing, delivery time commitment, weather, traffic, fleet availability, and other factors, to dispatch packages to either UPS and FedEx, the US Postal Service (USPS), or for home delivery arranged by Amazon itself.

Long and Mid-Haul Trucking: Amazon owns thousands of its own branded truck trailers that get loaded with customer packages at fulfillment centers.[104] While Amazon owns the trailers, they can be driven by any firm or independent contractor. Amazon is rolling out a service which is a sort of Uber for truckers, matching trucks with shippers, which could include Amazon or any other firms that need a load hauled. An app as part of the system offers driving directions, truck stop recommendations, and suggested pick-up and drop-off routes to maximize capacity, shorten delivery time, and cut costs. Even more important, this kind of software could cut out middleman trucking brokers that typically charge a 15 percent commission.[105]

Prime Air: For items that need to travel farther and faster than trucks, FedEx and UPS jets might be involved in forwarding Amazon packages, but Amazon has realized that in some cases it

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can fly cargo jets more cheaply and efficiently than shipping partners. Amazon has leased 40 Boeing 767-300 and has painted them with the "Prime Air" logo. These planes often fly in and out of low-traffic airports, like Pennsylvania's Lehigh Valley, which is near Amazon facilities and is only 90 minutes from downtown Manhattan. Reports suggest that Amazon cargo jets are flying full, but with lighter loads (cutting fuel costs). By running the numbers, Amazon software can decide when it makes sense to move products onto its own planes for delivery, and when products (likely fuel-burning heavier goods) are better sent through third-party shippers. Flying its own route-optimized planes point-to-point also offers speed advantages. FedEx planes leaving from the West Coast depart no later than 9 pm to ensure they arrive at the firm's massive Memphis, Tennessee sorting hub. However, if Amazon software says its can fill a plane with cargo that can skip the FedEx hub and go straight to its destination, Amazon planes can leave as late as 2 am—allowing the firm to take more orders even later, but still guaranteeing fast delivery.[106] And if a stop is necessary to channel orders to disparate locations, Amazon is building its own $1.49 billion 900-acre hub in northern Kentucky so it can handle these options without an air freight partner.[107]

The Last Mile: In the three-year period after UPS botched holiday deliveries, Amazon has built out its network of sortation facilities, which now number at 70 throughout the US. Today, 44 percent of the US population lives within 20 miles of an Amazon facility—in 2010 that number was just 5 percent.[108] These facilities are designed to take customer orders boxed up at the fulfillment centers and get them to customers as quickly as possible. Packages sorted by zip code might be dropped off at US Postal Service facilities, or Amazon could forward packages to its own facilities, where it controls the final delivery leg.

Amazon is also using technology that could eventually make it an even more attractive choice than FedEx, UPS, or the US Postal Service. The Amazon Key delivery option uses smart home technology to allow delivery people to drop off packages inside the home. This effort should be boosted even further with Amazon's $1 billion purchase of one-time Shark Tank reject, Ring, a maker of smart home security technologies.[109] Amazon also has an early lead in allowing you to accept delivery to the trunk of your car—partnering with GM and Volvo in a 37-city rollout linking an Amazon App to OnStar car systems.[110] As mentioned in our Moore's Law and More chapter, fast/cheap computing embedded in all sorts of devices is opening up new opportunities.

Amazon Key In-Car Service

Why would you need delivery to your car instead of your home? Hear from the first customers of Amazon Key In-Car service.



View the video online at: //www.youtube.com/embed/w4akHn0jQCc?rel=0

By Sea and Global Reach: Amazon is on land, air, and also at sea. Amazon's China subsidiary has become an ocean freight shipping operator moving goods from Chinese manufacturers to the US Ocean shipping isn't for rapid delivery, but for forecast demand, say to bulk up fulfillment cen-

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ters with goods Amazon knows it will need, managing ocean freight is another way for Amazon to control another leg of its value chain, cleave costs, and potentially even enter the $350 billion ocean freight market.[111]

Amazon's global logistics march continues beyond China and the US. In Europe, the firm has taken a stake in two European logistics companies, giving it partial control of 6,700 delivery trucks handling 170 million shipments in the UK and France,[112] and it has built out its last-mile delivery network in the highly competitive German logistics market (home to DHL and well serviced by FedEx).[113]

On Deck—Delivery by Drone: Bezos used a *60 Minutes* profile to announce and demonstrate Amazon Prime Air, an effort from the firm's next-generation R&D lab. The goal is to eventually use copter-style drones to deliver small packages to consumers in thirty minutes or less. While some initially thought this was a publicity stunt, the firm made its first test delivery outside of Amazon property in Cambridge, England, delivering a package of books in 13 minutes from click to delivery,[114] and it made its first US public demonstration commercial drone delivery, a four-pound package of sunscreen for attendees at an Amazon conference in Palm Springs. Regulation may be more difficult than building the technology—the FAA currently does not allow commercial drones to travel beyond operator line-of-sight, or through heavily populated areas.[115]

Amazon's First Commercial Drone Delivery

Watch a demo as Amazon details its pilot drone delivery program in Cambridge, England.



View the video online at: http://www.youtube.com/embed/vNySOrI2Ny8?rel=0

Key Takeaways

- Shipping represents a large portion of Amazon's expense for each order, and the firm leverages several approaches to bring down this cost.
- In the United States, Amazon can choose to deliver products to consumer homes via the US Postal Service, UPS, FedEx, or itself. Algorithms decide which path is most effective from both a cost and customer service perspective.
- Local delivery is coordinated in several ways, including Amazon's Uber-style recruitment of contract drivers.
- Amazon owns its own trucking fleet to handle long- and medium-haul product transit, when appropriate.
- The firm has also leased 40 cargo planes, allowing it to funnel the most cost-effective shipping to its own fleet, and giving it more time to accept orders for next-day shipment. Planes utilize underserved airports that are still near metro centers or other Amazon facilities. The

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company is also building its own air hub in the center of the US, to further improve cost and speed efficiency.

- Amazon also operates its own ocean freight for products from overseas (primarily East Asia), which it knows it will need in its warehouses, but which lack the immediacy of plane delivery.
- While Amazon is a customer of large shipping firms, it has also begun offering its own shipping option to third parties, making it both client and competitor to package delivery firms. Amazon's experience in shipping provides an opportunity to create a shipping and logistics business in the way that its expertise in computing allowed it to create a cloud computing business.
- Amazon has leveraged technology in ways that may make it a more attractive shipping partner, and which better serve consumers. Amazon Key is the firm's service for providing the option of in-home delivery, even when customers are not present. The acquisition of Ring smart home products gives Amazon a supplier of this tech, vertically integrating components of the solution offering. The firm has also partnered with GM and Volvo to offer app- and OnStar-powered delivery to customer automobiles.

Questions and Exercises

1. In what ways is Amazon increasingly taking over its own shipping and logistics needs? When can a firm attempt such a move? Why does this move make economic sense for Amazon?
2. What advantages does Amazon enjoy by being able to consider various shipping options at the time a package is to be shipped?
3. Why is Amazon leasing planes that are painted with the "Prime Air" logo? Why is it involved in ocean freight shipping? What advantages does this give the firm? Should Amazon fear other e-commerce rivals might do the same? Why or why not?
4. What sort of customer would use Amazon Key or Amazon Key In-Car (auto-delivery) options? Would you? Do you think this will be successful? Why or why not?
5. Describe the ways that Amazon has expanded its "last mile" delivery network. Act as an investor or stock analyst and research online to get a sense of the size of the delivery market, the savings Amazon may gain, and the potential for additional revenue that Amazon might earn by expanding these efforts. Would this prompt you to invest in the firm? To advise the firm to continue or slow these efforts? Come to class prepared to defend your answer.

7.4 Beyond Clicks: More Bricks

Learning Objectives

1. Understand how Amazon is expanding into campus bookstores, physical stores, kiosks, and groceries.
2. Examine various models for the grocery business, understand why this is an attractive option, and explore how Amazon can apply technology and logistics to improve real-world shopping.

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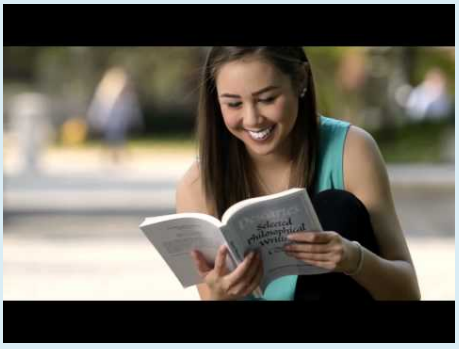
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Amazon as Your Campus Bookstore

Technology and the economics of being the world's largest e-commerce retailer are at the core of Amazon's success, but the firm is beginning to think more broadly about how the "bricks" of a physical retail presence can goose growth, expand into new markets, and better serve customers. For an example of this, look to your campus bookstore! Barnes & Noble was once a leader in operating campus bookstores, and the firm spun off the university business as a separate stock in 2015. But the college textbook market is changing. Many students are renting textbooks or going entirely digital, and Amazon sees an opportunity for disruption. Amazon opened its first Amazon Campus store at Purdue University in 2015, with similar facilities following at several others schools, including UMass Amherst and Stony Brook University. The Amazon-staffed Amazon@Purdue facility functions as a pick-up and drop-off location for Amazon products. Students who buy an item and specify the store as their shipping address will receive an e-mail or text alert once their shipment arrives. A link in the e-mail or text generates a bar code to gain access to an in-store self-service locker or pick-up desk. A modified Amazon website shows class information and required texts for Purdue classes. Students receive free one-day shipping on Purdue textbooks shipped to Amazon@Purdue.[116] The partnership is assumed to have lowered textbook costs by 40 percent,[117] and a Purdue administrator claims the school brought in $1 million from the Amazon deal in the first two years of the partnership.[118] Amazon has also been aggressively courting students without a Bezos bookstore, by offering Prime Student (http://amazon.com/primestudent), a six-month free membership to Amazon Prime.

Amazon@Purdue

Amazon@Purdue was Amazon's first consumer-facing brick and mortar facility.



View the video online at: http://www.youtube.com/embed/bMRrMv0wnEE?rel=0

Bezos's "Brick-based" Bookstores

Amazon has also opened over a dozen real-world Amazon Books stores. Amazon is unlikely to swoop in and replace old Barnes & Noble or Borders locations, and the stores aren't especially efficient when compared to the economics of its e-commerce business. Amazon financials show the stores don't really make any money,[119] and by offering only 6,000 titles in a small retail footprint, this isn't the place to go for selection. Amazon contends the main reason is to serve customers and help them discover great books—shelves are organized sort of like the website,[120] with signs like

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"Customers who bought this title also bought these." Other than new releases, the firm only carries books that have earned a four star or greater rating. Other highlights include "page turners"—books that Kindle users finish in three days or less, on average.

But bookstore as discovery engine can't be the only reason this makes sense, and a visit shows that "Amazon Books" carry much more—including Kindle, Echo, and Fire devices. Amazon Books are an on-ramp to recruit more Prime members and a perk that keeps them loyal. The store doesn't accept cash, and books don't carry prices—customers use the Amazon smartphone app to show how much an item will cost. Prime members pay the website price; those who don't subscribe to Amazon Prime may pay full list. In-store purchases also add Amazon Books orders to your online purchase history.[121] And Amazon has gotten physical without a full-fledged investment in storefronts, too. Roughly 30 Amazon popup stores, temporary kiosk-style spots in malls or other heavy-traffic retail spaces, have also appeared through Spring 2017. Popups typically focus on showcasing electronics. Consumers can talk to Alexa, try out a Dash Wand, or learn more about the Dash Buttons.[122] Such an investment makes sense if the economics of customer acquisition turn new buyers into more active shoppers who are more deeply attached to the Amazon ecosystem.

Want to hear from the VP of Amazon Books while getting a look at an Amazon Books retail store and what makes the experience special? See the video in Yahoo!'s report "Amazon Books chief: Why we opened brick-and-mortar bookstores."

More "Green" from Groceries?

Amazon has also rolled out its Amazon Fresh, a FreshDirect-style grocery competitor, in several metro markets in the US, offering same-day or next-day delivery of groceries and more. Groceries are a potentially attractive business for Amazon. While Amazon has 43 percent of the online retail market, over 90 percent of purchases happen in physical stores, and the US grocery business alone is worth three-quarters of a trillion dollars.[123] Amazon is still experimenting with getting the model for groceries right. New Amazon Fresh "click and collect" centers in Seattle allow customers to order online and then drive through to have their groceries loaded directly into their cars at a predetermined time. Set a pick-up time in as little as 15 minutes after placing your order. Stop by after you've picked up kids from the soccer game, or shortly after you leave work, and shopping remains low cost and is even more convenient. No minimum order, no delivery fee, and employees bring orders out to your car.[124]

But as we learned with FreshDirect, groceries are a lot different from books and consumer electronics, and Amazon still has a lot to learn. One estimate has Amazon Fresh losing more than twice as much due to spoilage than typical supermarkets, making early blunders like fixing banana orders as a "bundle of 5" where employees discarded the few extra bananas in a larger bundle.[125] And despite the heavy investment by Amazon and others, the number of online grocery shoppers is still a measly 4.5 percent in the US, increasing only 0.3 percent in the prior four years.[126] The anemic results of early attempts seems to have pushed Amazon to go old school—buying Whole Foods markets and its 450 stores for $13.7 billion. Whole Foods had been struggling, and had been in search of a buyer. In fact, about 70 percent of the cost was categorized in Amazon financials as "**goodwill**," meaning most of the gain wasn't for operations, but rather less tangible value.[127] And although the firm has initially committed to operating the firm with its old CEO under the Whole Foods name, Amazon gains the average twice-a-week visits from the grocery chain's tech-savvy, high-income, well-educated customers—a solid overlap with a large portion of Amazon's customer base.[128] Whole Foods comes with a trained workforce where many see their jobs as offering a long-term career path—unusual in an industry known for high employee turnover. An

goodwill

An accounting term for an intangible asset above and beyond the operations value of the firm. Goodwill can include the perceived value of the company's brand name, customer base, and loyalty, positive employee relations, as well as proprietary technology and patents.

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educated sales staff can boost sales as much as 60 percent, with 90 percent of consumers reporting an increased likelihood of making purchases from someone knowledgeable.[129] The firm has begun selling its line of customer products, accelerating the trend in in-store popup shops during holiday season that feature Kindles, Fire, FireTV, Echo, and more;[130] some stores have Amazon delivery lockers; and of course, Whole Foods will happily set you up with a Prime membership and Prime Visa rewards card. Integrating Amazon's logistics prowess in Whole Foods is a natural, and might keep Amazon's growing truck, van, and jet fleets efficiently filled with even more fast selling. With Whole Foods' emphasis on higher margin semi-prepared and prepared meals, Amazon could also lay the ground for an increased business catering push, or explore serving institutional customers like schools and hospitals (a business you may have seen in your community, served by Sysco trucks, not to be confused with Cisco, which is networking equipment). And tying in-store purchases (pay with your app, Prime members) with online shopping could also offer up a wealth of new data for additional consumer insights. Amazon has been pushing the perks for Prime members to spend their own green at the green grocer. The firm has begun rolling out free Whole Foods delivery for Prime members in select markets,[131] customers will get 10 percent off existing sale prices, and if you buy with an Amazon Prime Visa card you'll get an additional 5 percent off.[132]

Hello Machine Learning, Goodbye Checkout Line

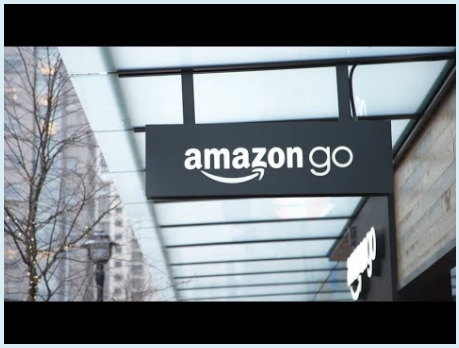
Finally, the new Amazon Go concept store shows how a tech giant could really advance retail. The initial concept shows a store without cashiers and registers, where customers enter by scanning an app. Image recognition, motion detection, weight sensors, and other advanced artificial intelligence can tell what a customer picks up, and charges them when they leave the store. The commercial viability of this technology underscores points on the impact of machine learning fueled by cloud-based server farms (and increasingly powered by special graphics processors, ASICs and FPGAs), that were introduced in the Moore's Law and More chapter. That growingly powerful Amazon cloud, described later in this chapter as well as in the chapter titled "Software in Flux," may be an important force redefining your real-world shopping experience, too! One important key to all of this: a store without registers can have a smaller footprint, or can carry more items, and could operate with fewer, but more highly skilled workers.[133] When it comes to revolutionizing the way we shop, Bezos clearly thinks it's still only "Day One."

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Amazon Go

The Amazon Go concept store uses sensors, image recognition, special package markings, and continually refined artificial intelligence to allow customers to scan a phone app and enter, then pick whatever they want and be billed automatically when they leave the store. No lines, no checkout. This technology could revolutionize the cost economics of convenience store retail.



View the video online at: http://www.youtube.com/embed/rPZdWuOPaHY?rel=0

Key Takeaways

- Amazon is expanding into the university bookstore business: providing a hub for free textbook delivery and rental, and a link to customer acquisition and retention among college students.
- Amazon Books is a real-world bookstore chain that offers website prices to Prime members, and that also sells the firm's growing line of consumer electronics.
- The grocery market is massive and could fuel significant Amazon growth. The firm's tech-fueled logistics model, and other advantages in leveraging tech for customer service and enhanced shopping convenience, are influencing several models, including Amazon Fresh delivery, Fresh "click and collect" pick-up centers, and even the firm's purchase of Whole Foods Markets.
- The Amazon Go concept store shows how machine learning influences computer vision, AI, and other techniques to eliminate cash registers. A shopping experience without lines is potentially far more attractive for consumers, and would offer any retailer benefits such as more shelf space, stores in a smaller real estate footprint, and perhaps even a smaller staff size.

Questions and Exercises

1. Have you seen an Amazon physical bookstore or kiosk? If so, what was your experience like? If not, browse online to find videos or write-ups about these. Do you think these make sense? Why, why not, or under what conditions?
2. Why are grocery stores attractive for Amazon? In what ways is Amazon entering the grocery business, and how do these models differ?
3. How is Amazon using Whole Foods? How is the firm creating synergies between the grocery chain and its existing businesses? What benefits, other than more sales through groceries, does Amazon get through Whole Foods?

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4. What does the accounting term "goodwill" mean? What was included in the goodwill category when Amazon acquired Whole Foods?
5. Are any aspects of Amazon's various grocery models appealing to you? Are there demographic trends in the US that might influence the rise of alternative models to conventional store shopping for others? List them, and also list any factors that might prompt you not to use an Amazon-powered grocery option. Have you or family members ever shopped for groceries online? If so, share your/their experience: if not, why not?
6. List the ways in which Amazon Go's in-store technology could improve the customer experience. How might it improve the cost economics of retail? What kinds of additional costs do you think are associated with the rollout of this tech?

7.5 Amazon's Disruptive Consumer Hardware Businesses: Kindle, Fire, Alexa, and More

Learning Objectives

1. Understand the motivation behind Amazon's consumer Kindle, Fire, and Echo businesses.
2. Recognize the various ways that Amazon earns money and strengthens its competitiveness via the Kindle platform.
3. Examine the changes Amazon's digital media offerings have brought to the traditional publishing industry value chain.
4. Understand key concepts such as channel conflict, wholesale pricing, and agency pricing.

While Amazon has built solid advantages by selling a broad array of products, media (books, music, and video) still represents about 20 percent of the firm's revenue,[134] and nearly all of that business is going to shift from atoms to bits, shipped not in physical packaging but through the Internet. Losing this market would be a blow that any publicly traded company, especially one with razor-thin margins, would find difficult to sustain. This is what prompted the creation of the Kindle. While many refer to the Kindle as an e-reader, the Kindle isn't as much about reading digital books as it is about putting a store in the hands of the firm's over 300 million customers,[135] not only allowing them to lap up goods from an increasingly massive digital trough, but also instantly linking those customers with the firm's entire inventory of physical products. What started as an e-book reader has now expanded to Kindle and Fire product lines that span categories that include tablet and television set-top boxes, and helped prime the pump for new product categories like the voice-responding Amazon Echo line. Beyond media consumption and sales, Amazon consumer electronics devices are also data-gathering conduits, arming Amazon to collect more customer insight to power existing and new initiatives.

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The Kindle Line: Igniting Possibilities on e-Book and Tablet

The first Kindle was optimized for book reading and featured a black-and-white display that used e-ink. That display can't refresh fast enough for animation or video, but it is legible in sunlight and only draws power when flipping a dot from black to white or vice versa, offering exceptionally long battery life. Thanks to Moore's Law, Kindles, originally offered at $399, grew in power while plummeting in price, with a low-end model selling for just $69 five years after introduction. The success of the Kindle is staggering. By the holiday season of the product's second year, the Kindle was Amazon's top-selling product in both dollar volume and unit sales.[136] That means Amazon was selling more Kindles than any single book, CD, movie title, or toy—or any other product among the millions that it offers. Consumer Intelligence Research Partners estimates that some 20 percent of Amazon's US customers own some form of Kindle device, an astounding rate.[137]

Up next is the high-resolution, color, and touch-screen Kindle Fire tablet. In its introduction, the Kindle Fire came to market for half the price of the competing iPad and quickly became the second best-selling tablet on the market. The Kindle is also a cloud machine. The first Fire came with half the RAM of the iPad, the thought being that your media would be snugly stored on Amazon's servers, downloaded when you need it, creating a big sticky switching cost in the process.

Even more noteworthy for competitors in the e-book and tablet space, Amazon doesn't look to make money directly from Kindle hardware sales; various Kindle versions are regularly sold at or below costs.[138] But any Kindle device ordered from Amazon arrives linked to your Amazon account. That means the device comes, out of the box, as a preconfigured cash register with a vacuum attached firmly to the credit card in your wallet. Over 5.5 million titles are offered in the Kindle "always-open" bookstore, with "search inside the book" features and the first chapter downloadable for free.[139] Voracious readers can gorge at the buffet of Kindle Unlimited, a subscription service providing unlimited access to over 1.4 million titles. Estimates of the firm's Kindle-generated revenue bump vary, but all point to positive Kindle-fueled sales gains. RBC Capital estimates that despite being sold at a loss, each Kindle Fire generates over $136 in operating income, with operating margins above 20 percent over the lifetime of the device.[140] Kindle owners buy three to four times more books than they did prior to owning the device.[141] And Amazon today sells more electronic books overall than their print counterparts.[142] In terms of fueling overall sales, *SmartMoney* reported that Amazon customers who don't own a Kindle spend an average of $87 each month while those with a Kindle spend $136 and Kindle Fire owners spend over $150.[143]

Amazon for Your TV

The e-book and tablet Kindles were followed by Fire TV. The firm offers a range of devices, from the often-discounted USB-sized $39 Fire TV stick that plugs directly into your TV's HDMI port, to a $69 version that supports 4k Ultra HD video. Fire TV also runs apps for a host of other services, including Netflix and Hulu. Voice search is enabled through a mic in the remote. An optional game controller opens up another world of entertainment. While Fire OS is based on Android, it's what is referred to as a modified Android "**fork**," with differences significant enough that fire runs only a subset of Android apps. During its launch, Fire TV only had 180 apps in total, while the competing Roku device, which had been on the market for years, was offering over 1,200 apps.[144] The savvy manager should consider what forking means when trying to create network effects from complementary apps.

fork

In software development (sometimes also called project fork). When developers start with a copy of a project's program source code, but modify it, creating a distinct and separate product from the original base.

The market for television streaming media players is crowded. Apple TV, Android TV, Google Chromecast, and Roku all have a head start, yet none of these has achieved any real scale. Fast/

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cheap computing means these devices are usually much less expensive than a phone or tablet, and nearly 70 million US households now have some sort of connected TV streaming media device.[145] That number will only climb. In a surprise partnership with its retail nemesis, Best Buy has partnered with Amazon to create and sell a Fire TV-branded version of its own Insignia house-brand televisions, and Fire TV will also be a platform that powers Toshiba products.[146]

Echo, Alexa, and the Breakout Success of Amazon's Voice Interface and AI-powered Assistant

While Fire TV lets you talk to your remote to search for video entertainment, Amazon Echo is the wireless speaker that you can talk to. The branding here is a little clunky—Echo is the brand name for voice-powered devices, while Alexa is the name of Amazon's voice assistant software platform. The original Echo was a high-quality speaker equipped with seven far-field-listening microphones that taps into Amazon's cloud. Call it by the name "Amazon" or "Alexa" and you can ask it questions ("How many teaspoons in a tablespoon?"); set a timer; inquire about the weather, traffic, or sports; ask it to tell you jokes; summon up a news briefing; dispatch it to play songs on Amazon Prime Music, TuneIn, or other services ("Play 80s music"); control *smart home* devices like the Belkin Wemo and Philips Hue lighting ("Turn off the living room lamp")[147]; read back your Google calendar appointments[148]; create reminders; and of course, create shopping lists and place shopping orders.[149] Voice recognition can be tricky (early versions would mistakenly think they were summoned with the name "Amazon" when you asked the kids to get their "pajamas on"), but with most of its brains in the cloud, Echo will only gets smarter over time and consumers will instantly see improvements the next time they talk to their devices.

Amazon has continued to expand the Echo line and had tens of thousands of "skills"' (the firm's term for apps) available, positioning the firm with a category-defining lead ahead of Google and Apple. Alexa-enabled products from Amazon include the low-end Echo Dot and Echo Dot Kids Edition; the camera-equipped, fashion-advice-dispensing Echo Look closet companion; the voice-call-capable Echo Dot, and the Echo Show with a touch-screen and video conferencing capabilities (for a look at the entire family of Echo devices, visit http://amazon.com/echo). Alexa has wheels, too, with Alexa skills extending to Toyota, Mercedes, BMW, Ford, Hyundai, and many others ("Alexa, start my car and turn on the air conditioner"). Visitors to my office will find an Alexa-powered robot that can answer student questions (e.g., "when are Professor Gallaugher's office hours?"), can perform certain tasks when it recognizes a particular face, and provides a form of telepresence, broadcasting my voice when I connect removely via an app and showing video and audio of anyone in its field of view. And Alexa for Business extends the Alexa platform for enterprise use, including running private, custom skills; acting as a corporate help desk; handling room scheduling; offering support for multiple users and device administration, and powering otherwise challenging tasks such as "set up a conference call." And remember, since these devices are powered by machine learning, the firm with more customers should have more data for accelerated improvement and skill refinement—potentially beefing up the appeal of the firm's AWS cloud offerings, as well.[150]

Ordering At Your Fingertips: Courtesy of the Internet of Things

Amazon is working to put inexpensive, specialty tech into the hands of its customers to make ordering even easier, and thanks to the fast/cheap power of Moore's Law, these unconventional

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computing devices are cheap enough to give away (or credit any modest purchase price to your first order). The firm's Amazon Dash Wand scanner helps Amazon Fresh customers build grocery lists and integrates with Alexa smarts to answer questions; see the video clip in this section showing the Dash Wand as a kitchen recipe helper. Not convenient enough for you? The Amazon Dash Button can be scattered about your home, allowing automatic ordering of high volume staples—things like Keurig cups, Kraft Macaroni and Cheese, Gillette razors, and Huggies diapers, via a single, branded, Wi-Fi-enabled press (see http://amazon.com/dashbutton for more info). You can even order an AWS Dash Button that savvy programmers can configure to do anything you can think of from Amazon Web Services.

The Amazon Dash Wand

The 2nd generation Amazon Dash Wand integrates Alexa smarts into a hand-held device, and lets Amazon Fresh customers build simple grocery lists for hundreds of thousands of items simply by speaking into the device or using the barcode scanner.



View the video online at: http://www.youtube.com/embed/s7lExS483wE?rel=0

The Failure of Fire Phone: Lessons for Late Movers

Amazon followed Fire TV with Fire Phone, a high-end smartphone that came with several innovative features: one-handed operation, 3D perspectives that shifted when the phone was tilted, and most notably, a signature feature called Firefly. Firefly software used the phone's camera to recognize all sorts of objects: bar codes, QR codes, books, artwork, and grocery items. It could also recognize songs and movies, Shazam style, and dial scanned phone numbers. A dedicated Firefly button on the phone brought up the feature even if you were outside the lock screen, trigger-ready for the quickest of draws to make an impulse buy or visual search. Why create a shopping list? Out of a household item? Just scan, hit 1-Click order, and you're done. [151]

Neat features, but no one bought it. The initial price of $199 with contract for the base phone placed it in line with Apple and Samsung's smartphone pricing, not the value-pricing Amazon customers have enjoyed on profitless Kindle hardware. The phone came bundled with a year of Prime, which equates to another $100 in value, but many of the customers Amazon hoped to appeal to were already wedded to iOS or Android, and getting them to break up means overcoming switching costs. In less than one year the price was cut to $99, or $189 out of contract. A little over a year after launch, the Fire Phone was canceled,[152] with Amazon declaring a $170 million write-off.[153] Like Fire TV, the Fire Phone's OS was an Android fork that didn't run the vast majority of Android apps—that means Fire Phone was fighting against switching costs with a malnourished network effect—it's snazzy new features alone weren't enough to gain any sort of market traction. A *New York Times* piece reminds us that "phones are a graveyard of tech dreams." Google struggled with the Nexus and sold off Motorola. Microsoft has been at it for years and has never gotten phones right. BlackBerry is withering. Apple and Samsung are the only players making money in hardware.[154]

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Amazon Gets into Content Publishing

As device and storefront, Amazon has begun to vertically integrate, capturing several segments in the traditional book value chain. The printed book, or "dead-tree," publication value chain involved a publisher, bookstore, agent, and author. Publishers typically get half of a physical book's retail price, the bookstore takes about 30 percent, and the author keeps about 15 percent as a royalty[155] but shares 15 to 20 percent of this with his or her agent. At the time of the Kindle's rise, six (then consolidated to five) large publishers controlled about 60 percent of the US book business commonly referred to as "trade publishing" (that means most of the books you'd find in a typical bookstore but not books such as educational, scientific, and medical texts).[156] While most Kindle titles are from publishers that sell both print and digital versions, Amazon has gotten into the book publishing business as well, creating several of its own "imprints" (publishing divisions that specialize in a genre, like foreign translations, romance, or sci-fi). For authors wanting to bring books to market through Amazon instead of through traditional publishers, Amazon offers royalty options ranging from 35 to 70 percent. There's even a "Kindle Singles" program that allows authors to sell work too short for a stand-alone book (fiction, essays, magazine articles).[157] And since digitally published work doesn't require printing, shipping, and shelf-stocking, these titles can often come to market far faster than physical offerings. Using Amazon as a publisher doesn't mean your titles will only be available through Kindle.[158] The firm will also produce print books and even offer them to bookstores willing to carry the titles. But Amazon has incentivized many authors to sell exclusively through the world's biggest e-commerce outlet and largest e-book platform. By March 2012, Bezos was proclaiming that sixteen of the firm's top one hundred best-selling titles were "exclusive to [their] store."[159] While some studies have shown e-book sales to be slowing down or even retreating slightly, independent authors (those working outside the traditional publishing system) are on the rise, with Amazon taking credit for fueling the demand through Kindle-powered products and services that shift power to authors. Jeff Bezos claims that over 1,000 authors surpassed over $100,000 royalties in 2017 through Kindle Direct Publishing.[160]

And Amazon's digital publishing ambitions aren't limited to the printed word. The firm's Amazon Game Studios has released titles for Kindle Fire as well as Android, iOS, and Facebook.[161] Amazon has also recruited top-tier talent to beef up its game platform for Fire devices. Many of the firm's staff have pedigrees from Microsoft's Xbox group and Nintendo USA, both located a short drive from Amazon HQ. The firm has also recruited industry stars Kim Swift (designer of the game *Portal*), Clint Hocking (designer of *Far Cry 2*), and Ian Vogel (senior designer on *Age of Empires Online* and *BioShock*).[162]

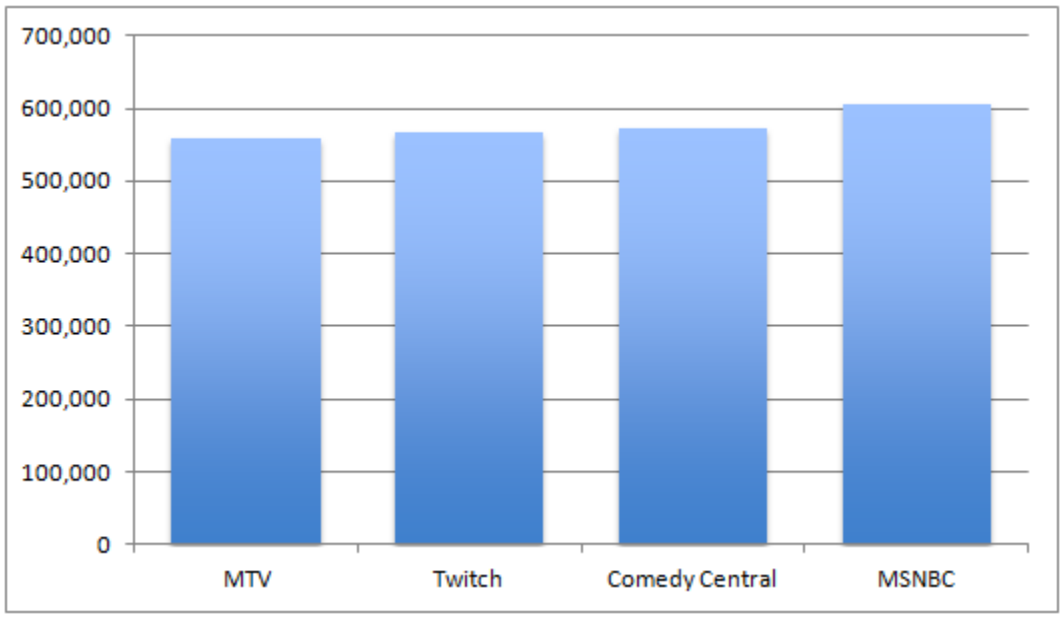
Amazon has also spent lavishly to build up digital media offerings, especially for Prime customers. Amazon spent $300 million for exclusive streaming access for a subset of HBO back titles,[163] and has locked up content from Nickelodeon and others. The firm offers a Spotify-like music streaming services for Prime subscribers, as well. None of this comes cheap. Reed Hastings of Netflix claims Amazon may be losing as much as $1 billion a year in video licensing.[164] Amazon is also pulling a Netflix, moving aggressively into original programming. Amazon Studios is touted by Bezos as a "completely new way of making movies" and television shows.[165] The firm has floated several feature film ideas and television pilots ranging from children's programming to adult comedies. Amazon Studios uses crowd feedback to drive what makes it to market.[166] Amazon has lagged Netflix, with its buzzy titles like *Stranger Things*, *Orange is the New Black*, and *Luke Cage*. But it had some success with series *Transparent* and *Mozart in the Jungle*, which both won Golden Globe Awards (although *Transparent* lost its star to a scandal, while *Mozart* was canceled), and the alternate-history sci-fi *Man in the High Castle*. Amazon has also extended an estimated $65 million a year deal with the NFL for streaming rights for Thursday Night Football (bundled with Prime, free on Twitch).[167] Amazon has also attracted well-known directors Woody Allen and Spike Lee for projects, and Amazon Studios has developed several motion pictures which have enjoyed critical success, including Oscar nominee *The Big Sick*, and Oscar winners *Moonlight* and *Manchester by the Sea*.

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Amazon is also spending big for non-conventional broadcast entertainment, buying the Twitch video game streaming site for roughly $1 billion. Twitch allows gamers to stream their gameplay live, and offer real-time commentary to viewers. Is watching other people play video games really a big business? You bet! The service boasted 55 million unique viewers before its third birthday, with 1.1 million broadcasters bringing in 16 billion minutes of total videos watched in a single month.[168] In terms of Internet traffic, only Netflix, Google, and Apple are bigger bandwidth hogs than Twitch.[169] The service has nearly as many viewers as the established cable networks MTV, Comedy Central, and MSNBC. Twitch shares ad revenue with broadcasting gamers, and while few are big earners, some Twitch stars have been known to pull in six figures a year.[170] The 32 million people who tuned in to watch the "League of Legends" championships comprised an audience bigger than the finales of *Breaking Bad*, *24*, and *The Sopranos* combined![171]

FIGURE 7.8 Viewership Comparison
At the time of its acquisition by Amazon, Twitch boasted a viewership comparable to several established cable networks.



Source: Data from N. Wingfield, "What's Twitch? Gamers Know, and Amazon Is Spending $1 Billion on It," The New York Times, August 25, 2014, https://www.nytimes.com/2014/08/26/technology/amazon-nears-a-deal-for-twitch.html?partner=rss&emc=rss&smid=tw-nytimes.

Channel Conflict and Consolidated Power

Amazon's ambitions to be a publisher that also sell e-readers, content, and just about everything else puts it at odds with partners who also increasingly see Amazon as a rival. **Channel conflict** exists when a firm's potential partners see that firm as a threat. This threat could come because it offers competing products or services via alternative channels or because the firm works closely with especially threatening competitors. Amazon has become a victim of channel conflict when other retailers have dropped its offerings. For example, Barnes & Noble and other book retailers have refused to carry titles from Amazon's publishing arm.[172] And Walmart and Target once carried the Kindle but have since stopped, fearing Amazon's e-reader would also be a conduit for stealing physical sales.[173] Authors and firms partnering with Amazon can also suffer channel conflict. When Amazon announced a partnership with DC Comics involving exclusive digital rights to Superman and Batman comics, Barnes & Noble and other book retailers pulled DC titles from their shelves.[174] The winner in channel conflict is the firm or group that offers greater value to conflicted partners.[175] As Amazon's scale grows to a seemingly insurmountable size and offers additional deal

channel conflict
Exists when a firm's potential partners see that firm as a threat. This threat could come because it offers competing products or services via alternative channels or because the firm works closely with especially threatening competitors.

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sweeteners like better author royalty rates, authors and providers of other goods may not care that working with Amazon will cut off other distribution channels. Those fearing that Amazon is achieving this kind of scale worry that the firm may gain near-monopoly market power.[176]

Amazon's power in the publishing industry again became an issue when the firm faced off with one of the big five book publishers, Hachette, over e-book terms. As a pressure tactic against Hachette, Amazon refused to allow customers to preorder Hachette books, it delayed sales (stating books that should ship in two days would usually ship in "one to two months"), and refused to offer some Hachette e-books.[177] Several big-name authors were impacted, including Harry Potter scribe J.K. Rowling. Comedian Stephen Colbert, whose books are also published by Hachette, skewered Amazon on his TV show, encouraging book patrons to shop at other websites. Amazon had enjoyed advocacy among some authors for helping spur sales and deliver greater author royalties, but the dispute eroded goodwill. Even worse, it called into question the firm's commitment to the customer.[178] The dispute was eventually settled with Hachette continuing to set its own prices for e-books, but gaining additional incentives (presumably in terms of the percentage of revenue it can keep) if it sets lower prices.[179] While Amazon's stated intentions were to lobby for lower e-book prices and hence, benefit the consumer, the short-term negative impact on customers (and authors) continues to raise concerns about power concentration. With Amazon controlling 41 percent of US new book sales and 61 percent of online sales,[180] the firm will need to tread carefully to avoid government inquiry and possible sanctions.

A lawsuit involving Apple and Amazon shows the uncertain terrain when a firm with feared dominance (Amazon) comes up against an oligopoly of suppliers seeking to balance the market by favoring a rival (Apple). Amazon's initial pricing agreement with many e-book publishers was what is often referred to as *wholesale pricing*, where Amazon paid publishers for titles and then sold those books at whatever price it wished. Jeff Bezos has stated that traditional trade books should not be priced at more than ten dollars,[181] and Amazon offered many digital titles near or even below the wholesale price in order to fuel the market for Kindle and cement its own dominant standard. When Apple introduced the iPad, five of the top publishers switched from wholesale pricing to *agency pricing*, where the publisher sets the price and the reseller gets a cut (usually around 30 percent). Agency pricing isn't illegal, but rivals colluding to set prices is. A lawsuit contends that publishers collectively introduced agency pricing to the iOS bookstore and shut out Amazon unless Bezos's firm agreed to switch to agency pricing, too.[182] Apple and the publishers have since settled the case, and Amazon has regained the ability to offer wholesale pricing, but the case shows challenging issues that arise as network effects, switching costs, scale, and standards in the digital world create radical power shifts. And even as publishers allow Amazon to resume wholesale pricing, Apple still has weapons to wield on its own devices. Apple legally charges app developers 30 percent for all revenue earned through in-app purchases, a fee that would further crater Amazon's thin-to-nonexistent margins on many e-books. As a result, Amazon dropped the "purchase" button from iOS Kindle apps. (You can still buy e-books to read in your iOS Kindle app, but you've got to exit the app and do so from the Web, a Kindle, or some other standard that Apple doesn't control).

Key Takeaways

- About one-quarter of Amazon revenues come from the sale of media businesses that are rapidly shifting from atoms to bits.
- Moore's Law has allowed Amazon to radically drop the price of Kindle offerings while increasing device functionality.
- Amazon does not make money by selling Kindle hardware; instead, it seeks to fuel media and e-commerce sales as well as side businesses such as on-Kindle and in-app advertising.
- It is estimated that 20 percent of Amazon's US customers own at least one Kindle device. The dominance of the platform potentially creates several advantages, including network effects (more Kindle users attract more Kindle-compatible titles and products), switching costs, and user data.

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- The firm's Kindle Fire, Fire TV, and Echo are additional platforms for delivering digital content, sales, and data gathering. These platforms face significant challenges in growing market share, and none has seen the success of the firm's e-book readers.
- Fire tablets and Fire TV have prompted Amazon to accelerate gaming efforts.
- Fire Phone provides a cautionary tale to late-movers. A high price, entrenched rivals, consumer switching costs, and a lack of compatible apps all contributed to the device's failure.
- Amazon has upended the publishing value chain and significantly changed the cost structure of the industry.
- Amazon has also become a force in sponsoring original film and video series and creating video games, and has spent over $1 billion in the acquisition of the extremely popular Twitch video game broadcasting service.
- Amazon and partners have also been victims of channel conflict, stopping the sale of Kindles and blocking the sale of books published through Amazon imprints. But when channel conflict occurs, the winner will likely be the channel that offers the greatest aggregate value to its partners.
- Amazon's dominance of publishing, 41 percent of new US book sales and 61 percent of online sales, suggests inordinate market influence. The firm will need to be careful how aggressively it uses its bargaining power, as this could prompt domestic and international regulation and sanctions.

Questions and Exercises

1. Roughly how big is Amazon's existing "media" business? What is happening to much of the physical media business?
2. Both Amazon and Apple would like you to store books, music, and other media in their "cloud." What critical key strategic advantage comes to a firm when consumers adopt one firm's cloud versus the other?
3. Amazon prices Kindle hardware at or below cost. Conduct research to find out Apple's margins on iPad hardware. How does Amazon make money from the Kindle? Which firm do you think will win the battle for tablet computing? Is it the same firm you think will win the battle for e-readers? Do you think there should be one winner? Why or why not?
4. Why is e-ink useful in an e-reader?
5. What operating system do Fire devices use? How does this impact the firm's network effects from complementary products?
6. Investigate the Amazon Echo online. Would you buy the product? Why or why not? Why will the Echo get "smarter" and offer more features over time?
7. Why do you suppose Amazon's Fire Phone struggled in its first iteration? Do you think Amazon could ever be successful in phones? Why not, or what will it take to be successful? What, beyond phone hardware, could Amazon do to leverage smartphone platforms?
8. How successful have Kindle e-book readers been? How about Fire tablet, Fire TV, and Echo? What barriers does the firm face in competing? What advantages does Amazon have?
9. How has Kindle pricing changed over time? Would you expect similar changes with Amazon's other consumer electronics products? Why or why not?
10. How does the traditional publishing value chain differ from the Kindle value chain when Amazon is an author's publisher? List the rough percentages of revenue taken by each element in the value chain.
11. What advantages does the Echo platform offer for Amazon? Would you (or do you) use an Echo? Why or why not?
12. If you were an author, would you use Amazon as a publisher or not? What factors would influence this decision? What do you think will happen regarding trends and these factors over time?
13. How is Amazon acting as a hothouse for content creation beyond books? What other categories of media products is Amazon involved in developing? Investigate these—has Amazon

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done well, or have these products been flops? Does your research suggest why the firm has had success or struggled in various categories?

14. What is channel conflict, and how has Amazon been subject to channel conflict?
15. Is Amazon good or bad for the book business? Explain your answer.
16. What is Twitch? Why did Amazon buy it? Why is it a compelling service for the firm?
17. Why do you suppose Amazon has begun publishing video games? Producing more original video content?
18. Consider the e-book publishing case between Amazon and Apple, as well as the spat between Amazon and Hachette. Research the current state of these disputes and any court rulings. Is Amazon a monopoly? Does Amazon have too much power, and do you think it should be regulated? Is Amazon's pricing "predatory" in a way that unfairly disadvantages would-be competitors? Should Amazon be allowed to continue agency pricing without limitations? Do you think publishers were wrong to work with Apple? What is the current status of this case? (Note: similar cases in the United States and Europe may be at differing stages or have differing outcomes.) Are Amazon's actions with respect to Hachette fair? Do you believe they help or hurt consumers? How might this impact Amazon's brand? The firm's relationship with authors? Come to class prepared to discuss your opinions and findings.

7.6 Amazon and the Cloud: From Personal Storage to AWS

Learning Objectives

1. Identify several of Amazon's personal cloud offerings, how they are used, and the value they provide both users and Amazon.
2. Understand Amazon's cloud-computing offerings, the services provided, the firms that use AWS, the size of this business, and the firm's vision for its future growth.
3. Recognize why firms use cloud-computing platforms and some of the risks associated with giving up control of certain infrastructure.

thin devices

Thin or thin client computing devices have very little computing power in the device itself, and instead perform the bulk of computing and storage over the network, "in the cloud." Smart speakers and television streaming sticks are all examples of thin clients. The term is also used to describe applications that run in a browser, but where most of the computing happens remotely (e.g., SaaS tools like Salesforce).

Amazon's shift from selling media atoms to selling media bits has led to its expansion into consumer cloud-based offerings that store and serve up digital content over the Internet. It's already been pointed out that the Kindle can load a customer's "virtual bookshelf" and other content on demand, even if you delete purchases from your device. The same is true with Kindle Fire apps. Fire TV and Alexa services are also **thin devices**, with very little computing in the devices themselves, and the bulk of computing (apps, recommendation software, media storage) happening at a remote location, over the Internet. Amazon Cloud Drive offers file storage similar to Dropbox and Google Drive. Amazon Prime users get free, unlimited photo storage in the Amazon cloud. And Amazon Music is a Spotify-style DJ in the cloud. But Amazon's biggest cloud push comes in offering access to corporate-quality computing as a service.

AWS, or Amazon Web Services, allows firms, and really anyone with a credit card, to rent industrial-strength computing capacity on an as-needed basis. The best-known offerings are Amazon's EC2 (Elastic Computing Cloud), which provides the virtual equivalent of physical computing hardware; and S3 (Simple Storage Service), providing Web-based storage. But AWS provides dozens of service offerings, including various operating systems, database products, enterprise software, programming environments, networking services, security, artificial intelligence and machine learning tools, and more. Amazon WorkSpaces provides access to fully functional, remotely served, virtual

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Windows PCs through the cloud—offered up in a desktop browser window, or even on an iPad or Kindle Fire—for prices starting at just $25 a month. These kinds of products are great choices for clients that want securely locked down PCs—think call centers and law enforcement. They're also an alternative to a student who may have a Chromebook, but needs access to a Windows PC for a particular class or project. Amazon AppStream is a cloud offering for game developers wanting to use Amazon's massive processing power for rendering complex images and gaming environments, squirting the results down to devices that would not otherwise be able to quickly create complex graphics on their own (think smartphones and tablets).[183] When it comes to AWS cloud offerings, it seems the sky's the limit.

For years, big server firms like IBM, HP, and Sun worked at creating a market for so-called utility computing—a rent-not-buy model where consumers paid for technology as needed, similar to how one pays for water or electricity. But in true disruptive form, it wasn't enterprise-class hardware firms but rather a company originally launched as an online bookstore that managed to get real traction in this market. Today AWS powers thousands of businesses, including Etsy, Airbnb, Pinterest, Yelp, and Zynga. It's Amazon's services that allowed thirteen guys to scale Instagram to tens of millions of users and a billion-dollar acquisition price in just fifteen months. And firms that might consider Amazon as a rival, including Netflix and Dropbox, rely on AWS as well. What's notable is that many of these firms aren't just big firms; they're the *largest* firms in their categories.[184] NASA, Eli Lilly, the New York Times Corporation, and ESPN have all used AWS for key tasks, too. Advantages of using the cloud are outlined in Chapter 14; they include allowing organizations to rent server capacity as needed—scaling up during high demand periods or intensive but short-term projects without having to over-invest in hardware, software, and personnel. And Amazon's deep experience in scalability, security, machine learning, and fault tolerance are usually far better than a smaller firm could develop on its own. AWS isn't fool proof. Well-known outages have temporarily taken down or dramatically slowed several sites that have used the service, but most don't feel they could do a better job at a better price, even if this means relying on another firm to provide vital resources. Target provides a cautionary tale: The discount retailer had been relying on Amazon to power its website but left in an effort to create its own infrastructure. Three weeks later, an unexpectedly popular Target promotion crashed the firm's website.[185]

AWS was introduced in 2006, although some offerings were available as early as 2002. Google's competing AppEngine wasn't offered until 2008, and Microsoft's Windows Azure cloud platform came out in 2010, although Bezos is found of referring to AWS as really having a "seven-year lead head start" before facing serious, "like minded" competition.[186] There are advantages to moving early as a platform provider. An early lead with a market-serving product creates a big share, customer lock-in, internal learning, and a network effect derived from complementary offerings ranging from the employment base provided by a growing number of AWS-skilled developers to a rich assortment of software capable of using the platform. Even server providers like Rackspace and HP are playing catch-up with Amazon.[187] They've got a long way to go. Research firm Gartner estimates that "AWS offers five times the utilized compute capacity of the next fourteen cloud providers combined!"[188]

> *"I have never seen any person develop two really important industries at the same time and really be the operational guy in both… You do not want to give Jeff Bezos a 7-year head start."*[189]
>
> *—Investment legend Warren Buffet, praising Amazon's founder and CEO, referring to Amazon's dominance in providing industrial-grade cloud computing services over the Internet. By all measures, AWS dwarfs rivals, and the division is responsible for the majority of Amazon's profits.*

While e-commerce brings in the most in terms of sales revenue, AWS is now responsible for the majority of the firm's profits. AWS brought in $17.5 billion in 2017,[190] so much so that if it were

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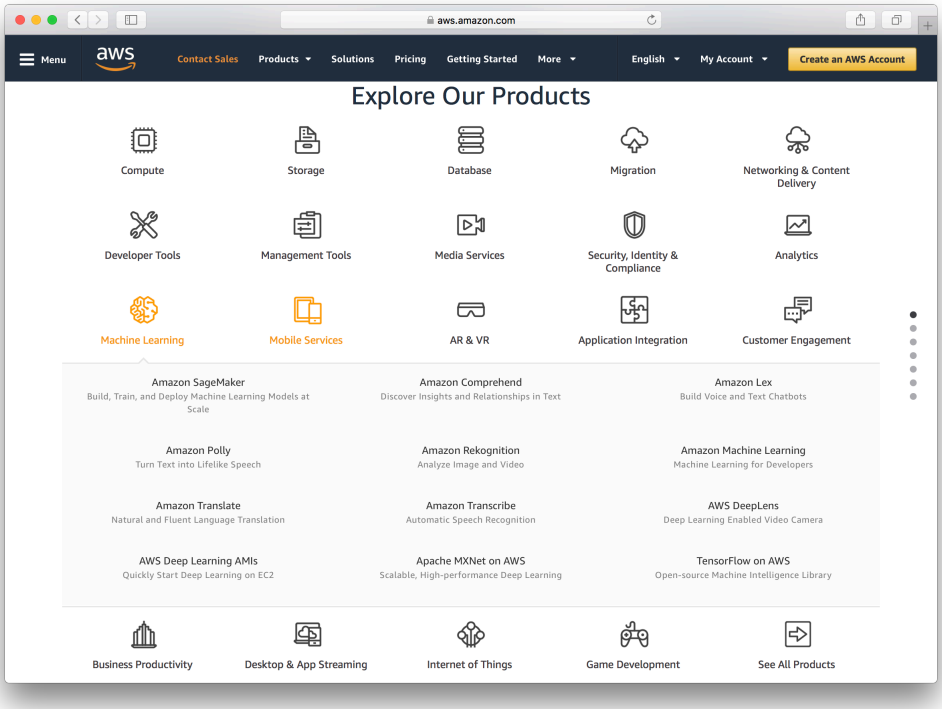
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a separate business, it would be ranked 167 on the *Fortune* 500 list. In fact, it is so big that regulations required Amazon to treat it as a top-level division, with the firm reporting results as "US and Canada," "International," and "AWS."[191] Noting the growth, Amazon has appointed two additional division CEOs under Bezos—one to run the cloud business, the other to handle retail and consumer businesses.

As for the competition, research firm Gartner has estimated that, for two years in a row, AWS "ran more than ten times the computing capacity as the next 14 cloud providers combined."[192] Another report has estimated that Amazon's cloud business earns over seventy times the revenue of Google's corporate cloud.[193] Why did Amazon decide to get into this business in the first place? Some have suggested that AWS came out of Amazon's desire to make money from the firm's excess computing capacity, but the firm's CTO has debunked that as a myth and a misconception. The real goal of AWS was to monetize the firm's *expertise* in scalability and reliability and turn this into a revenue-generating business. The benefits of having an entire skilled division of technicians creating reliable, standard platforms that Amazon can then use itself (instead of buying these services from others) is also seen as a key benefit.[194] Building this capacity doesn't come cheap. From 2005 through 2013, Amazon spent $12 billion building out the AWS infrastructure.[195] But long term, Bezos sees the future unfolding, and he wants to rake in billions more, not only by selling you just about everything you need, but also by powering any organization that is willing to farm out computing to the cloud.

FIGURE 7.9 Amazon's AWS Web Page

A visit to Amazon's AWS site will show the growing breadth of the firm's cloud offerings. The "Machine Learning" section has been expanded, and lists products for understanding natural language, translation, image recognition for photos and video, machine learning training tools, and more.



Source: Amazon's AWS Web page; https://aws.amazon.com/.

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Key Takeaways

- Amazon offers personal cloud storage options for all forms of media, including books, games, music, and video. It even offers file storage akin to Dropbox and Google Drive. These personal cloud offerings allow users to access files from any app, browser, or device with appropriate access.
- Amazon Web Services (AWS) allows anyone with a credit card to access industrial-strength, scalable computing resources. Services include computing capability, storage, and many operating systems, software development platforms, and enterprise-class applications.
- Firms using cloud providers lose control of certain aspects of their infrastructure, and an error or crash caused by the cloud provider could shut off or scale back vital service availability. Amazon and other vendors have experienced outages that have negatively impacted clients. Despite these challenges, most firms believe they lack resources and scale to do a higher-quality or more cost-effective job than specialized cloud providers.
- AWS and competing cloud services offer several advantages, including increased scalability, reliability, security, lower labor costs, lower hardware costs, and the ability to shift computing from large, fixed-cost investments to those with variable costs. Since Amazon also uses products developed by AWS, the firm's e-commerce and Kindle operations also benefit from the effort.
- AWS provides the majority of Amazon's corporate profit and is significantly ahead of rivals in terms of market share and available infrastructure.

Questions and Exercises

1. What other personal cloud products exist for vendors beyond Amazon?
2. Do you use personal cloud services? Do you use Amazon products, or products provided by rivals? Why have you made these choices regarding cloud platforms?
3. What is AWS, and what services are provided? Investigate online and report back on the costs associated with key services such as EC2 and S3.
4. Consider Amazon WorkSpaces: Why would a firm want a virtual version of Windows served in a browser? How might AWS AppStream help the firm's Fire efforts?
5. Which firms use AWS? What do they gain by using a cloud provider, and what do they give up? How might Amazon or other cloud firms reduce concerns potential and existing clients might have?
6. If there are alternatives available, why would firms that compete with Amazon in some businesses use Amazon anyway?
7. Are network effects at work in cloud platforms? How so? What kinds of complementary products might make AWS seem more attractive than a new cloud computing effort?
8. How big is this business relative to Amazon's other divisions? How big does Amazon think it can get?
9. Why did Amazon decide to get into cloud computing? This business is radically different from shipping books and other physical products. Do you think Amazon should continue to keep AWS as part of Amazon, or should it spin the firm out as a separate company? What would be the advantages to either approach? Search online to see if you can find opinions that analysts or journalists may have regarding AWS's growth prospects in Amazon or as a separate firm, and be prepared to report your findings back to class.

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CHAPTER 8

Platforms, Network Effects, and Competing in a Winner-Take-All World

8.1 Introduction

Learning Objectives

1. Define network effects.
2. Recognize products and services that are subject to network effects.
3. Understand the factors that add value to products and services that are subject to network effects.

Network effects are sometimes referred to as "Metcalfe's Law" or "network externalities." But don't let the dull names fool you—this concept is rocket fuel for technology firms. Bill Gates leveraged network effects to turn Windows and Office into virtual monopolies and, in the process, became the wealthiest man in America. Mark Zuckerberg of Facebook; Sergey Brin and Larry Page of Google; Pierre Omidyar of eBay; Kevin Systrom of Instagram; Jack Dorsey, Evan Williams and Biz Stone of Twitter; Nik Zennström and Janus Friis of Skype; Steve Chen and Chad Hurley of YouTube; Jan Koum and Brian Acton of WhatsApp; Jeff Bezos's Kindle; Travis Kalanick of Uber; and the Airbnb triumvirate of Brian Chesky, Joe Gebbia, and Nathan Blecharczyk—all these entrepreneurs have built massive user bases by leveraging the concept. And while US firms dominate in creating gargantuan firms fueled by network effects, the phenomenon isn't limited to the United States. China's Alibaba, Tencent (with WeChat, QQ, and Qzone), and Didi are all firms that have built multibillion dollar firms leveraging the concept. When network effects are present, *the value of a product or service increases as the number of users grows*. Simply, more users = more value. Of course, most products aren't subject to network effects; you probably don't care if someone wears the same socks, uses the same pancake syrup, or buys the same trash bags as you. But when network effects are present, they're among *the most important* reasons you'll pick one product or service over another. You may care very much, for example, if others are part of your social network, if your video game console is popular, if the VR (virtual reality) platform you're considering is likely to be a market leader, and if the Wikipedia article you're referencing has had previous readers. And all those folks who bought HD DVD players sure were bummed when the rest of the world declared Blu-ray the winner. In each of these examples, network effects are at work.

network effects

Also known as Metcalfe's Law, or network externalities. When the value of a product or service increases as its number of users expands.

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platforms

Products and services that allow for the development and integration of software products and other complementary goods, effectively creating an ecosystem of value-added offerings. Windows, iOS, the Kindle, and the standards that allow users to create Facebook apps are all platforms.

Building a network of users is powerful, building a network of firms that enhance the network's value, even more so, and that's the promise of platforms. **Platforms** create an ecosystem, rather than a singular product or service offering. Think of the number of products and services available for iOS (Apps, hardware, cars, gym equipment, medical records). Still need convincing? As of this writing, ten of the world's most valuable firms by market capitalization not only benefit from network effects, they are platform firms (Apple, Alphabet, Microsoft, Amazon, Tencent, Alibaba, and Facebook).[1]

Not That Kind of Network

The term "network" sometimes stumps people when first learning about network effects. In this context, a network doesn't refer to the physical wires or wireless systems that connect pieces of electronics. It just refers to a common user base that is able to communicate and share with one another. So Facebook users make up a network. So do owners of Blu-ray players, traders who buy and sell stock over the NASDAQ, or the sum total of hardware and outlets that support the BS 1363 electrical standard.

Key Takeaway

- Network effects are among the most powerful strategic resources that can be created by technology-based innovation. Many category-dominating organizations and technologies, including Microsoft, Apple, NASDAQ, eBay, Facebook, and Visa, owe their success to network effects. Network effects are also behind the establishment of most standards, including Blu-ray, Wi-Fi, and Bluetooth.

Questions and Exercises

1. What are network effects? What are the other names for this concept?
2. List several products or services subject to network effects. What factors do you believe helped each of these efforts achieve dominance?
3. Which firm do you suspect has stronger end-user network effects: Google's online search tool or Microsoft's Windows operating system? Why?
4. Network effects are often associated with technology, but tech isn't a prerequisite for the existence of network effects. Name a product, service, or phenomenon that is not related to information technology that still dominates due to network effects.

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8.2 Platforms Are Powerful, But Where Does All That Value Come From?

Learning Objectives

1. Identify the three primary sources of value for network effects.
2. Recognize factors that contribute to the staying power and complementary benefits of a product or service subject to network effects.
3. Understand how firms like Microsoft and Apple each benefit from strong network effects.

The value derived from network effects comes from three sources: exchange, staying power, and complementary benefits.

Exchange

Facebook for one person isn't much fun, and the first guy in the world with a fax machine didn't have much more than a paperweight. But as each new Facebook friend or fax user comes online, a network becomes more valuable because its users can potentially communicate with more people. These examples show the importance of *exchange* in creating value. Every product or service subject to network effects fosters some kind of exchange. For firms leveraging technology, this might include anything you can represent in the ones and zeros of digital storage, such as messaging, movies, music, money, video games, and computer programs. And just about any standard that allows things to plug into one another, interconnect, or otherwise communicate will live or die based on its ability to snare network effects.

Exercise: Graph It

Some people refer to network effects by the name Metcalfe's Law. It got this name when, toward the start of the dot-com boom, Bob Metcalfe (the inventor of the Ethernet networking standard) wrote a column in *InfoWorld* magazine stating that the value of a network equals its number of users squared. What do you think of this formula? Graph the law with the vertical axis labeled "value" and the horizontal axis labeled "users." Do you think the graph is an accurate representation of what's happening in network effects? If so, why? If not, what do you think the graph really looks like?

Staying Power

Users don't want to buy a product or sign up for a service that's likely to go away, and a number of factors can halt the availability of an effort: a firm could go bankrupt or fail to attract a critical mass of user support, or a rival may successfully invade its market and draw away current customers. Networks with greater numbers of users suggest a stronger **staying power**. The staying power, or

staying power

The long-term viability of a product or service.

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long-term viability, of a product or service is particularly important for consumers of technology products. Consider that when someone buys a personal computer and makes a choice of Windows, Mac OS, or Linux, their investment over time usually greatly exceeds the initial price paid for the operating system. A user invests in learning how to use a system, buying and installing software, entering preferences or other data, creating files—all of which means that if a product isn't supported anymore, much of this investment is lost.

switching costs

The cost a consumer incurs when moving from one product to another. It can involve actual money spent (e.g., buying a new product) as well as investments in time, any data loss, and so forth.

The concept of staying power (and the fear of being stranded in an unsupported product or service) is directly related to **switching costs** (the cost a consumer incurs when moving from one product to another), and switching costs can strengthen the value of network effects as a strategic asset. The higher the value of the user's overall investment, the more they're likely to consider the staying power of any offering before choosing to adopt it. Similarly, the more a user has invested in a product, the less likely he or she is to leave. Considering e-book readers? A user aware of Barnes & Noble's struggles might think twice about choosing the Nook over Amazon's thriving and dominant Kindle.

Switching costs also go by other names. You might hear the business press refer to products (particularly websites) as being "sticky" or creating "friction." Others may refer to the concept of "lock-in." And the elite Boston Consulting Group is really talking about a firm's switching costs when it refers to how well a company can create customers who are "barnacles" (that are tightly anchored to the firm) and not "butterflies" (that flutter away to rivals). The more friction available to prevent users from migrating to a rival, the greater the switching costs. And in a competitive market where rivals with new innovations show up all the time, that can be a very good thing!

total cost of ownership

An economic measure of the full cost of owning a product (typically computing hardware and/or software). TCO includes direct costs such as purchase price, plus indirect costs such as training, support, and maintenance.

How Important are Switching Costs to Microsoft?

*"It is this switching cost that has given our customers the patience to stick with Windows through all our mistakes, our buggy drivers, our high TCO [**total cost of ownership**], our lack of a sexy vision at times, and many other difficulties [...] Customers constantly evaluate other desktop platforms, [but] it would be so much work to move over that they hope we just improve Windows rather than force them to move. [...] In short, without this exclusive franchise [meaning Windows] we would have been dead a long time ago."*

—Comments from a Microsoft General Manager in a memo to Bill Gates[2]

Complementary Benefits

complementary benefits

Products or services that add additional value to the primary product or service that makes up a network.

Complementary benefits are those products or services that add additional value to the network. These products might include "how-to" books, software, and feature add-ons, even labor. You'll find more books about auctioning that focus on eBay, more cameras that upload video to YouTube, and more accountants who know Excel than other rival software. Why? Book authors, camera manufacturers, and accountants invest their time and resources where they're likely to reach the biggest market and get the greatest benefit. In auctions, video, and spreadsheet software, eBay, YouTube, and Excel each dwarf their respective competition.

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Products and services that encourage others to offer complementary goods are sometimes called **platforms**.[3] Many firms do this by providing **APIs** or application programming interfaces that allow third parties to integrate with their products and services. Allowing other firms to contribute to your platform can be a brilliant strategy because those firms will spend *their* time and money to enhance *your* offerings. Consider the billion-dollar hardware ecosystem that Apple has cultivated around iOS products. There are over ninety brands selling some 280 models of speaker systems.[4] Apple has begun to extend iOS into all sorts of products. CarPlay puts Siri on your steering wheel and allows auto manufacturers to integrate phone, maps, messaging, music, and other apps into automobile dashboards. Eighteen auto manufacturers, from Ford to Ferrari, committed to CarPlay at launch, and many more have been added since then. HealthKit allows Apple to use iOS as a platform for exercise and personal health measurement (products and services that measure fitness and health are sometimes referred to by the term "quantified self"). HomeKit and the Home app allow iOS to control home products including locks, lighting, security cameras, and thermostats. Today, every major maker of home accessories supports the HomeKit platform. Apple Message has also become a platform, allowing developers to build apps to share cash via a text or jointly order food with friends. Apple's CloudKit allows developers to plug into Apple's storage, hopefully creating greater bonds with iOS at the center instead of choosing rival storage platforms from Dropbox, Google, Microsoft, or others. AirPlay links Macs, iOS devices, and AppleTV. Apple Watch is designed as a tool that integrates and extends the iPhone. And Apple Pay and Siri make iOS platforms all the more valuable by allowing developers to integrate payments and voice into their apps. Each add-on enhances the value of choosing iOS over rival platforms. Software-based ecosystems can grow very quickly. Less than one year after its introduction, the iTunes App Store boasted over fifty thousand applications, collectively downloaded over one billion times. Today, well over two million iOS apps have been downloaded over 130 billion times, collectively.[5]

platforms

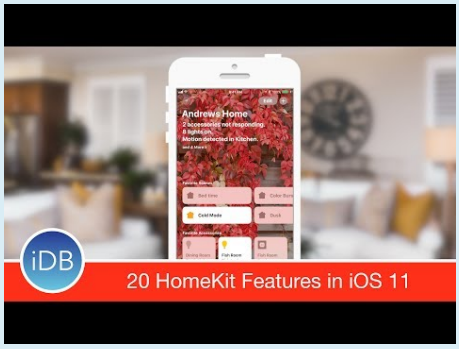
Products and services that allow for the development and integration of software products and other complementary goods, effectively creating an ecosystem of value-added offerings. Windows, iOS, the Kindle, and the standards that allow users to create Facebook apps are all platforms.

APIs

Programming hooks, or guidelines, published by firms that tell other programs how to get a service to perform a task such as send or receive data. For example, Amazon provides application programming interfaces (APIs) to let developers write their own applications and websites that can send the firm orders.

Overview of Apple's HomeKit

A video overview of Apple's HomeKit, including partner products and capabilities.



View the video online at: http://www.youtube.com/embed/JdazaciENGk?rel=0

These three value-adding sources—*exchange*, *staying power*, and *complementary benefits*—often work together to reinforce one another in a way that makes the network effect even stronger. When users *exchanging* information attract more users, they can also attract firms offering *complementary* products. When developers of complementary products invest time writing software—and users install, learn, and customize these products—switching costs are created that enhance the *staying power* of a given network. From a strategist's perspective this can be great news for dominant firms in markets where network effects exist. The larger your network, the more difficult it becomes for rivals to challenge your leadership position.[6]

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Key Takeaways

- Products and services subject to network effects get their value from exchange, perceived staying power, and complementary products and services. Tech firms and services that gain the lead in these categories often dominate all rivals.
- Many firms attempt to enhance their network effects by creating a platform for the development of third-party products and services that enhance the primary offering.

Questions and Exercises

1. What are the factors that contribute to the value created by network effects?
2. Why is staying power particularly important to many technology products and services?
3. Think about the kinds of technology products that you own that are subject to network effects. What sorts of exchange do these products leverage (e.g., information, money, software, or other media)?
4. Think about the kinds of technology projects you own. What sorts of switching costs are inherent in each of these? Are these strong switching costs or weak switching costs? What would it take for you to leave one of these services and use a rival? How might a competitor try to lessen these switching costs to persuade you to adopt their product?
5. Which other terms are sometimes used to describe the phenomenon of switching costs?
6. Think about the kinds of technology products that you own that are subject to network effects. What sorts of complementary benefits are available for these products? Are complementary benefits strong or weak (meaning, do people choose the product primarily based on these benefits, or for some other reason)?
7. Identify firms that you believe have built a strong platform. Can you think of firms that have tried to develop a platform, but have been less successful? Why do you suppose they have struggled?

8.3 One-Sided or Two-Sided Markets?

Learning Objectives

1. Recognize and distinguish between one-sided and two-sided markets.
2. Understand same-side and cross-side exchange benefits.

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Understanding Network Structure

To understand the key sources of network value, it's important to recognize the structure of the network. Some networks derive most of their value from a single class of users. An example of this kind of network is messaging. While you might have different messaging apps for different purposes (Snapchat for disposable posts, Instagram for photos), you pretty much choose a tool based on how many of your contacts you can reach. Economists would call messaging a **one-sided market** (a market that derives most of its value from a single class of users), and the network effects derived from users attracting more users as being **same-side exchange benefits** (benefits derived by interaction among members of a single class of participant).

But some markets comprise two distinct categories of network participants. Consider video games. People buy a video game console largely based on the number of really great games available for the system. Software developers write games based on their ability to reach the greatest number of paying customers, so they're most likely to write for the most popular consoles first. Economists would call this kind of network a **two-sided market** (network markets that comprise two distinct categories of participant, both of which are needed to deliver value for the network to work). When an increase in the number of users on one side of the market (console owners, for example) creates a rise in the other side (software developers), that's called a **cross-side exchange benefit**.

one-sided market

A market that derives most of its value from a single class of users (e.g., instant messaging).

same-side exchange benefits

Benefits derived by interaction among members of a single class of participant (e.g., the exchange value when increasing numbers of IM users gain the ability to message each other).

two-sided market

Network market that comprises two distinct categories of participant, both of which are needed to deliver value for the network to work (e.g., video game console owners and developers of video games).

cross-side exchange benefit

When an increase in the number of users on one side of the market (console owners, for example) creates a rise in the other side (software developers).

The Positive Feedback Loop of Network Effects: One-Sided, Two-Sided, and Sometimes a Bit of Both

Messaging is considered a one-sided market (or one-sided network), where the value-creating, positive-feedback loop of network effects comes mostly from same-side benefits from a single group (messaging members who attract other members who want to communicate with them). Mobile payment efforts like Square, Apple Pay, and Android Pay, however, are considered to be two-sided markets, where significant benefits come from two distinct classes of users that add value by attracting each other. In the case of mobile payments, the more people who use a given payment platform, the more attractive that platform will be to storefronts and other businesses, and if more businesses accept these forms of mobile payment, then this in turn should attract more end consumers (and so on). Jump-starting a two-sided network can be tricky. Google and Apple use their mobile operating systems to embed their payment apps in millions of hardware products. Google hopes that its presence on Android and its ad relationship with many retailers will help it jump-start Android Pay–accepting merchant adoption. iTunes and the App Store helped Apple have over 800 million credit cards on file at the launch of Apple Pay for iOS.[7] Firms need a strong incentive for users to download and set up payments. Starbucks built a wildly successful payments app by offering rewards for frequent customer purchases. However, Square's payment app struggled when customers saw little incentive to install an app when cash and credit worked fine and using the app offered no incentive over alternatives.

It's also possible that a network may have both same-side and cross-side benefits. Microsoft's Xbox benefits from cross-side benefits in that more users of that console attract more developers writing more software titles and vice versa. However, the Xbox Live network that allows users to play against each other has same-side benefits. If your buddies use Xbox Live and you want to play against them, you're more likely to buy an Xbox. Apple also created a two-sided game in messaging when it turned iOS messaging into a platform, allowing app developers to add all sorts of new capabilities, from custom emojis and animations to collaborative apps shared via what used to be simple text messaging.

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Key Takeaways

- In one-sided markets, users gain benefits from interacting with a similar category of users (think messaging apps, where everyone can send and receive messages to and from one another).
- In two-sided markets, users gain benefits from interacting with a separate, complementary class of users (e.g., in the mobile payment business, payment app–wielding consumers are attracted to a platform because there are more merchants offering convenient payment, while merchants are attracted to a payment system that others will actually use and that yields clear benefits over cash).

Questions and Exercises

1. What is the difference between same-side exchange benefits and cross-side exchange benefits?
2. What is the difference between a one-sided market and a two-sided market?
3. Give examples of one-sided and two-sided markets.
4. Identify examples of two-sided markets where both sides pay for a product or service. Identify examples where only one side pays. What factors determine who should pay? Does paying have implications for the establishment and growth of a network effect? What might a firm do to encourage early network growth?
5. The Apple iOS Developer Program provides developers access to the App Store, where they can distribute their free or commercial applications to millions of iPad, iPhone, and iPod touch customers. Would the iPhone market be considered a one- or two-sided market? Why?

8.4 How Are These Markets Different?

Learning Objectives

1. Understand how competition in markets where network effects are present differ from competition in traditional markets.
2. Understand the reasons why it is so difficult for late-moving, incompatible rivals to compete in markets where a dominant, proprietary standard is present.

When network effects play a starring role, competition in an industry can be fundamentally different than in conventional, non-network industries.

First, network markets experience *early, fierce competition*. The positive-feedback loop inherent in network effects—where the biggest networks become even bigger—causes this. Firms are very aggressive in the early stages of these industries because once a leader becomes clear, *bandwagons* form, and new adopters begin to overwhelmingly favor the leading product over rivals, tipping the market in favor of one dominant firm or standard. This tipping can be remarkably swift. Once the majority of major studios and retailers began to back Blu-ray over HD DVD, the latter effort folded within weeks.

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These markets are also often winner-take-all or winner-take-most, *exhibiting monopolistic tendencies* where one firm dominates all rivals. Look at all of the examples listed so far—in nearly every case the dominant player has a market share well ahead of all competitors. When, during the US Microsoft antitrust trial, Judge Thomas Penfield Jackson declared Microsoft to be a **monopoly** (a market where there are many buyers but only one dominant seller), the collective response should have been "of course." Why? The *natural state* of markets where strong network effects are present (and this includes operating systems and Office software) is for there to be one major player. Since bigger networks offer more value, they can charge customers more. Firms with a commanding network effects advantage may also enjoy substantial bargaining power over partners. For example, Apple, which controls over 75 percent of digital music sales, for years was able to dictate song pricing despite the tremendous protests of the record labels.[8] In fact, Apple's stranglehold was so strong that it leveraged bargaining power even though the "Big Four" record labels (Universal, Sony, EMI, and Warner) were themselves an **oligopoly** (a market dominated by a small number of powerful sellers) that together provide over 85 percent of music sold in the United States.

monopoly

A market where there are many buyers but only one dominant seller.

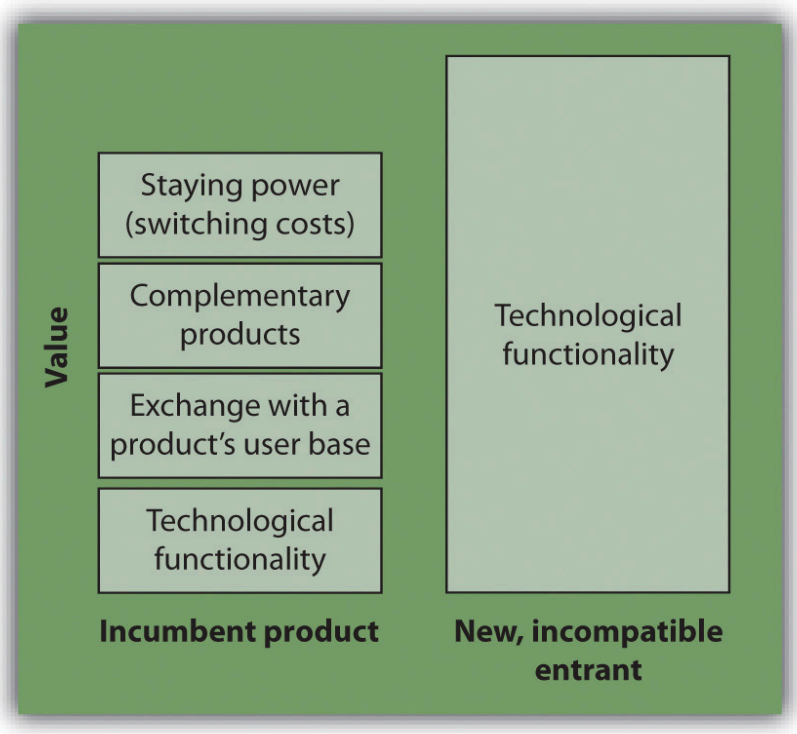
oligopoly

A market dominated by a small number of powerful sellers.

Finally, it's important to note that the best product or service doesn't always win. PlayStation 2 dominated the original Xbox in a prior generation's game console war, despite the fact that nearly every review claimed the Xbox was hands-down a technically superior machine. Why were users willing to choose an inferior product (PS2) over a superior one (Xbox)? The power of network effects! PS2 had more users, which attracted more developers offering more games.

FIGURE 8.1 Battling a Leader with Network Effects

A new rival facing a strong, incompatible incumbent can't just offer a superior product—the upstart must have an overwhelming additional value that exceeds the benefit of exchange, switching costs, and complementary products, as well.[9]



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technological leapfrogging

Competing by offering a new technology that is so superior to existing offerings that the value overcomes the total resistance that older technologies might enjoy via exchange, switching cost, and complementary benefits.

This last note is a critical point to any newcomer wishing to attack an established rival. Winning customers away from a dominant player in a network industry isn't as easy as offering a product or service that is better. Any product that is incompatible with the dominant network has to exceed the value of the technical features of the leading player, plus (since the newcomer likely starts without any users or third-party product complements) the value of the incumbent's exchange, switching cost, and complementary product benefit (see Figure 8.1). And the incumbent must not be able to easily copy any of the newcomer's valuable new innovations; otherwise the dominant firm will quickly match any valuable improvements made by rivals. As such, **technological leapfrogging**, or competing by offering a superior generation of technology, can be really tough.[10]

Is This Good for Innovation?

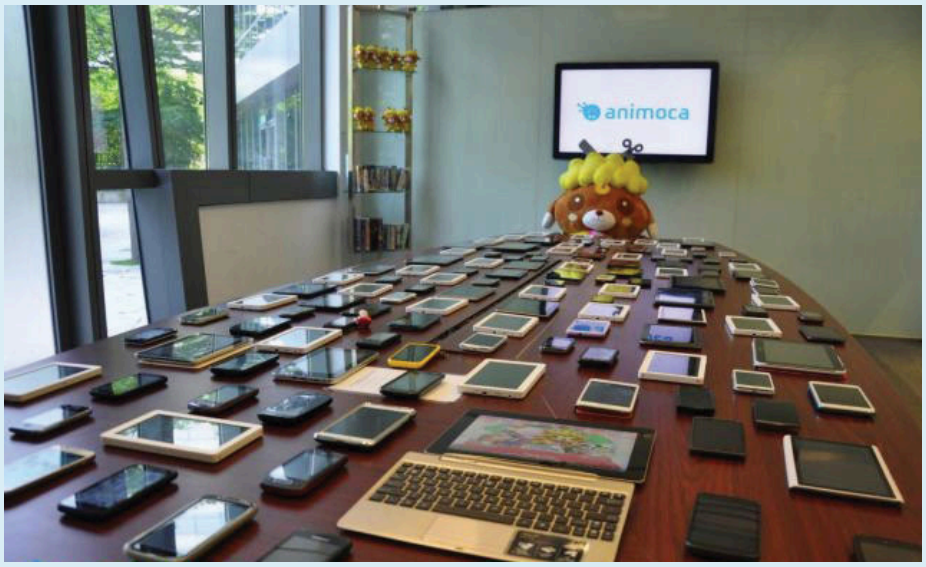
Critics of firms that leverage proprietary standards for market dominance often complain that network effects are bad for innovation. But this statement isn't entirely true. While network effects limit competition *against* the dominant standard, innovation *within* a standard may actually blossom. Consider Windows. Microsoft has a huge advantage in the desktop operating system market, so few rivals try to compete with it. Apple's Mac OS and the open source Linux operating system are the firm's only credible rivals, and both have tiny market shares. But the dominance of Windows is a magnet for developers to innovate within the standard. Programmers with novel ideas are willing to make the investment in learning to write software for Windows because they're sure that a Windows version can be used by the overwhelming majority of computer users.

By contrast, look at the mess we initially had in the mobile phone market. With so many different handsets containing differing computing hardware, offering different screen sizes, running different software, having different key layouts, and working on different carrier networks, writing a game that's accessible by the majority of users is nearly impossible. Glu Mobile, a maker of online games, launched fifty-six reengineered builds of Monopoly to satisfy the diverse requirements of just one telecom carrier.[11] As a result, entrepreneurs with great software ideas for the mobile market were deterred because writing, marketing, and maintaining multiple product versions is both costly and risky. It wasn't until Apple's iPhone arrived, offering developers both a huge market and a consistent set of development standards, that third-party software development for mobile phones really took off. The fact that there are many different Android devices with different hardware specs running different versions of Google's mobile operating system also creates a challenge for developers. Hong Kong mobile app developer Animoca does quality assurance testing with about four hundred Android devices on every app the firm offers.[12]

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FIGURE 8.2 Innovation in Fractured Standards
Because Android runs on so many different devices using various versions of the OS, game developers like Hong Kong-based Animoca test each product released on as many as four hundred devices.



Source: TechCrunch, http://techcrunch.com/2012/05/11/this-is-what-developing-for-android-looks-like/; https://creativecommons.org/licenses/by-nd/3.0/.

Key Takeaways

- Unseating a firm that dominates with network effects can be extremely difficult, especially if the newcomer is not compatible with the established leader. Newcomers will find their technology will need to be so good that it must leapfrog not only the value of the established firm's tech, but also the perceived stability of the dominant firm, the exchange benefits provided by the existing user base, and the benefits from any product complements. For evidence, just look at how difficult it's been for rivals to unseat the dominance of Windows.
- Because of this, network effects might limit the number of rivals that challenge a dominant firm. But the establishment of a dominant standard may actually encourage innovation within the standard, since firms producing complements for the leader have faith the leader will have staying power in the market.

Questions and Exercises

1. How is competition in markets where network effects are present different from competition in traditional markets?
2. What are the reasons why it is so difficult for late-moving, incompatible rivals to compete in markets where a dominant, proprietary standard is present? What is technological leapfrogging and why is it so difficult to accomplish?
3. Does it make sense to try to prevent monopolies in markets where network effects exist?
4. Are network effects good or bad for innovation? Explain.
5. What is the relationship between network effects and the bargaining power of participants in a network effects "ecosystem"?
6. Cite examples where the best technology did not dominate a network effects–driven market.

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8.5 Competing When Network Effects Matter

Learning Objectives

1. Plot strategies for competing in markets where network effects are present, both from the perspective of the incumbent firm and the new market entrant.
2. Give examples of how firms have leveraged these strategies to compete effectively.

Why do you care whether networks are one-sided, two-sided, or some sort of hybrid? Well, when crafting your plan for market dominance, it's critical to know if network effects exist, how strong they might be, where they come from, and how they might be harnessed to your benefit. Here's a quick rundown of the tools at your disposal when competing in the presence of network effects.

Strategies for Competing in Markets with Network Effects (Examples in Parentheses)

- Move early (Yahoo! auctions in Japan).
- Subsidize product adoption (PayPal).
- Leverage viral promotion (Skype, WhatsApp, Uber, Airbnb, Blue Apron).
- Expand by redefining the market to bring in new categories of users (Nintendo Wii) or through convergence (iPhone).
- Form alliances and partnerships (NYCE vs. Citibank, Didi/Ola/GrabTaxi/Lyft global ride-sharing alliance vs. Uber).
- Establish distribution channels (Java with Netscape; Microsoft bundling Media Player with Windows; Apple embedding Apple Music in all Macs and iOS devices).
- Seed the market with complements (Blu-ray, Nintendo, thredUP).
- Encourage the development of complementary goods—this can include offering resources, subsidies, reduced fees, market research, development kits, and training (Oculus and Amazon Echo developer funds, Apple Swift Playgrounds).
- Maintain backward compatibility (Apple's Mac OS X Rosetta translation software for PowerPC to Intel, Samsung Pay using existing mag-stripe standards).
- For rivals, be compatible with larger networks (Apple's move to Intel; Samsung Pay's compatibility with magstripe credit card standards).
- For incumbents, constantly innovate to create a moving target and block rival efforts to access your network (Apple's efforts to block access to its own systems).
- For large firms with well-known followers, make preannouncements (Microsoft, Apple).

Move Early

In the world of network effects, this is a biggie. Being first allows your firm to start the network effects snowball rolling in your direction. In Japan, worldwide auction leader eBay showed up just five months after Yahoo! launched its Japanese auction service. But eBay was never able to mount a credible threat and ended up pulling out of the market. Being just five months late cost eBay bil-

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lions in lost sales, and the firm eventually retreated, acknowledging it could never unseat Yahoo!'s network effects lead.

Another key lesson from the loss of eBay Japan? Exchange depends on the ability to communicate! eBay's huge network effects in the United States and elsewhere didn't translate to Japan because most Japanese aren't comfortable with English, and most English speakers don't know Japanese. The language barrier made Japan a "greenfield" market with no dominant player, and Yahoo!'s early move provided the catalyst for victory.

Timing is often critical in the video game console wars, too. Sony's PlayStation 2 enjoyed an eighteen-month lead over the technically superior Xbox (as well as Nintendo's GameCube). That time lead helped to create what for years was the single most profitable division at Sony. By contrast, the technically superior PS3 showed up months after Xbox 360 and at roughly the same time as the Nintendo Wii, and has struggled in its early years, racking up multibillion-dollar losses for Sony.[13]

What If Microsoft Threw a Party and No One Showed Up?

Microsoft launched the Zune media player with features that should be subject to network effects—the ability to share photos and music by wirelessly "squirting" content to other Zune users. The firm even promoted Zune with the tagline "Welcome to the Social." The problem was the Zune Social was a party no one wanted to attend. The late-arriving Zune garnered a market share of just 3 percent, and users remained hard-pressed to find buddies to leverage these neat social features.[14] A cool idea does not automatically make a network effect happen.

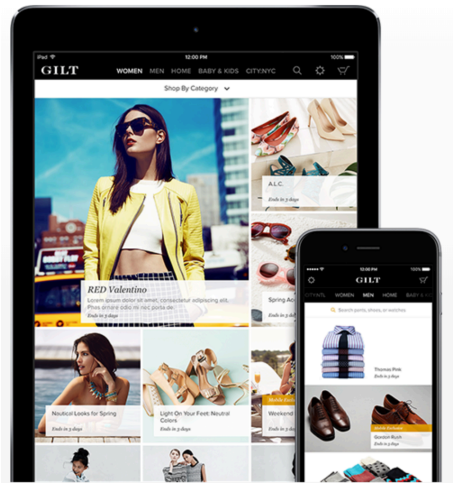
Subsidize Adoption

Starting a network effect can be tough—there's little incentive to join a network if there's no one in the system to communicate with. In one admittedly risky strategy, firms may offer to subsidize initial adoption in hopes that network effects might kick in shortly after. Subsidies to adopters might include a price reduction, rebate, or other giveaways. PayPal, a service that allows users to pay one another using credit cards, gave users a modest rebate as a sign-up incentive to encourage adoption of its new effort (in one early promotion, users got back $15 when spending their first $30). This brief subsidy paid to early adopters paid off handsomely. eBay later tried to enter the market with a rival effort, but as a late mover its effort was never able to overcome PayPal's momentum. PayPal was eventually purchased by eBay for $1.5 billion, and spun out of eBay at a $45 billion valuation.

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FIGURE 8.3 Gilt Groupe iPad App
Gilt's ten-dollar iPad subsidy and instant membership offer helped fuel adoption of the iPad app. Mobile apps now account for 15 percent of the high-end fashion site's sales.



Source: "Tap into the Gilt App," Gilt, https://www.gilt.com/apps/iphone.

Gilt Groupe, a high-end fashion flash deals site, used subsidies to increase adoption of the firm's mobile app "Gilt on the Go"—fueling the growth of a new and vital distribution channel. Gilt knew that getting its app into the purses and pockets of more of its users would increase the chance that a customer would view more deals and act on them. To encourage mobile owners to download the Gilt app, the company offered instant membership (as opposed to its normal invitation-only model) and a ten-dollar credit to the first ten thousand new subscribers. Awareness of Gilt on the Go spread virally, and apps grew in a flash, accounting for 15 percent of the firm's revenue within months.[15] Some of the best approaches to competing in network markets will simultaneously leverage several of the strategies we're outlining here, and in the case of Gilt, the *subsidy* helped create *viral* promotion that in turn helped establish a new *distribution channel*. Mobile is especially important for Gilt, since the firm offers flash sales. Making sure the firm can message users on their nondesktop screens increases the chances for the firm to reach and engage consumers, and rack up more sales.

When Even Free Isn't Good Enough

Subsidizing adoption after a rival has achieved dominance can be an uphill battle, and sometimes even offering a service for free isn't enough to combat the dominant firm. When Yahoo! introduced a US auction service to compete with eBay, it initially didn't charge sellers at all (sellers typically pay eBay a small percentage of each completed auction). The hope was that with the elimination of seller fees, enough sellers would jump from eBay to Yahoo! and help the late-mover catch up in the network effect game.

But eBay sellers were reluctant to leave for two reasons. First, there weren't enough buyers on Yahoo! to match the high bids they earned on much-larger eBay. Some savvy sellers played an arbitrage game where they'd buy items on Yahoo!'s auction service at lower prices and resell them on eBay, where more users bid prices higher.

Second, any established seller leaving eBay would give up their valuable "seller ratings," and would need to build their Yahoo! reputation from scratch. Seller ratings represent a critical switching cost, as many users view a high rating as a method for reducing the risk of getting scammed or receiving lower-quality goods.

Auctions work best for differentiated goods. While Amazon has had some success in peeling away eBay sellers who provide commodity products (a real danger as eBay increasingly relies on fixed-price sales), eBay's dominant share of the online auction market still towers over all rivals.[16] While there's no magic in the servers used to create eBay, the early use of technology allowed the firm to create both network effects and switching costs—a dual strategic advantage that has given it a hammerlock on auctions even as others have attempted to mimic its service and undercut its pricing model.

Leverage Viral Promotion

Since all products and services foster some sort of exchange, it's often possible to leverage a firm's customers to promote the product or service. Internet calling service Skype (now owned by Microsoft) has over 600 million registered users yet has spent almost nothing on advertising. Neither has WhatsApp (now part of Facebook) with over a billion monthly active users.[17] Most Skype and WhatsApp users were recruited by others who shared the word on free and low-cost Internet

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calls and text messaging. And rise of social media has made viral promotion a tool that many firms can exploit. Facebook, Twitter, and mobile app integration with a phone's address book all act as a catalyst for friends to share deals, spread a good word, sign up for services, and load applications.

social proof

The positive influence created when someone finds out that others are doing something.

Viral promotions are also often linked to subsidies (e.g., recruit a new customer and you both get money to spend), but they can also provide the additional benefit of leveraging a trusted friend to overcome adoption inertia. Sharing economy firms Uber and Airbnb have both used these kinds of incentives as trust proxies, or what is sometimes referred to as **social proof**. When a friend sends an invite to a service where users may otherwise have trust concerns (e.g., Uber and stepping into a car driven by a stranger, staying in someone's home through Airbnb), an endorsement by a friend can ease concerns. Airbnb saw bookings increase as much as 25 percent in markets after offering friend referral incentives, and the firm says patrons referred by friends are more likely to revisit the site and book future trips, and they are much more likely to send referrals themselves.[18]

Meal kit service Blue Apron leveraged social proof as a key to building a $3 billion firm with $600 million in annual sales in just three years.[19] Users love photographing food they've prepared, so Facebook and Instagram posts raise awareness. Members are also rewarded with meals they can "gift" to friends who haven't yet tried the service. And leveraging the subsidy method mentioned above, Blue Apron also gives new subscribers free meals as an incentive to try the service. These strategies have helped the firm grow to profitability and become the undisputed market leader in a crowded market.[20]

Expand by Redefining the Market

If a big market attracts more users (and in two-sided markets, more complements), why not redefine the space to bring in more users? Nintendo did this when launching the Wii. While Sony and Microsoft focused on the graphics and raw processing power favored by hard-core male gamers, Nintendo chose to develop a machine to appeal to families, women, and age groups that normally shunned alien shoot-'em-ups. By going after a bigger, redefined market, Nintendo was able to rack up sales that exceeded the Xbox 360, even though it followed the system by twelve months.[21]

blue ocean strategy

An approach where firms seek to create and compete in uncontested "blue ocean" market spaces, rather than competing in spaces and ways that have attracted many, similar rivals.

Seeking the Blue Ocean? Better Think Strategically

Reggie Fils-Aimé, the president of Nintendo of America, has described the Wii Strategy as a blue ocean effort.[22] The concept of **blue ocean strategy** was popularized by European Institute of Business Administration (INSEAD) professors W. Chan Kim and Renée Mauborgne (authors of a book with the same title).[23] The idea—instead of competing in *blood-red* waters where the sharks of highly competitive firms vie for every available market scrap, firms should seek the *blue waters* of uncontested, new market spaces.

For Nintendo, the granny gamers, moms, and party-goers who flocked to the Wii represented an undiscovered feast in the blue ocean. Talk about new markets! Consider that the best-selling video game following the Wii's breakout launch was Wii Fit—a genre-busting title that comes with a scale so you can weigh yourself each time you play. That's a far cry from Grand Theft Auto IV, the title ranking fifth in 2008 sales, and trailing four Wii-only exclusives.

Blue ocean strategy often works best when combined with strategic positioning described in Chapter 2. If an early mover into a blue ocean can use this lead to create defensible assets for sustainable advantage, late moving rivals may find markets unresponsive to their presence. Of course, if your firm's claim in the blue ocean is based on easily imitated resources (like technology features), then holding off rivals will be tougher. For holiday season 2010, Microsoft showed up with its own motion-gaming controller, the Kinect video camera system. Kinect was such a hit with generation Wii that it became the fastest-selling consumer electronics product in history, pumping up Xbox 360 console sales and goosing Microsoft's entertainment division from zero to a billion dollars in profits in just two years.[24]

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convergence

When two or more markets, once considered distinctly separate, begin to offer features and capabilities. As an example: the markets for mobile phones and media players are converging.

envelopment

When one market attempts to conquer a new market by making it a subset, component, or feature of its primary offering.

Market expansion sometimes puts rivals who previously did not compete on a collision course as markets undergo **convergence** (when two or more markets, once considered distinctly separate, begin to offer similar features and capabilities). Consider the market for portable electronic devices. Separate product categories for media players, cameras, gaming devices, phones, and global positioning systems (GPS) are all starting to merge. Rather than cede its dominance as a media player, Apple leveraged a strategy known as **envelopment**, where a firm seeks to make an existing market a subset of its product offering. Apple deftly morphed the iPod into the iPhone, a device that captures all of these product categories in one device. But the firm went further; the iPhone is Wi-Fi capable and offers browsing, e-mail, and an application platform in iOS that was initially based on a scaled-down version of the same OS X operating system used in Macintosh computers. As a "Pocket Mac," the appeal of the device broadened beyond just the phone or music player markets, and within two quarters of launch, iPhone became the second-leading smartphone in North America—outpacing Palm, Microsoft, Motorola and every other rival, except RIM's BlackBerry,[25] and it was only a matter of time before that rival was vanquished, as well.

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Alliances and Partnerships

Firms can also use partnerships to grow market share for a network. Sometimes these efforts bring rivals together to take out a leader. In a classic example, consider ATM networks. Citibank was the first major bank in New York City to offer a large ATM network. But the Citi network was initially proprietary, meaning customers of other banks couldn't take advantage of Citi ATMs. Citi's innovation was wildly popular, and being a pioneer in rolling out cash machines helped the firm grow deposits fourfold in just a few years. Competitors responded with a partnership. Instead of each rival bank offering another incompatible network destined to trail Citi's lead, competing banks agreed to share their ATM operations through NYCE (New York Cash Exchange). While Citi's network was initially the biggest, after the NYCE launch a Chase bank customer could use ATMs at a host of other banks that covered a geography far greater than Citi offered alone. Network effects in ATMs shifted to the rival bank alliance, Citi eventually joined NYCE and today, nearly every ATM in the United States carries a NYCE sticker.

While Uber continues its relentless march toward world domination, four of its biggest global competitors have formed an alliance to reduce costs, preserve their strength in markets where they lead, and build a global rival to Uber-everywhere. The firms Lyft, Ola, Didi Chuxing, and GrabTaxi, now known as Grab, share technology, local market knowledge, and business resources, with the leading firm in each nation handling mapping, routing, and payments. The firms, which operate regionally and don't really compete with one another, will allow users to book cabs from each other's apps in all the regions where they operate. Didi dominates China and enjoys deep integration in the wildly popular WeChat app (it is so dominant there that Uber sold its China business to Didi). Ola is India's local leader. GrabTaxi is big in Malaysia, Singapore, Indonesia, Philippines, Vietnam, and Thailand. Firms hope that cost savings, tech sharing, and global appeal will keep Uber at bay,[26] although it is unclear how the deal between Uber and Didi will impact the future of this alliance.[27]

Share or Stay Proprietary?

Defensive moves like the ones above are often meant to diffuse the threat of a proprietary rival. Sometimes firms decide from the start to band together to create a new, more open standard, realizing that collective support is more likely to jump-start a network than if one firm tried to act with a closed, proprietary offering. Examples of this include the coalitions of firms that have worked together to advance standards like Bluetooth and Wi-Fi. While no single member firm gains a direct profit from the sale of devices using these standards, the standard's backers benefit when the market for devices expands as products become more useful because they are more interoperable.

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Leverage Distribution Channels

Firms can also think about novel ways to distribute a product or service to consumers. Sun faced a challenge when launching the Java programming language—no computers could run it. In order for Java to work, computers need a little interpreter program called the Java Virtual Machine (JVM). Most users weren't willing to download the JVM if there were no applications written in Java, and no developers were willing to write in Java if no one could run their code. Sun broke the logjam when it *bundled* the JVM with Netscape's browser. When millions of users downloaded Netscape, Sun's software snuck in, almost instantly creating a platform of millions for would-be Java developers. Today, even though Netscape has failed, Sun's Java remains one of the world's most popular programming languages. Indeed, Java was cited as one of the main reasons for Oracle's 2009 acquisition of Sun, with Oracle's CEO saying the language represented "the single most important software asset we have ever acquired."[28]

FIGURE 8.4 Apple's Retail Stores
Most pundits expected Apple retail to fail. Instead the stores provided a wildly successful channel to reach customers, explain products, and make sales.



Source: View Apart / Shutterstock.com

And when you don't have distribution channels, create them. That's what Apple did when it launched the Apple retail stores a little over a decade ago. At the time of launch, nearly every pundit expected the effort to fail. But it turns out, the attractive, high-service storefronts were the perfect platform to promote the uniqueness of Apple products. Apple's more than four hundred stores worldwide now bring in over $21 billion in revenue[29] and are among the world's most successful retail outlets on a sales-per-square-foot basis.[30]

As mentioned in Chapter 2, Microsoft is in a particularly strong position to leverage its products as distribution channels. The firm often bundles its new products into its operating systems, Office suite, Internet Explorer browser, and other offerings. The firm used this tactic to transform once market-leader Real Networks into an also-ran in streaming audio. Within a few years of bundling Windows Media Player (WMP) with its other products, WMP grabbed the majority of the market, while Real's share had fallen to below 10 percent.[31]

Caution is advised, however. Regional antitrust authorities may consider product bundling by dominant firms to be anticompetitive. European regulators have forced Microsoft to unbundle Windows Media Player from its operating system and to provide a choice of browsers alongside Internet Explorer. Over the past decade the EU has slapped Microsoft with penalties that have amounted to over 2 billion euros in total.[32]

Seed the Market

When Sony launched the PS3, it subsidized each console by selling at a price estimated at three hundred dollars below unit cost.[33] Subsidizing consoles is a common practice in the video game industry—game player manufacturers usually make most of their money through royalties paid by game developers. But Sony's subsidy had an additional benefit for the firm—it helped sneak a Blu-ray player into every home buying a PS3 (Sony was backing the Blu-ray standard over the rival HD DVD effort). PS3 has struggled with fierce competition, but initially seeding the market with low-cost Blu-ray players at a time when that hardware sold at a very high price gave eventual winner Blu-ray some extra momentum. Since Sony is also a movie studio and manufacturer of DVD players and other consumer electronics, it had a particularly strong set of assets to leverage to encourage the adoption of Blu-ray over rival HD DVD.

Giving away products for half of a two-sided market is an extreme example of this kind of behavior, but it's often used. In two-sided markets, you charge the one who will pay. Adobe gives

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away the Acrobat reader to build a market for the sale of software that creates Acrobat files. Firms with Yellow Page directories give away countless copies of their products, delivered straight to your home, in order to create a market for selling advertising. And Google does much the same by providing free, ad-supported search.

Consignment firm thredUP buys clothing from one group of customers, then photographs and warehouses them for resale to others. Sending high-quality used clothes to thredUP can be a quick way to earn cash, but it can also lead to a lopsided market, where supply exceeds demand. In order to seed the "buy" side for its duds by encouraging sellers to become buyers, too, thredUP will give clothes sellers immediate purchase credit for any resale items that thredUP accepts for sale. Want cash instead? You'll get it, but you'll have to wait two weeks.

Encourage the Development of Complementary Goods

There are several ways to motivate others to create complementary goods for your network. These efforts often involve some form of developer subsidy or other free or discounted service. A firm may charge lower royalties or offer a period of royalty-free licensing. It can also offer free software development kits (SDKs), training programs, co-marketing dollars, or even startup capital to potential suppliers. Microsoft and Apple both allow developers to sell their products online through Xbox LIVE Marketplace and iTunes, respectively. This channel lowers developer expenses by eliminating costs associated with selling physical inventory in brick-and-mortar stores and can provide a free way to reach millions of potential consumers without significant promotional spending.

Firms are also leveraging several techniques to encourage the creation of complementary goods for their platforms. Oculus has a $10 million fund to encourage indie game developers to build for the platform; Slack has announced an $80 million investment fund intended to boost companies that are building products that enhance the firm's business productivity platform[34]; and Amazon has a $100 million fund to developers enhancing technologies and providing new apps (called "skills" by Amazon) for its voice-activated Echo products.[35] Apple has taken encouraging developers a step further by offering Swift Playgrounds in the iPad, a kid-focused learn-to-program environment featuring the created-by-Apple Swift programming language. Apple has since open sourced Swift so it can be used on development efforts outside its own products, and its broad efforts to encourage Swift adoption have made Swift one of the world's most popular and in-demand programming languages.[36]

Leverage Backward Compatibility

Those firms that control a standard would also be wise to ensure that new products have **backward compatibility** with earlier offerings. If not, they reenter a market at installed-base zero and give up a major source of advantage—the switching costs built up by prior customers. For example, when Nintendo introduced its 16-bit Super Nintendo system, it was incompatible with the firm's highly successful prior generation 8-bit model. Rival Sega, which had entered the 16-bit market two years prior to Nintendo, had already built up a large library of 16-bit games for its system. Nintendo entered with only its debut titles, and no ability to play games owned by customers of its previous system, so there was little incentive for existing Nintendo fans to stick with the firm.[37] iTunes users also found migration to Spotify made particularly easy since the latter offered the option of importing iTunes playlists.

backward compatibility

The ability to take advantage of complementary products developed for a prior generation of technology.

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adaptor
A product that allows a firm to tap into the complementary products, data, or user base of another product or service.

Backward compatibility was the centerpiece of Apple's strategy to revitalize the Macintosh through its move to the Intel microprocessor. Intel chips aren't compatible with the instruction set used by the PowerPC processor used in earlier Mac models. Think of this as two entirely different languages—Intel speaks French, PowerPC speaks Urdu. To ease the transition, Apple included a free software-based **adaptor**, called Rosetta, that automatically emulated the functionality of the old chip on all new Macs (a sort of Urdu to French translator). By doing so, all new Intel Macs could use the base of existing software written for the old chip; owners of PowerPC Macs were able to upgrade while preserving their investment in old software; and software firms could still sell older programs while they rewrote applications for new Intel-based Macs. Even more significant, since Intel is the same standard used by Windows, Apple developed a free software adaptor called Boot Camp that allowed Windows to be installed on Macs. Boot Camp (and similar solutions by other vendors) dramatically lowered the cost for Windows users to switch to Macs. Within two years of making the switch, Mac sales skyrocketed to record levels. Apple now boasts a commanding lead in notebook sales to the education market,[38] and a survey by Yankee Group found that 87 percent of corporations were using at least some Macintosh computers, up from 48 percent at the end of the PowerPC era two years earlier.[39]

Samsung also leveraged backward compatibility to make Samsung Pay accepted at more retailers than either Apple Pay or Android Pay. Samsung Pay uses a technology called magnetic secure transmission (MST), which emits a magnetic signal that simulates the magnetic strip found on the back of a credit or debit card. Since vendor point-of-sale (POS) systems see Samsung Pay as if it were a regular credit card, merchants don't even need to agree to accept Samsung, it just works like plastic. A small subset of POS systems, like gas station pumps and ATMs, still require physically inserting a card, but the vast majority of merchant terminals accept the Samsung MST signal. Samsung Pay is still limited because it only works with certain phones, bank cards, and carriers, but its broad acceptance removes a major barrier to customer acceptance.[40]

Rivals: Be Compatible with the Leading Network

Companies will want to consider making new products compatible with the leading standard. Microsoft's Live Maps and Virtual Earth 3D arrived late to the Internet mapping game. Users had already put in countless hours building resources that meshed with Google Maps and Google Earth. But by adopting the same keyhole markup language (KML) standard used by Google, Microsoft could, as *TechCrunch* put it, "drink from Google's milkshake." Any work done by users for Google in KML could be used by Microsoft. Voilà, an instant base of add-on content!

Incumbents: Close Off Rival Access and Constantly Innovate

Oftentimes, firms that control dominant networks will make compatibility difficult for rivals who try to connect with their systems. For example, while many firms offer video conferencing and Internet calling, the clear leader is Skype, a product that for years had been closed to unauthorized Skype clients.

Firms that constantly innovate make it particularly difficult for competitors to become compatible. Again, we can look to Apple as an example of these concepts in action. While Macs run Windows, Windows computers can't run Mac programs. Apple has embedded key software in Mac hardware, making it difficult for rivals to write a software emulator like Boot Camp that would let

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Windows PCs drink from the Mac milkshake. And if any firm gets close to cloning Mac hardware, Apple sues. The firm also modifies software on other products like the iPhone and iTunes each time wily hackers tap into closed aspects of its systems. And Apple has regularly moved to block competing third-party hardware products from plugging into iTunes.[41] Even if firms create adaptors that emulate a standard, a firm that constantly innovates creates a moving target that's tough for others to keep up with.

Apple has been far more aggressive than Microsoft in introducing new versions of its software. Since the firm never stays still, would-be cloners never get enough time to create a reliable emulator that runs the latest Apple software.

Large, Well-Known Followers: Preannouncements

Large firms that find new markets attractive but don't yet have products ready for delivery might *preannounce* efforts in order to cause potential adaptors to sit on the fence, delaying a purchasing decision until the new effort rolls out. Preannouncements only work if a firm is large enough to pose a credible threat to current market participants. While Apple rarely preannounces products, it previewed Apple Watch roughly eight months before it was ready to ship. Rivals from the Kickstarter darling, Pebble, to Google's Android Wear were courting developers, but Apple's early product demonstration caused many customers considering wearables to hold off until Apple Watch was out. Developers also knew that, unlike fragmented Android Wear offerings with varying watch face shapes and capabilities, Apple Watch would provide a uniform standard offered by the industry's biggest player. While large, respected firms may be able to influence markets through preannouncements, startups often lack credibility to delay user purchases. The tech industry acronym for the impact firms try to impart on markets through preannouncements is *FUD,* for fear, uncertainty, and doubt.

The Osborne Effect

Preannouncers, beware. Announce an effort too early and a firm may fall victim to what's known as "**The Osborne Effect**." It's been suggested that portable computer manufacturer Osborne Computer announced new models too early. Customers opted to wait for the new models, so sales of the firm's current offerings plummeted. While evidence suggests that Osborne's decline had more to do with rivals offering better products, the negative impact of preannouncements has hurt a host of other firms.[42] Among these, Sega, which exited the video game console market entirely after preannouncements of a next-generation system killed enthusiasm for its Saturn console.[43]

The Osborne Effect

When a firm preannounces a forthcoming product or service and experiences a sharp and detrimental drop in sales of current offerings as users wait for the new item.

Too Much of a Good Thing?

When network effects are present, more users attract more users. That's a good thing as long as a firm can earn money from this virtuous cycle. But sometimes a network effect attracts too many users, and a service can be so overwhelmed that it becomes unusable. These so-called **congestion effects** occur when increasing numbers of users lower the value of a product or service. This most often happens when a key resource becomes increasingly scarce. *Fortune* reported how the launch of a new version of the hit EA game SimCity fell victim to congestion effects, stating that "thanks to what the company called 'overwhelming demand,' players experienced a myriad of problems like failures to load the game entirely and wait times of twenty minutes to log in. Gameplay became so problematic that Amazon temporarily halted sales of the

congestion effects

When increasing numbers of users lower the value of a product or service.

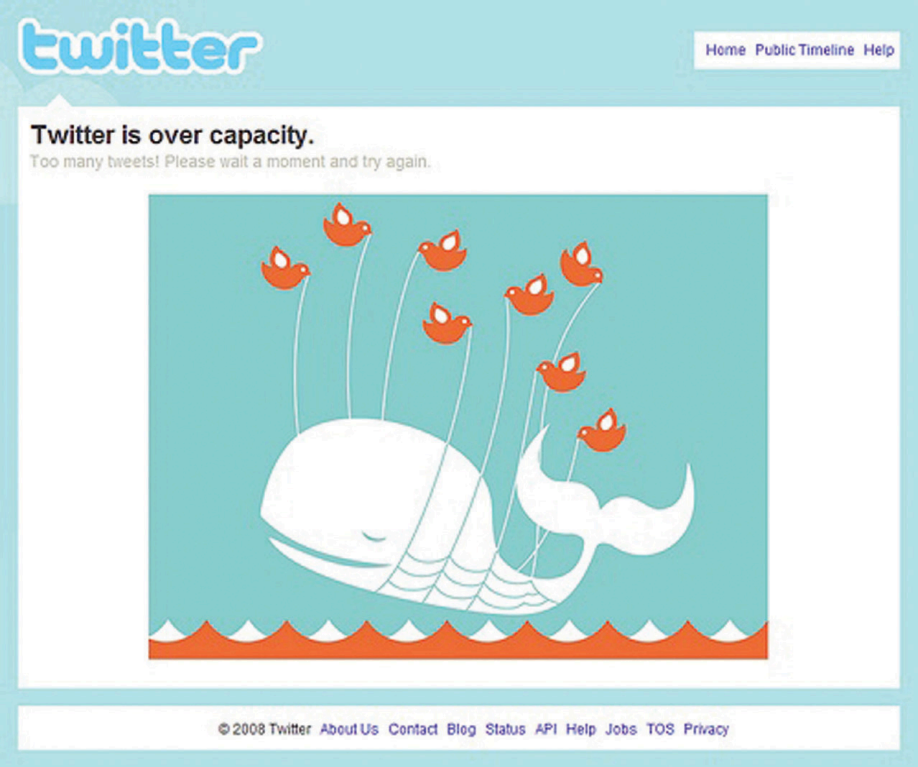
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game, and EA offered users the option of downloading a free game from its online store."[44] Twitter's early infrastructure was often unable to handle the demands of a service in hypergrowth (leading to the frequent appearance of a not-in-service graphic known in the Twitter community as the "fail whale"). Facebook users with a large number of friends may also find their attention is a limited resource, as feeds push so much content that it becomes difficult to separate interesting information from the noise of friend actions.

And while network effects can attract positive complementary products, a dominant standard may also be the first place where virus writers and malicious hackers choose to strike.

FIGURE 8.5 The Twitter Fail Whale



Source: Rob Friedman / playerx / @px (http://px.ns1.net).

Feel confident! Now you've got a solid grounding in network effects, the key resource leveraged by some of the most dominant firms in technology. And these concepts apply beyond the realm of tech, too. Network effects can explain phenomena ranging from why some stock markets are more popular than others to why English is so widely spoken, even among groups of nonnative speakers. On top of that, the strategies explored in the last half of the chapter show how to use these principles to sniff out, create, and protect this key strategic asset. Go forth, tech pioneer—opportunity awaits!

Key Takeaways

- Moving early matters in network markets—firms that move early can often use that time to establish a lead in users, switching costs, and complementary products that can be difficult for rivals to match.
- Additional factors that can help a firm establish a network effects lead include subsidizing adoption; leveraging viral marketing, creating alliances to promote a product or to increase a service's user base; redefining the market to appeal to more users; leveraging unique distrib-

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ution channels to reach new customers; seeding the market with complements; encouraging the development of complements; and maintaining backward compatibility.

- Established firms may try to make it difficult for rivals to gain compatibility with their users, standards, or product complements. Large firms may also create uncertainty among those considering adoption of a rival by preannouncing competing products.

Questions and Exercises

1. Is market entry timing important for network effects markets? Explain and offer an example to back up your point.
2. How might a firm subsidize adoption? Give an example.
3. Give an example of a partnership or alliance targeted at increasing network effects.
4. Is it ever advantageous for firms to give up control of a network and share it with others? Why or why not? Give examples to back up your point.
5. Do firms that dominate their markets with network effects risk government intervention? Why or why not? Explain through an example.
6. How did Sony seed the market for Blu-ray players?
7. What does backward compatibility mean and why is this important? What happens if a firm is not backward compatible?
8. What tactic did Apple use to increase the acceptability of the Mac platform to a broader population of potential users?
9. How has Apple kept clones at bay?
10. What are preannouncements? What is the danger in announcing a product too early? What is the term for negative impacts from premature product announcements?
11. How did PayPal subsidize adoption?
12. Why is viral adoption especially important to PayPal and Uber?
13. Name two companies that leveraged viral promotion to compete.
14. Name a product that is the result of the *convergence* of media players, cameras, and phones.
15. What is bundling? What are the upsides and downsides of bundling?
16. Why does Adobe allow the *free* download of Acrobat Reader?
17. How does thredUP leverage its seller payout policy to balance sell-side supply with buy-side demand?
18. What tactic might an established firm employ to make it impossible, or at least difficult, for a competitor to gain access to, or become compatible with, their product or service?
19. How do Apple, Microsoft, and Facebook encourage the development of complementary products?
20. What is the "congestion effect"? Give an example.
21. Do network effects apply in nontech areas? Give examples.

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CHAPTER 9

Social Media, Peer Production, and Leveraging the Crowd

9.1 Introduction

Learning Objectives

1. Recognize the unexpected rise and impact of social media and peer production systems, and understand how these services differ from prior generation tools.
2. List the major classifications of social media services.

Over the past few years, a fundamentally different class of Internet services has attracted users, made headlines, and increasingly garnered breathtaking market valuations. Originally grouped under the poorly defined umbrella term "**Web 2.0**," these new services are targeted at harnessing the power of the Internet to empower users to collaborate, create resources, and share information in a distinctly different way than the static websites and transaction-focused storefronts that characterized so many failures in the dot-com bubble. While much of what was once often called Web 2.0 is now categorized as **social media** (as it relates to content that is created, shared, and commented on by a broader community of users) or the even broader classification of **peer production** (a superset of social media—collaborative work among users to create content and/or provide services), the precision of definitions in a category that is constantly evolving is less important. What is significant is how quickly the social media revolution came about, how unexpected it was, and how deeply impactful these efforts have become for individuals, businesses, and society. Consider the following:

- As of mid-2018, half of the world's most popular Internet sites focused on social media, peer-produced content (Facebook, YouTube, Wikipedia, Reddit, and China's QQ).[1] Worldwide, users spend more than 135 minutes each day, on average, using social media.[2] Nine of the top ten most downloaded iPhone apps of 2018 were social, including several Chinese apps (iQiyi—video streaming, QQ—messaging, WeChat—messaging), several owned by Facebook (Facebook, Messenger, Instagram, and WhatsApp), and YouTube.[3]
- The social landscape can change with whip crack speed. The most downloaded iPhone app on the list was Tik Tok (known as Douyin, for "Shaking Music," in China), a Beijing-based social media app where users shoot 15-second music videos, enhancing them with effects and stickers. Tik Tok parent Byte dance paid $1 billion to acquire a similar app, Musical.ly—an app whose popularity rose so quickly that it was used by half of US teens at the time of acquisition.[4]
- Microsoft acquired LinkedIn, the world's dominant professional social network, for $26.2 billion, the largest acquisition in the firm's history.

Web 2.0

A term broadly referring to Internet services that foster collaboration and information sharing; characteristics that distinctly set "Web 2.0" efforts apart from the static, transaction-oriented Web sites of "Web 1.0." The term is often applied to websites and Internet services that foster social media or other sorts of peer production.

social media

Content that is created, shared, and commented on by a broader community of users.

peer production

When users work, often collaboratively, to create content and provide services.

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- With only seven full-time employees and an operating budget of less than $1 million, the non-profit site Wikipedia became the fifth most visited site on the Internet.[5] The site boasts well over 30 million articles in over 280 different languages, all of them contributed, edited, and fact-checked by volunteers.
- Just twenty months after its founding, YouTube was purchased by Google for $1.65 billion. An estimated five hundred hours of video are uploaded to YouTube each minute.[6] The site has emerged as the Web's leading destination for video, hosting everything from apologies from CEOs for service gaffes to questions submitted as part of presidential debates. Every day, YouTube's over one billion users watch hundreds of millions of hours of video and generate billions of views. Mobile revenue on YouTube is up over 100 percent year over year, and half of the site's views come from mobile devices, with an increasing number watching from non-PC devices, including mobile phones, tablets, and televisions.[7]
- The population of Facebook users is now so large that it could be considered the largest "nation" in the world. Over seventy percent of the site's users log in at least once a day, spending an average of fifty-two minutes a day on the site.[8] Facebook is solidly profitable, and revenues have been growing with astonishing speed (more than $40 billion in revenues and nearly $16 billion in profits in 2017).[9] US users spend more time on Facebook than on any other app; a full 42 percent of app time on smart mobile devices is spent in the Facebook app. Telcos in emerging economies often compete by offering Facebook as a free service, usually via so-called text-based "dumb" phones. Says Kenya-based tech guru Erik Hersman, "That means that for those people in Africa with mobile phones but likely no computer access, Facebook is their Internet."[10]
- Facebook-owned Instagram has 800 million monthly active users (MAUs) who share over ninety-five million photos each day.[11] WhatsApp is the world's most popular messaging client. The service has over 1.5 billion million MAUs. Each day WhatsApp users send over 1.6 billion photos, 250 million videos, 65 billion messages, and spend over 2 billion minutes in voice calls.[12] The firm's message volume has outpaced *the entire worldwide* SMS messaging standard since 2014, and by 2016, Facebook and Messenger were three times larger, by volume, than worldwide SMS text messages.[13]
- On par with social media colossus Facebook is China's Tencent, a firm that owns three of the world's top five social platforms: QQ, Qzone, and WeChat.[14] Tencent's market cap in Spring 2018 was roughly half a trillion US dollars, with 2017 profits at nearly $11 billion.[15]
- While Snapchat has proven popular in the US, with 65 percent of US 18- to 24-year-olds using the app, by 2018 the firm had less than 200 million users. Although it pioneered ephemeral "stories," both Instagram and WhatsApp each post nearly double the daily stories through their apps.[16]
- The trend extends to business. By its first birthday, workgroup productivity app Slack had over half a million daily active users sending 300 million messages each month on the platform, making it the fastest growing business app, ever. The firm was valued at over $1 billion after a $120 million funding round in October 2014. An April 2016 round raised another $200 million at a $3.8 billion valuation, with daily users soaring to 2.7 million.[17] Slack's success is based largely on corporate users finding it wildly effective at reducing the glut of internal emails.[18]
- For many, social media is the "newspaper," the "news magazine," or the "news program." Pew Research reports that two-thirds of US adults get news from social media.[19] Media brands that have learned to appeal to social media users have prospered. At less than ten years old, the Huffington Post and BuzzFeed both attract significantly more monthly online users than the digital versions of the venerable stalwarts of American media, *The New York Times* and *The Wall Street Journal*.[20]
- The rise of social media as news source has also lead to the plague of "fake news." In an attempt to deepen US political divisions and influence the 2016 US elections, Russia's Internet Research Agency had purchased at least 3,500 Facebook ads. Yet ads were the tip of the iceberg, with fake Russian accounts linked to 80,000 Facebook posts and 120,000 on Instagram, reaching an estimated [21]146 million Americans.

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- Facebook and Twitter have become activist tools and have played vital roles in supporting protest movements worldwide. China and Iran are among the governments so threatened by the power of these services that each has, at times, blocked Facebook and Twitter access within their borders.
- At only 336 million monthly users and 500 million tweets a day, Twitter is smaller than other social media sources,[22] but as a first-choice source for disseminating opinions from politicians and celebrities, Twitter wields influence above its ranking, and is seen as a force for breaking news and shaping public opinion. In another nod to the service's significance, the US Library of Congress announced plans to archive every tweet ever sent.[23]
- After just five years, Tumblr, founded by then twenty-one-year-old David Karp, emerged as one of the top ten most visited websites in the United States.[24] One year later, the site was purchased by Yahoo! for over $1 billion.[25]
- The websites Stack Overflow and GitHub have emerged as critically important software developer learning tools and effective ways to establish and strengthen one's reputation. Roughly 5.7 million developers participate on the Stack Overflow question-and-answer site worldwide, with 73 percent of posted questions receiving an answer, and answers posted in an average of just eleven minutes.[26] With its roots as a collaborative software development resource, GitHub is now the world's largest online storage space for collaborative works.[27] Participants are free to download, study, enhance, and share anything in the network. Over 20 million GitHub users collaborating on 57 million project repositories.[28] As *Forbes* declares, "Software Engineers Are in Demand, and GitHub Is How You Find Them."[29]
- Image curating and sharing site Pinterest became the fastest growing website of all time,[30] with some studies suggesting the site has driven more sales than Facebook[31] and more blog traffic than Twitter.[32] A 2017 venture investment valued the firm at $12.3 billion.[33]
- Social media is also a driving source in gaming, fueling profitable public companies like Zynga,[34] as well as 2018 phenomenon Fortnite by Epic Games, the most popular free-to-play game ever, and a title that earned nearly a quarter of a billion dollars in March 2018 alone.[35]
- Services such as Twitter, Yelp, and TripAdvisor have unleashed the voice of the customer so that gripes, praise, and ratings are now often captured and broadcast immediately at the point of service. Reviews are now incorporated into search results and maps, making them the first thing many customers see when encountering a brand online.
- Google uses peer production to improve maps, purchasing the five-year-old Israeli crowdsourced traffic app, Waze, for $1 billion. At the time of acquisition, the service had 50 million users in 100 countries.[36]
- All sorts of mobile and social apps are garnering increased interest and sky-high valuations. At just over two years old, mobile dating site Tinder (majority owned by IAC, the parent of conventional dating site Match.com) has an estimated 22 million users,[37] processing 1.4 billion "swipes" and twenty-six million "matches" a day,[38] and has added Snapchat-style self-destructing images. The twenty-seven-person firm has grown 960 percent in just six months, with investors valuing the firm at $3.3 billion by the end of 2015.[39]

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FIGURE 9.1 Slack Business Messaging App
The business messaging app Slack is called the "e-mail killer." The firm is the fastest growing business app ever, and was valued at $2.8 billion when it was barely a year old.



Source: Permission granted by Slack at https://brandfolder.com/slack.

TABLE 9.1 The World's Largest Social Media Platforms
Of the world's top eleven social platforms, Facebook owns four (Facebook, FB Messenger, WhatsApp, Instagram), and China's TenCent owns three (QQ, Qzone, and WeChat).

Top 11 Social Platforms
1. Facebook
2. YouTube
3. WhatsApp
4. Messenger
5. WeChat
6. QQ
7. Instagram
8. Tumblr
9. QZone
10. Sina Weibo
11. Twitter

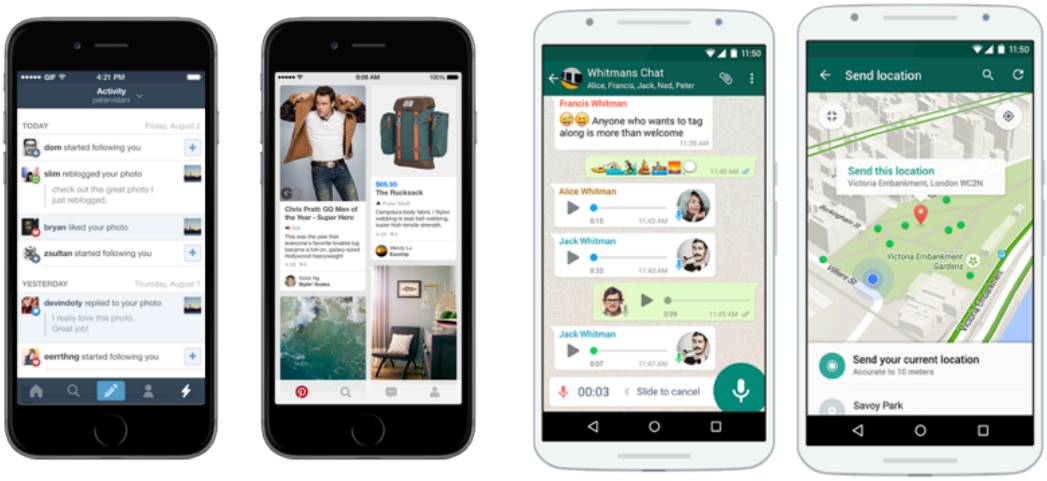
Source: Digital in 2018 Report, HootSuite.

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FIGURE 9.2 Mobile Continues to Drive Fast-Growing Social Services

Managers must continually scan the social media landscape for new channels and potentially impactful trends. Nine of the top ten most-used apps worldwide are social. Social and other peer-produced sites grow rapidly, upend industries, and create new communication channels. Images show mobile apps from Tumblr, Pinterest, and WhatsApp.



Sources: WhatsApp: https://www.whatsappbrand.com/WhatsApp-Brand-Guidelines.pdf; Snapchat: https://www.snap.com/en-US/brand-guidelines/ (nearly exact boiler plate wording); Tumblr: https://about.pinterest.com/en/press/press.

Social media efforts include blogs, wikis, social networks, messaging services, Twitter, and photo- and video-sharing sites. The rise of social media has also coincided with the rise of mobile computing—meaning the worldwide Internet conversation is always in your pocket. The peer production leveraged by collaborating users isn't only used to create social media; it can be used to create *services*, too. Skype and BitTorrent leverage users' computers instead of a central IT resource to forward phone calls and video. This ability saves their sponsors the substantial cost of servers, storage, and bandwidth. Peer production is also leveraged to create much of the open source software that supports many of the Internet's largest sites. Techniques such as crowdsourcing, where initially undefined groups of users band together to solve problems, create code, and develop services, are also a type of peer production. These efforts often seek to leverage the so-called wisdom of crowds, the idea that a large, diverse group often has more collective insight than a single or small group of trained professionals.

Related to peer production is the concept of the sharing economy, or **collaborative consumption**, where participants share access to products and services rather than having ownership. While the resources shared via collaborative consumption can be owned by a firm overseeing efforts (e.g., vehicles owned by the car-sharing service Zipcar, or the plane-sharing service NetJets), in other efforts participants come together to pool resources to provide a larger selection of services for customers. The latter is the case with RelayRides, which allows consumers to share their own cars Zipcar-style; Airbnb, which allows you to rent your entire home or a spare room in limited time periods whenever you'd like; and Uber, which provides an app to summon and pay for taxi-style service from a pooled, unused inventory provided by firm-vetted citizen suppliers. While some forms of collaborative consumption can be considered as relating to peer production, we'll cover the phenomenon distinctly and separately from the efforts in this chapter. For more on collaborative consumption, see Chapter 10.

collaborative consumption

When participants share access to products and services rather than having ownership. Shared resources can be owned by a central service provider (e.g., Zipcar) or provided by a community that pools available resources (e.g., Airbnb, Uber).

Millions of users, billions of dollars, huge social impact, and most of these efforts grew to influence millions in less time than it takes the average freshman to complete college. When technology moves that quickly, even some of the world's most preeminent thought leaders can be sideswiped.

Consider that when management guru Michael Porter wrote a piece titled "Strategy and the Internet" at the end of the dot-com bubble, he lamented the high cost of building brand online, questioned the power of network effects, and cast a skeptical eye on ad-supported revenue models. Well, it turns out that social media and peer-produced efforts challenged *all* of these concerns.

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Among the efforts above, all built brand on the cheap with little conventional advertising, and each owes its hypergrowth and high valuation to its ability to harness the network effect.

This chapter can be considered in two parts. The first explains many technologies behind the social media/peer production movement, and we provide several examples of their use and impact. Next, the concepts of prediction markets and crowdsourcing will be detailed, with focus on how they are helping and best used in modern organizations. The final part of this chapter describes how firms should organize to engage with and take advantage of social media—specifically detailing how to "Get SMART" (with a social media awareness and response team). After going through the chapter, you should have a solid overview of major social technologies, how businesses are leveraging them, and how firms can organize for effective use while avoiding pitfalls.

TABLE 9.2 Major Social Media Tools

	Description	Features	Technology Providers
Blogs	Short for "Web log"—an online publication that keeps a running chronology of entries. Readers can comment on posts. Can connect to other blogs through blog rolls or trackbacks. **Key Uses:** Share ideas, obtain feedback, mobilize a community.	• Immediate publication and distribution • Reverse chronology • Comment threads • Persistence • Searchability • Tags • Trackbacks	• Blogger (Google) • WordPress • Tumblr
Wikis	A website that anyone can edit directly from within the browser. **Key Uses:** Collaborate on common tasks or to create a common knowledge base.	• Collaborative content creation • All changes are attributed • Revision history, with the ability to roll back changes and revert to earlier versions • Automatic notification of updates • Searchability • Tags • Monitoring	• Socialtext • PBWorks • Google Sites • Atlassian • Jive • Microsoft (SharePoint) • Apple OS X Server

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	Description	Features	Technology Providers
Electronic Social Network	Online community that allows users to establish a personal profile, link to other profiles (i.e., friends), share content, and communicate with members via messaging, posts. Most personal relationships are reciprocal (i.e., both parties agree to be "friends"). **Key Uses:** Discover and reinforce affiliations; identify experts; message individuals or groups; virally share media.	• Detailed personal profiles using multimedia • Affiliations with groups, organizations, and individuals • Messaging and public discussions • Media sharing • "Feeds" of recent activity among members	Open/Public • Facebook • LinkedIn • Google+ Enterprise/Private Platforms • Ning • Lithium • SelectMinds • LiveWorld • IBM/Lotus Connections • Salesforce.com • Socialtext
Microblogging	Short, asynchronous messaging system. Users send messages to "followers" who aren't required to follow back. **Key Uses:** Distribute time-sensitive information, share opinions, virally spread ideas, run contests and promotions, solicit feedback, provide customer support, track commentary on firms/products/issues, organize protests.	• 280-character messages sent and received from mobile devices • Ability to respond publicly or privately • Can specify tags to classify discussion topics for easy searching and building comment threads • Follower lists	Open/Public • Twitter • Google+ Enterprise Platforms • Slack • HipChat • Socialtext Signals • Yammer • Salesforce.com (Chatter)

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	Description	Features	Technology Providers
Messaging Services	**Key Uses:** Communicate with individuals or groups of users using short-format text, graphics, and video. Most messaging is done using mobile devices.	• Communication can be public or private, identifying or anonymous • Some focus on a specific media type (e.g., photos/Instagram, video/Vine) • Others focus on ephemeral, nonpermanent posts that go away, typically after they are read (e.g., Snapchat)	SMS Replacement • WhatsApp • Snapchat • Viber • WeChat Photo • Instagram (permanent) • Snapchat (ephemeral) Enterprise • Slack • HipChat Anonymous • Whisper • Yik Yak
Question-and-Answer Sites	**Key Uses:** Knowledge sharing, discovery, learning, reputation building.	• Public, member-posted questions • Permanent listing, searchable repository • Community voting on "best" or most appropriate answer • Reputation building, ranking, badging to encourage active participation	• Quora (general) • Stack Exchange/ Stack Overflow (favored by technical professionals)

Key Takeaways

- A new generation of Internet applications is enabling consumers to participate in creating content and services online. While the term Web 2.0 was once widely used, these efforts are now being categorized as social media (creating, sharing, curating, and commenting on content), peer production (when users collaboratively work to create content, products, and services, which includes social media as well as user-created services like Skype and BitTorrent), and collaborative consumption (participants share access to products and services rather than having ownership). Shared resources can be owned by a central service provider (e.g., Zipcar) or provided by a community that pools available resources (e.g., Airbnb, Uber).
- These efforts have grown rapidly, most with remarkably little investment in promotion. Nearly all of these new efforts leverage network effects to add value and establish their dominance and viral marketing to build awareness and attract users.

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- Many of these services often leverage the wisdom of crowds to provide insight, products, or ideas that can be far more accurate or valuable than those provided by a smaller group of professionals. Question-and-answer sites like Quora and Stack Overflow are both learning tools and methods to establish one's reputation and authority while helping the broader user community.
- Microblogging is a channel for sharing and consuming short pieces of content. The category is dominated by Twitter, although many private and public services exist.
- Services aren't limited to consumer use. Firms advertise, promote, and engage with customers over social networks. Other tools, such as Slack, Stack Overflow, and GitHub are considered essential in many modern enterprises.
- Messaging services have exploded with the advent of mobile devices. Many efforts are now preferred to SMS and offer rich exchange of media, specialization in a media topic, public or private postings, and public or anonymous identities.
- Network effects play a leading role in enabling these efforts. Many of these services also rely on ad-supported revenue models and open source software.

Questions and Exercises

1. What distinguishes social media and peer production sites from the prior generation of Internet sites? How have you seen social media sites impact businesses, large and small?
2. Make a list of some noteworthy dominant as well as up-and-coming social media sites and apps. Would you invest in them? Why or why not? Are there cautionary tales of efforts that may not have lived up to their initial hype or promise? Why do you suppose they failed?
3. In what ways do social, peer-produced efforts challenge the assumptions that Michael Porter made regarding strategy and the Internet?
4. Trends in computing platforms and Internet services change quickly. How have the firms profiled in the bullet points above fared? Has each increased in use, value, and impact, or shrunk? Are there other efforts or updates that you think are worthy of making the list in the next edition of this book? If so, tweet out any useful articles to #BizTechBook.
5. How has social media changed the way you consume entertainment, play games, and learn about news? How important are these services to your generation versus the way your parents consume such information? What do these trends mean for managers and marketers?
6. Research the dark side of social media, including Internet addiction, social media's impact on mental health, and "fake news." Do you consider these to be significant problems? If not, why not? If so, what, if anything can be done about them?
7. If you have a smartphone, try more than one of the major messaging products. Be sure to explore one that is popular outside of your own country. Why do you suppose the products you've examined are popular? Are there major differences that you've noticed? Would you use the products you tested that were new to you? Why or why not?
8. Try Slack or another enterprise-oriented social productivity tool. Use it for group project work, a campus club, or in your own work environment. Share your experiences (good and/or bad) with your class. Would you recommend this to others? Why or why not?

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9.2 Blogs

Learning Objectives

1. Know what blogs are and how corporations, executives, individuals, and the media use them.
2. Understand the benefits and risks of blogging.
3. Appreciate the growth in the number of blogs, their influence, and their capacity to generate revenue.

blogs

Online journal entries, usually made in a reverse chronological order. Blogs typically provide comment mechanisms where users can post feedback for authors and other readers.

long tail

In this context, refers to an extremely large selection of content or products. The long tail is a phenomenon whereby firms can make money by offering a near-limitless selection.

trackbacks

Links in a blog post that refer readers back to cited sources. Trackbacks allow a blogger to see which and how many other bloggers are referring to their content. A "trackback" field is supported by most blog software, and while it's not required to enter a trackback when citing another post, it's considered good "netiquette" to do so.

blog rolls

A list of a blogger's favorite blogs. While not all blogs include blog rolls, those that do are often displayed on the right or left column of a blog's main page.

Blogs (short for Web logs) first emerged almost a decade ago as a medium for posting online diaries. As of early 2015, Tumblr reported hosting nearly 415 million blogs.[40] WordPress is said to power over 30 percent of Internet sites.[41] This is clearly a **long tail** phenomenon, loaded with niche content that remains "discoverable" through search engines and that is often shared via other types of social media like Facebook and Twitter. **Trackbacks** (citation links back to the original blog post) and **blog rolls** (a list of a blogger's favorite sites—a sort of shout-out to blogging peers)—as well as link-sharing on sites like Facebook, Twitter, Google+, LinkedIn, and Reddit—also help distinguish and reinforce the reputation of widely read blogs.

Most blogs offer a two-way dialogue, allowing users to comment (a sort of "letters to the editor" section for each post). The running dialogue can read like an electronic bulletin board and can be an effective way to gather opinion, brainstorm, and vet ideas. Comments also help keep a blogger honest—a vigorous community of commenters will quickly expose a blogger's errors of fact or logic.

Blogging can have significant appeal for an organization looking to be heard. Corporations that blog can enjoy *immediate* and *unfiltered* distribution of their ideas, with no limits on page size, word count, or publication deadline. And they can gather immediate *feedback* from readers via comments. Corporate blogs can be published directly to the public, skipping what bloggers call the mainstream media (MSM) and presenting their words without a journalist filtering their comments or an editor cutting out key points they'd hoped to make. That appeal has attracted some of the most senior executives to blogging. Hotel chief Bill Marriott, Zappos's Tony Hsieh, Virgin Group's Richard Branson, and venture capitalist Ben Horowitz are among those senior leaders who have used their blogs for purposes that have included a combination of marketing, sharing ideas, gathering feedback, press response, image shaping, and reaching consumers directly.

Most mainstream news outlets also supplement their content with blogs that offer greater depth, more detail, and an immediacy for breaking news that is unavailable in print. And many leading online news outlets got their start, first being called blogs: *The Huffington Post* and *TechCrunch* (now both owned by Verizon) are prime examples.

Blogs

While the feature set of a particular blog depends on the underlying platform and the preferences of the blogger, several key features are common to most blogs:

- *Immediate and unfiltered publication.* The ability to reach the public without limits on publication size and without having posts filtered, edited, or cut by the mainstream media.
- *Ease of use.* Creating a new post usually involves clicking a single button.
- *Comment threads.* Readers can offer comments on posts.
- *Reverse chronology.* Posts are listed in reverse order of creation, making it easy to see the most recent content.

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- *Persistence.* Posts are maintained indefinitely at locations accessible by permanent links.
- *Searchability.* Current and archived posts are easily searchable.
- *Tags.* Posts are often classified under an organized tagging scheme.
- *Trackbacks.* Allows an author to acknowledge the source of an item in their posts, which allows bloggers to follow the popularity of their posts among other bloggers.

Despite this increased popularity, blogging has its downside. Blog comments can be a hothouse for spam and the disgruntled. Ham-handed corporate efforts (such as poor response to public criticism or bogus "praise posts") have been ridiculed. Employee blogging can be difficult to control, and public postings can "live" forever in the bowels of an Internet search engine or as content pasted on other websites. Bloggers, beware: there are dozens of examples of workers who have been fired for what employers viewed as inappropriate posts. The voice of the blogosphere can also wield significant influence. While not all blogosphere commentary deserves a response, firms ignore social media at their own peril (see the sidebar called "The New Marketing Lexicon: Owned, Paid, and Earned Media, and Inbound Marketing"). Tips on how firms should organize for social media engagement, issues to consider when developing corporate social media policy, and examples of effective and poor social media use are covered in Section 8.

Like any Web page, blogs can be public, or isolated for internal use by being tucked behind a corporate firewall or password protected. Third-party blogging services include Google Blogger, WordPress, and Tumblr, with most offering a combination of free and premium features. The most popular platform for organizations choosing to host their own blog server is the open source WordPress system. Firms often choose this option to gain more control over security and formatting. Tumblr is built for speed and sharing.

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owned media

Communication channels that an organization controls. These can include firm-run blogs, websites, apps, and organization accounts on social media such as Twitter, Facebook, Pinterest, YouTube, and Instagram.

paid media

Refers to efforts where an organization pays to leverage a channel or promote a message. Paid media efforts include things such as advertisement and sponsorships.

earned media

Promotions that are not paid for or owned but rather grow organically from customer efforts or other favorable publicity. Social media, word of mouth, and unsolicited positive press mentions are all examples of earned media.

inbound marketing

Leveraging online channels to draw consumers to the firm with compelling content rather than conventional forms of promotion such as advertising, e-mail marketing, traditional mailings, and sales calls.

SEO

Search engine optimization. The process of improving a page's organic page rankings (rank in search results).

The New Marketing Lexicon: Owned, Paid, and Earned Media, and Inbound Marketing

Online marketers and social media executives often refer to owned, paid, and earned media, so some definitions are in order:[42]

Owned media are communication channels that an organization controls. These can include firm-run blogs and websites, any firm-distributed corporate mobile website or app, and organization accounts on social media such as Twitter, Facebook, Pinterest, YouTube, and Instagram. Visit the Starbucks website? That's media owned by Starbucks.

Paid media refers to efforts where an organization pays to leverage a channel or promote a message. Paid media efforts include things such as advertisement and sponsorships. See a Starbucks ad online? That's paid media.

Earned media are promotions that are not paid for or owned but rather grow organically from customer efforts or other favorable publicity. Social media can be a key driver of earned media (think positive tweets, referring Facebook posts, and pins on Pinterest). Other forms of earned media include unsolicited positive press and positive customer word of mouth. View unsolicited praise of Starbucks in your Twitter feed by folks you follow? That's earned media.

Inbound marketing refers to leveraging online channels to draw consumers to the firm with compelling content rather than conventional forms of promotion such as advertising, e-mail marketing, traditional mailings, and sales calls.

Successful inbound marketers produce interesting content that acts as a magnet for the attention of potential customers. Inbound marketers look to attract traffic that is converted to leads that result in sales and hopefully repeat business.[43] Popular blog posts and other forms of social media play a critical role here, as do other online material such as free whitepapers and eBooks. Material deemed useful is likely to gain more Web links and cause firm-affiliated content to rise in **SEO** rankings, making your firm easy to find, pushing your firm higher in search results than your rivals, and solidifying perception of your firm as an expert. A catchy viral campaign can also bring in customers to an owned channel and gain earned media referrals. P&G's Old Spice Man (which included paid media advertisements as well as owned content on the firm's YouTube channel) eventually brought in 40 million YouTube views and is credited with a 107 percent increase in body wash sales in the thirty days following the campaign launch.[44] Many firms with sophisticated inbound marketing programs leverage social media analytic platforms (see Section 8). In fact, the term inbound marketing (sometimes called permission marketing) was coined by Brian Halligan, cofounder and CEO of HubSpot, a provider of social media and other analytics tools.

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Dollar Shave Club Viral Ad

Viral videos alone don't make a winning firm, but Dollar Shave Club founder & CEO Mike Dublin (who trained with the legendary comedy group Upright Citizens Brigade) leveraged spot-on timing in an irreverent video to launch his low-cost, direct-to-consumer brand of men's razors. In three months, the video here, which cost just $4,500 to produce (owned media), was widely shared via social media, receiving over 4.75 million views (earned media) from consumers who would never think of posting a Gillette commercial. Four years later the firm had a $200 million-a-year sales run rate and was bought by Unilever for $1 billion.



View the video online at: http://www.youtube.com/embed/ZUG9qYTJMsI?rel=0

Key Takeaways

- Blogs provide a rapid way to distribute ideas and information from one writer to many readers.
- Search engines, social media sharing, and trackbacks allow a blogger's community of readers to spread the word on interesting posts and help distinguish and reinforce the reputations of widely read blogs.
- The comments section in blogs can create a conversation to gather opinion, vet ideas, and brainstorm. Public commentary can also apply pressure to correct inaccuracies and keep a blogger honest.
- Well-known blogs can be powerfully influential, acting as flashpoints on public opinion.
- Firms ignore influential bloggers at their peril, but organizations should also be cautious about how they use and engage blogs and avoid flagrantly promotional or biased efforts.
- Senior executives from several industries use blogs for business purposes, including marketing, sharing ideas, gathering feedback, press response, image shaping, and reaching consumers directly without press filtering.
- Blogs are a type of "owned" media, but when users online share blog posts from an organization, this constitutes a type of "earned" media that generates even more awareness at no additional cost.
- Effective blogs can improve a firm's SEO (search engine rankings results), making the firm easier to find and possibly pushing online visibility ahead of rivals.

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Questions and Exercises

1. Search online to find out which blogs are currently the most popular. Why do you suppose the leaders are so popular?
2. How are popular blogs discovered? How is their popularity reinforced?
3. Are blog comment fields useful? If so, to whom or how? What is the risk associated with allowing users to comment on blog posts? How should a blogger deal with comments that they don't agree with?
4. Why would a corporation, an executive, a news outlet, or a college student want to blog? What are the benefits? What are the concerns?
5. Identify firms and executives that are blogging online. Bring examples to class and be prepared to offer your critique of their efforts. Show what you feel are effective examples, as well as those that you think are weak. How can the bad ones improve?
6. Investigate blogs that aren't corporate but that you still find useful. Share your list of favorites with your professor. Why do you like the blogs on your list? Are there blogs that are particularly useful for students of this course? Which ones?
7. Investigate current US Federal Trade Commission laws (or the laws in your home country) that govern bloggers and other social media use. How do these restrictions impact how firms interact with bloggers? What are the penalties and implications if such rules aren't followed? Are there unwritten rules of good practice that firms and bloggers should consider as well? What might those be?
8. What advantage do blogs have over the MSM? What advantage does the MSM have over the most popular blogs?
9. Start a blog using Tumblr, Blogger.com, WordPress.com, or some other blogging service. Post a comment to another blog. Look for the trackback field when making a post—if it's available, be sure to enter the trackback for any content you cite in your blog.
10. Gather examples of paid, earned, and owned media. Share with your class. Indicate whether you find this media effective or ineffective and if you've got suggestions for improvement, share them with your class.

9.3 Wikis

Learning Objectives

1. Know what wikis are and how they are used by corporations and the public at large.
2. Understand the technical and social features that drive effective and useful wikis.
3. Suggest opportunities where wikis would be useful and consider under what circumstances their use may present risks.
4. Recognize how social media such as wikis and blogs can influence a firm's customers and brand.

wiki

A website that can be modified by anyone, from directly within a web browser (provided that user is granted edit access).

A **wiki** is a website anyone can edit directly within a Web browser (provided the site grants the user edit access). Wikis derive their name from the Hawaiian word for "quick." Wikis can be one of the speediest ways to collaboratively create content online.

Many popular online wikis serve as a shared knowledge repository in some domain. The largest and most popular wiki is Wikipedia, but there are hundreds of publicly accessible wikis that anyone can participate in, with examples including Wine Wiki for oenophiles, Brickipedia for Lego enthusiasts, and Wookieepedia, the Star Wars wiki. Wikis can also be used for any collaborative

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effort—from meeting planning to project management. And in addition to the hundreds of public wikis, there are many thousand more that are hidden away behind firewalls, used as proprietary internal tools for organizational collaboration. Many wikis also serve as knowledge management systems that act as a sort of collective corporate memory that's vital for sharing skills, learning, and preserving expertise even when employees leave the firm.

Want to add to or edit a wiki entry? On most sites you just click the "Edit" link. Wikis support **what you see is what you get (WYSIWYG)** editing that, while not as robust as traditional word processors, is still easy enough for most users to grasp without training or knowledge of arcane code or markup language. Users can make changes to existing content and can easily create new pages or articles and link them to other pages in the wiki. Wikis also provide a version history. Click the "History" link on Wikipedia, for example, and you can see when edits were made and by whom. This feature allows the community to **roll back** a wiki to a prior state, in the event that someone accidentally deletes key info, or intentionally defaces a page. While the downside of most wikis is that only one person at a time can edit a page, many users find the version history and roll back features of wikis to be more clear than collaborating simultaneously in a tool such as Google Docs or Office365.

what you see is what you get (WYSIWYG)
A phrase used to describe graphical editing tools, such as those found in a wiki, page layout program, or other design tool.

roll back
The ability to revert a wiki page to a prior version. This is useful for restoring earlier work in the event of a posting error, inaccuracy, or vandalism.

Wikis are available both as software (commercial as well as open source varieties) that firms can install on their own servers and as hosted online services (subscription or ad-supported) where software and content are housed "in the cloud" by third parties that run the technology for wiki users. Since wikis can be started without the oversight or involvement of a firm's IT department, their appearance in organizations often comes from grassroots user initiative.

Wikis

As with blogs, a wiki's features set varies depending on the specific wiki tool chosen, as well as administrator design, but most wikis support the following key features:

- All changes are *attributed*, so others can see who made a given edit.
- A complete *revision history* is maintained so changes can be compared against prior versions and rolled back as needed.
- There is automatic *notification* and *monitoring* of updates; users subscribe to wiki content and can receive updates via e-mail or RSS feed when pages have been changed or new content has been added.
- All the pages in a wiki are *searchable*.
- Specific wiki pages can be classified under an organized *tagging* scheme.

Jump-starting a wiki can be a challenge, and an underused wiki can be a ghost town of orphan, out-of-date, and inaccurate content. Fortunately, once users see the value of wikis, use and effectiveness often snowballs. The unstructured nature of wikis is also both a strength and weakness. Some organizations employ **wikimasters** to "garden" community content: "prune" excessive posts, "transplant" commentary to the best location, and "weed" as necessary.

wikimasters
Individuals often employed by organizations to review community content in order to delete excessive posts, move commentary to the best location, and edit as necessary.

The larger and more active a wiki community, the more likely it is that content will be up to date and that errors or vandalism will be quickly corrected (again, we see the influence of network effects, where products and services with larger user bases become more valuable). At Wikipedia, for example, **griefers** and partisans regularly alter pages (in one noteworthy stretch, the page of former US President Jimmy Carter was regularly replaced with a photo of a "scruffy, random unshaven man with his left index finger shoved firmly up his nose)."[45] But the Wikipedia community is so large and attentive that such changes are often recognized in seconds and rolled back, and mischief makers soon give up and move on. Several studies have shown that large community wiki entries are as or more accurate than professional publication counterparts.[46]

griefers
Internet vandal and mischief maker; also sometimes referred to as a troll.

Wikis can make workers more productive and informed, and kill corporate time-wasters. At Disney's Pixar, wikis are used to improve meeting efficiency, with agendas and key materials dis-

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tributed in advance. Posting corrections, comments, goals, deadlines, and completion keeps everyone involved and aware of expectations and progress.[47] Sony uses wikis for cross-functional collaboration on projects (finance, engineering, marketing), with secure access making sure that information is released on a need-to-know basis. Nonprofits, investment banks, law offices, even the US intelligence services all take advantage of the power of wikis.[48]

Wiki use at Kiva.org

In this promotional video from Atlassian, makers of the Confluence wiki, members of microlending non-profit Kiva.org share how their wiki use better fits the needs of their organization, citing that all new projects start with a wiki page.



View the video online at: http://www.youtube.com/embed/3gJDapvSxo0?rel=0

neutral point of view (NPOV)

An editorial style that is free of bias and opinion. Wikipedia norms dictate that all articles must be written in NPOV.

Don't Underestimate the Power of Wikipedia

Not only is the nonprofit Wikipedia, with its enthusiastic army of unpaid experts and editors, replacing the three-hundred-year reference reign of *Encyclopedia Britannica*, Wikipedia entries can impact nearly all large-sized organizations. Wikipedia is the go-to, first-choice reference site for a generation of "netizens," and Wikipedia entries are invariably one of the top links, often the first link, to appear in Internet search results.

This position means that anyone, from top executives to political candidates to any firm large enough to warrant an entry, has to contend with the very public record of Wikipedia. In the same way that firms monitor their online reputations in blog posts and Twitter tweets, they've also got to keep an eye on wikis.

But firms that overreach and try to influence an entry outside of Wikipedia's mandated **neutral point of view (NPOV)** risk a backlash and public exposure. Version tracking means the wiki sees all. Wikipedia banned edits from IP addresses used by the US Congress after staffers were outed for trolling;[49] controversial former Trump aide Sebastian Gorka was accused of editing information in his own Wikipedia entry as it related to a gun charge;[50] Sony staffers were flagged as editing the entry for a version of the exclusive Xbox Halo game;[51] and none other than Wikipedia founder Jimmy Wales was criticized for editing his own Wikipedia biography[52]—acts that some consider bad online form at best, and dishonest at worst.

One last point on using Wikipedia for research. Remember that according to its own stated policies, Wikipedia isn't an original information source; rather, it's a clearinghouse for verified information. So citing Wikipedia as a reference usually isn't considered good form. Instead, seek out original (and verifiable) sources, such as those presented via the links at the bottom of Wikipedia entries.

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Key Takeaways

- Wikis can be powerful tools for many-to-many content collaboration, and can be ideal for creating resources that benefit from the input of many, such as encyclopedia entries, meeting agendas, and project status documents.
- The greater the number of wiki users, the more likely the information contained in the wiki will be accurate and grow in value.
- Wikis can be public or private.
- The availability of free or low-cost wiki tools can create a knowledge clearinghouse on topics, firms, products, and even individuals. Organizations can seek to harness the collective intelligence (wisdom of crowds) of online communities, and create a living knowledge repository. The openness of wikis also acts as a mechanism for promoting organizational transparency and accountability.

Questions and Exercises

1. Visit a wiki, either an established site like Wikipedia, or a wiki service like Socialtext, PBworks, or Atlassian Confluence. Make an edit to a wiki entry or use a wiki service to create a new wiki for your own use (e.g., for a class team to use in managing a group project). Be prepared to share your experience with the class.
2. What factors determine the value of a wiki? Which key concept, first introduced in Chapter 2, drives a wiki's success?
3. If anyone can edit a wiki, why aren't more sites crippled by vandalism or by inaccurate or inappropriate content? Are there technical reasons not to be concerned? Are there "social" reasons that can alleviate concern?
4. Give examples of corporate wiki use, as well as examples where firms used wikis to engage their customers or partners. What is the potential payoff of these efforts? Are there risks associated with these efforts?
5. Do you feel that you can trust content in wikis? Do you feel this content is more or less reliable than content in print encyclopedias? Than the content in newspaper articles? Why?
6. Have you ever run across an error in a wiki entry? Describe the situation.
7. Is it ethical for a firm or individual to edit its own Wikipedia entry? Under what circumstances would editing a Wikipedia entry seem unethical to you? Why? What are the risks a firm or individual are exposed to when making edits to public wiki entries? How do you suppose individuals and organizations are identified when making wiki edits?
8. Would you cite Wikipedia as a reference when writing a paper? Why or why not?

9.4 Social Networks

Learning Objectives

1. Know what social networks are, be able to list key features, and understand how they are used by individuals, groups, and corporations.
2. Understand the difference between major social networks such as Facebook, Google+, and LinkedIn.

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3. Recognize the benefits and risks of using social networks.
4. Be aware of trends that may influence the evolution of social networks.

social networks

An online community that allows users to establish a personal profile and communicate with others. Large public social networks include Facebook, LinkedIn, Google+, and Pinterest.

Social networks allow you to set up a profile, share content, comment on what others have shared, and follow the updates of particular users, groups, firms, and brands that may also be part of those networks. Many also are platforms for the deployment of third-party applications. The two most dominant public social networks are Facebook and LinkedIn, sites often described as the personal and professional networks, respectively. But there are also several other potentially high-value social networks that firms should consider. Instagram is photo-centric and more than a messaging app, but has fewer features than parent Facebook, but the site now has more users than Twitter and Snapchat, combined.[53] Instagram's estimated 2018 advertising revenue is nearly $7 billion.[54] Instagram now has over 200,000 advertisers on its platform, and 98 of the top 100 advertisers on Facebook also choose to advertise on Instagram.[55] Google+ is smaller and has less engaged users than Facebook, but it is also integrated into the Google toolbar, the search feature, Gmail, and many of the Web giant's other services. And the Hangouts feature of Google+ (a video chat and broadcast platform with integrated messaging) is considered an "unmitigated success"[56] that is transforming workplace collaboration and webinars[57] while providing a platform for everything from online education to hosting live concerts.[58] And a host of third-party networks, including Ning, Lithium, and SelectMinds (now part of Oracle), allow firms to "roll their own" private networks.

Another example is the visually oriented social network Pinterest, which is driving cool-hunting, high-value buyers. Web-based home furnishings provider One Kings Lane benefits greatly from the viral sharing of Pinterest fans. Since offering "Pin It" buttons next to all items sold on its website, Pinterest traffic has nearly exceeded that of Facebook, while referrals from Pinterest are three times more likely to result in a sale than visits from the site's typical visitor.[59] The Pinterest buy button is an obvious evolution, moving the firm from public scrapbook to shopping cart.[60] Some see Pinterest as a powerful vehicle for e-commerce, since it focuses on the interest graph (what I like) rather than simply the social ties of "who I know."

Hundreds of firms have established pages on major social networks, and these are now legitimate customer- and client-engagement platforms. Social networks are a hothouse for "earned" media, where enthusiast-consumers can help spread the word about products and services. Much of the activity that takes place on social networks is spread via feed (or news feed). Pioneered by Facebook but now adopted by most services, feeds provide a timely list of the activities of and public messages from people, groups, and organizations that an individual has an association with.

viral

In this context, information or applications that spread rapidly between users.

Feeds are inherently **viral**. By seeing what others are doing on a social network, and by leveraging the power of others to act as word-of-mouth evangelists, feeds can rapidly mobilize populations, prompt activism, and offer low-cost promotion and awareness of a firm's efforts. Many firms now see a Facebook presence and social engagement strategy as vital. Facebook's massive size and the viral power of spreading the word through feeds, plus the opportunity to invite commentary and engage consumers in a dialogue, rather than a continual barrage of promotion, is changing the way that firms and customers interact (indeed, you'll hear many successful social media professionals declare that social media is more about conversations with customers than about advertising-style promotion).

Feeds are also controversial. Many users have reacted negatively to a public broadcast of their online activity, and feed mismanagement can create accusations of spamming, public relations snafus, a reduction in the likelihood that a firm's message will appear in a given fan's feed, and user discontent, and can potentially open up a site to legal action. And some networks are curating user feeds, so it's not guaranteed that what you're posting on social networks will even be seen. Want more reach? Most firms will sell you this through its advertising products.

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Social Networks

The foundation of a social network is the user profile, but utility goes beyond the sort of listing found in a corporate information directory. Typical features of a social network include support for the following:

- Detailed personal profiles
- Affiliations with *groups* (e.g., alumni, employers, hobbies, fans, health conditions, causes); with *individuals* (e.g., specific "friends"); and with *products*, *firms*, and other *organizations*
- Private *messaging* and public *discussions*
- Media *sharing* (text, photos, video)
- Discovery-fueling feeds of recent activity among members (e.g., status changes, new postings, photos, applications installed)

While Facebook was originally targeted at the social lives of college students (see Chapter 11), LinkedIn was conceived from the start as a social network for business users. On LinkedIn, members post profiles and contact information, list their work history, and can be "endorsed" by others on the network. It's sort of like having your resumé and letters of recommendation in a single location. Users can pose questions to members of their network, engage in group discussions, and ask for introductions through mutual contacts. The site has also introduced a variety of additional services, including messaging, information sharing, and news and content curation—yes, LinkedIn will help you find stuff you're likely to be most interested in (wasn't that Google's job?). Services owned by LinkedIn include SlideShare, a great place to discover educational presentations (and for individuals and firms to showcase their best work); and Lynda.com, an online education platform where users can learn all sorts of new skills.[61] Want tips on how to best use the service? Look online for "LinkedIn for Students." LinkedIn also makes money from online ads, premium subscriptions, and hiring tools for recruiters.

Active members find the site invaluable for maintaining professional contacts, seeking peer advice, networking, and even recruiting. The manager of enterprise staffing at Starbucks has stated that LinkedIn is "one of the best things for finding midlevel executives,"[62] while others claim it is a far better place to uncover quality candidates than sites like Monster.com or CareerBuilder.[63] Several of my former students have been hired by Apple and other elite tech firms when HR contacted them over LinkedIn, citing interest piqued from their shared programming projects on GitHub, and their activity on the Q&A coder network Stack Overflow. Such networks are also putting increasing pressure on firms to work particularly hard to retain top talent. While once HR managers fiercely guarded employee directories for fear that a list of talent may fall into the hands of rivals, today's social networks make it easy for anyone to gain a list of a firm's staff, complete with contact information and a private messaging channel.

Corporate Use of Social Networks

Social networks have also become organizational productivity tools. While LinkedIn can help network all of a firm's employees, and Facebook has introduced a similar "Facebook at Work" service, many firms are choosing to implement their own internal social network platforms that they hope are more secure and tailored to firm needs. At the most basic level, these networks have supplanted the traditional employee directory. Social network listings are easy to update and expand, and employees are encouraged to add their own photos, interests, and expertise to create a living digital identity.

Firms such as Deloitte, Dow Chemical, and Goldman Sachs have created social networks for "alumni" who have left the firm or retired. These networks can be useful in maintaining contacts for

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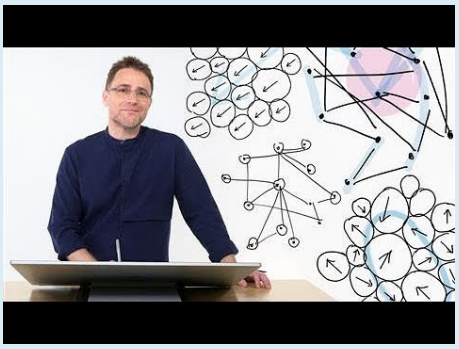
future business leads, rehiring former employees (20 percent of Deloitte's experienced hires are so-called *boomerangs*, or returning employees), or recruiting retired staff to serve as contractors when labor is tight.[64] Maintaining such networks will be critical in industries like IT and health care that are likely to be plagued by worker shortages for years to come.

Social networking can also be important for organizations like IBM, where some 42 percent of employees regularly work from home or client locations. IBM's social network makes it easier to locate employee expertise within the firm, organize virtual work groups, and communicate across large distances.[65] As a dialogue catalyst, a social network transforms the public directory into a font of knowledge sharing that promotes organization flattening and value-adding expertise sharing.

While IBM has developed its own social network platforms, firms are increasingly turning to third-party vendors like SelectMinds (adopted by Deloitte, Dow Chemical, and Goldman Sachs) and LiveWorld (adopted by Intuit, eBay, the NBA, and Scientific American). With more robust corporate tools now offered by LinkedIn and Facebook, we might see proprietary, in-house efforts start to migrate there over time. The corporate messaging service Slack is also emerging as a major enterprise networking player. Channels are archived, easily searchable, and accessible across desktop and mobile. Entrepreneurs take note: Slack (started by Flickr co-founder Stewart Butterfield) shows that an elegant, easy-to-use solution that delivers value can grow big, even as social giants bulk up their services. *The New York Times* calls the tool the "App that may finally kill email."[66] They should know, the *Times* is a user, along with other biggies that include Walmart, HBO, and even the US State Department.[67]

The Future of Work

Hear Slack co-founder Stewart Butterfield discuss "The Future of Work" and how his firm improves on e-mail for organizational coordination.



View the video online at: http://www.youtube.com/embed/mHXJkZwJlUI?rel=0

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A Little Too Public?

As with any type of social media, content flows in social networks are difficult to control. Embarrassing disclosures can emerge from public systems or insecure internal networks. Employees embracing a culture of digital sharing may err and release confidential or proprietary information. Networks could serve as a focal point for the disgruntled (imagine the activity on a corporate social network after a painful layoff). Publicly declared affiliations, political or religious views, excessive contact, declined participation, and other factors might lead to awkward or strained employee relationships. Users may not want to add a co-worker as a friend on a public network if it means they'll expose their activities, lives, persona, photos, sense of humor, and friends as they exist outside of work. And many firms fear wasted time as employees surf the musings and photos of their peers.

All are advised to be cautious in their social media sharing. Employers are trawling the Internet, mining Facebook, and scouring YouTube for any tip-off that a would-be hire should be passed over. A word to the wise: those Facebook party pics, YouTube videos of open mic performances, snarky Stack Overflow responses, or blog postings from a particularly militant period might not age well and may haunt you forever in a Google search. Think twice before clicking the upload button! As *Socialnomics* author Erik Qualman puts it, "What happens in Vegas stays on YouTube (and Flickr, Twitter, Facebook…)."

Firms have also created their own online communities to foster brainstorming and customer engagement. Dell's IdeaStorm.com forum collects user feedback and is credited with prompting line offerings, such as the firm's introduction of a Linux-based laptop.[68] At MyStarbucksIdea.com, the coffee giant has leveraged user input to launch a series of innovations ranging from splash sticks that prevent spills in to-go cups, to new menu items. Both IdeaStorm and MyStarbucksIdea run on a platform offered by Salesforce.com that not only hosts these sites but also provides integration into Facebook and other services. Starbucks (36.2 million Facebook "fans"[69]) has extensively leveraged the site, using Facebook as a linchpin in the "Free Pastry Day" promotion (credited with generating one million in-store visits in a single day) and promotion of the firm's AIDS-related RED campaign, which garnered an astonishing three hundred ninety million "viral impressions" through feeds, wall posts, and other messaging.[70]

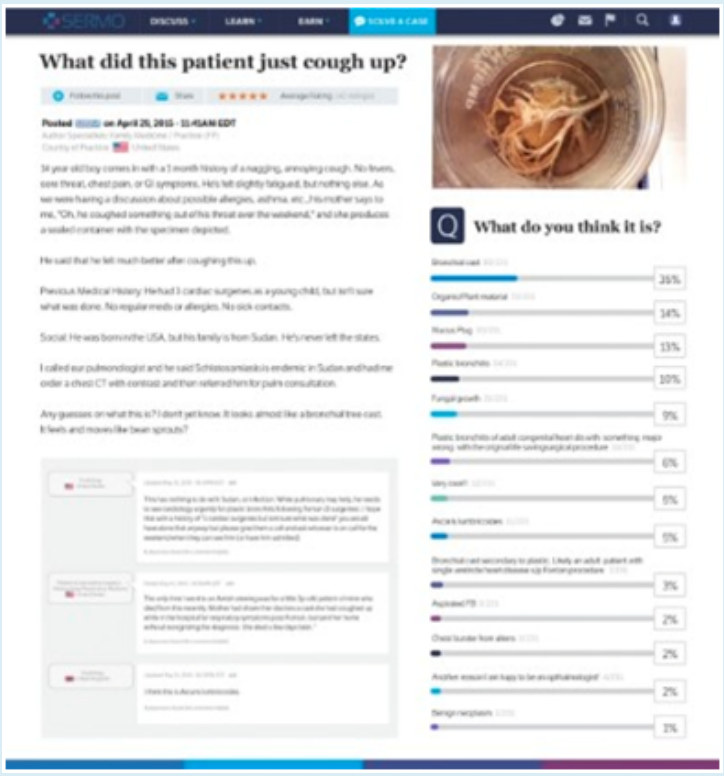
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Social Networks and Health Care

The mother of a fourteen-year-old boy returned to his doctor after her son coughed up a strange "branch-like" mass. The boy had no sore throat, pains, or fever. His lungs were clear, and he reported feeling better after expectorating the mass. The boy's doctor prepped the specimen to send out for lab analysis, but doc first took a photo of it, and posted it to Sermo, a social network for physicians. He invited other doctors to comment and included a survey asking colleagues what they thought it was. Answers started coming in within thirty minutes, and the consensus prompted urgent action. One doc posted, "He needs to see cardiology urgently for plastic bronchitis" (ultimately proved to be the correct diagnosis). Another shared that a three-year-old patient had died recently when a similar plastic bronchitis incident went undiagnosed. Plastic bronchitis is an extremely rare respiratory illness and most primary care physicians have never encountered it. Thanks to Sermo, the boy was referred to specialists before any lab results came back, and he was treated successfully.[71]

FIGURE 9.3 Social Network Diagnosis
A photo posted to the physicians' social network Sermo of a mass coughed up by an otherwise healthy fourteen-year-old patient prompted life-saving treatment to get under way even before lab results were returned.



Source: Courtesy of Sermo.

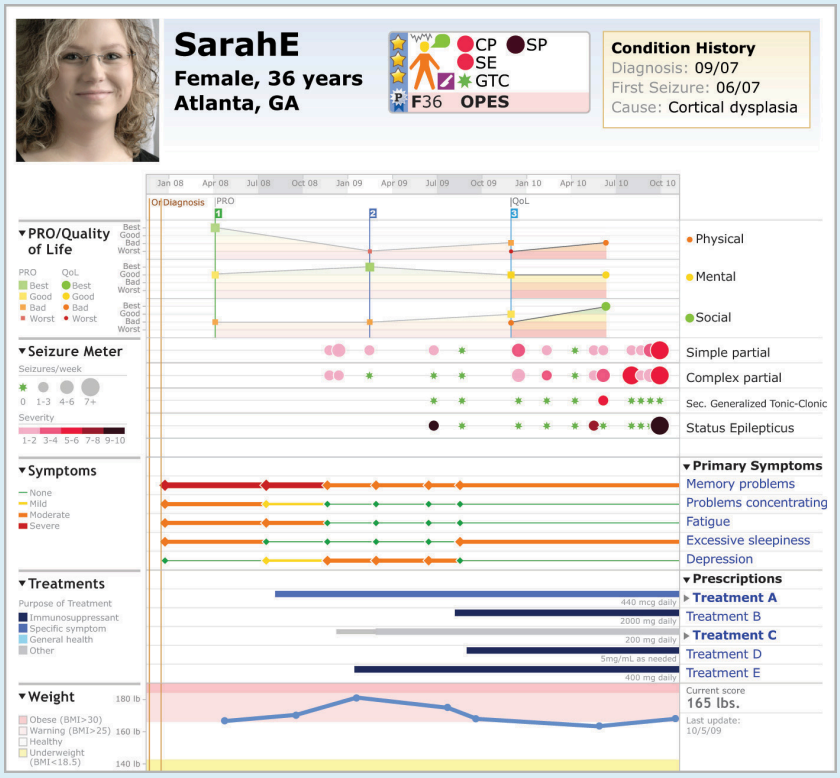
Sermo (which means conversation in Latin) is a godsend to physicians looking to gain peer opinion on confounding cases or other medical questions. Sermo claims most doctors receive responses within an hour and a half of posting, and most cases are solved within twenty-four hours. Eighty-five percent of posting physicians say they received information they were looking for. More than 340,000 doctors in the US and UK are Sermo members, although a much smaller percentage is active on the site. Member physicians are first screened and verified to maintain the integrity of the service. Harnessing the wisdom of the medical crowd can be powerful. The US National Center on Policy Analysis reports that from 10 to 20 percent of cases are misdiagnosed annually, and 28 percent of those are life-threatening, contributing to some 40,000 diagnostic error deaths each year, just in US intensive care units. In a recent year, member physicians posted 3,500 challenging patient cases to the site, which were viewed 700,000

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times and received 50,000 total comments.[72] Sermo posts can also send valuable warning signals on issues such as disease outbreaks or unseen drug side effects. And doctors have also used the service to rally against insurance company policy changes.[73]

FIGURE 9.4 PatientsLikeMe
These are some of the rich health monitoring and sharing tools available on PatientsLikeMe. Note that treatments, symptoms, and quality-of-life measures can be tracked over time.



Source: PatientsLikeMe, 2011.

While Sermo focuses on the provider side of the health care equation, PatientsLikeMe (PLM) offers a social network empowering chronically ill patients across a wide variety of disease states. The firm's "openness policy" is in contrast to privacy rules posted on many sites and encourages patients to publicly track and post conditions, treatments, and symptom variation over time, using the site's sophisticated graphing and charting tools. The goal is to help others improve the quality of their own care by harnessing the wisdom of crowds.

Todd Small, a multiple sclerosis sufferer, used the member charts and data on PLM to discover that his physician had been undermedicating him. After sharing site data with his doctor, his physician verified the problem and upped the dose. Small reports that the finding changed his life, helping him walk better than he had in a decade and a half and eliminating a feeling that he described as being trapped in "quicksand."[74] In another example of PLM's people power, the site ran its own clinical trial–like experiment to rapidly investigate promising claims that the drug Lithium could improve conditions for ALS (amyotrophic lateral sclerosis) patients. While community efforts did not support these initial claims, a decision was arrived at in months, whereas previous efforts to marshal researchers and resources to focus on the relatively rare disease would have taken many years, even if funding could be found.[75]

Both Sermo and PatientsLikeMe are startups that are still exploring the best way to fund their efforts for growth and impact. Regardless of where these firms end up, with the rise of new methods for users to track and share health and fitness information (e.g., Apple's HealthKit and ResearchKit, and Google's Fit), it should be clear from these examples that social media will remain a powerful force on the health care landscape.

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Key Takeaways

- Electronic social networks help individuals maintain contacts, discover and engage people with common interests, share updates, and organize as groups.
- Modern social networks are major messaging services, supporting private one-to-one notes, public postings, and broadcast updates or "feeds."
- Social networks also raise some of the strongest privacy concerns, as status updates, past messages, photos, and other content linger, even as a user's online behavior and network of contacts changes.
- Network effects and cultural differences result in one social network being favored over others in a particular culture or region.
- Information spreads virally via news feeds. Feeds can rapidly mobilize populations and dramatically spread the adoption of applications. The flow of content in social networks is also difficult to control and sometimes results in embarrassing public disclosures.
- Feeds have a downside and there have been instances where feed mismanagement has caused user discontent, public relations problems, and the possibility of legal action.
- The use of public social networks within private organizations is growing, and many organizations are implementing their own, private, social networks. LinkedIn is seen as a key recruiting, contact maintenance, and learning tool, while corporate messaging tools like Slack are used to increase employee productivity.
- Firms are also setting up social networks for customer engagement and mining these sites for customer ideas, innovation, and feedback.

Questions and Exercises

1. Visit the major social networks (Facebook, LinkedIn, Google+, Pinterest). What distinguishes one from the other? Are you a member of any of these services? Why or why not?
2. How are organizations like Deloitte, Goldman Sachs, and IBM using social networks? What advantages do they gain from these systems?
3. What factors might cause an individual, employee, or firm to be cautious in their use of social networks?
4. How do you feel about the feed feature common in social networks like Facebook? What risks does a firm expose itself to if it leverages feeds? How might a firm mitigate these kinds of risks?
5. Investigate Workplace by Facebook. Would you want to use this service? Would it concern you? Why or why not?
6. What sorts of restrictions or guidelines should firms place on the use of social networks or the other Web 2.0 tools discussed in this chapter? Are these tools a threat to security? Can they tarnish a firm's reputation? Can they enhance a firm's reputation? How so?
7. Why do information and applications spread so quickly within networks like Facebook? What feature enables this? What key promotional concept (described in Chapter 2) does this feature foster?
8. Investigate social networks on your own. Look for examples of their use for fostering political and social movements; for their use in health care; and for their use among other professional groups or enthusiasts. Identify how these networks might be used effectively, and also look for any potential risks or downside. How are these efforts supported? Is there a clear revenue model, and do you find these methods appropriate or potentially controversial? Be prepared to share your findings with your class.
9. Investigate the Hangouts feature of Google+ and come to class prepared to discuss how it can be effectively used to improve your education experience. Consider inviting a guest speaker to have a Hangout with the class. Search online for tips on running an effective hangout, and share them with the speaker and your classmates before running the event. If

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the program is a success, share your experiences and recommendations with other faculty, your dean, and others at your university.

10. Visit Quora, Stack Exchange, or another popular question-and-answer site (considered a subset of social networks by some). Search the website. Did you find that a question you were interested in was already answered? Do you trust answers on these websites, and would you return to use them in the future? Why or why not?
11. Visit LinkedIn for Students. Use information on this page to create or enhance your own LinkedIn page. Share what you've learned with your class. Identify a "best practice" LinkedIn page and be prepared to share with your class why you think the page is so effective and what others can learn from the person profiled.
12. Visit SlideShare and browse on topics of interest. Do you find the site useful? Would you publish your own content here? Why or why not?
13. Firms often rely on young people to bring new social technologies into the firm. Keep pace with products: try an enterprise messaging tool like Slack, HipChat, or other social service (most have free trials or are free for a small number of users). Use it for a club or group project. Report back to your class on your experiences, and offer a review.

9.5 Twitter and the Rise of Microblogging

Learning Objectives

1. Appreciate the rapid rise of Twitter—its scale, scope, and broad appeal.
2. Understand how Twitter is being used by individuals, organizations, and political movements.
3. Contrast Twitter and microblogging with Facebook, conventional blogs, and other social media efforts.
4. Understand how organizations use Twitter for organic as well as paid promotion.
5. Consider the commercial viability of the effort, its competitive environment, and concerns regarding growth.

Twitter is a microblogging service that allows users to post 280-character messages (tweets) via the Web, SMS, or a variety of third-party desktop and smartphone applications. Originally spawned as a side project at the now-failed podcasting start-up Odeo (an effort backed by Blogger.com founder Evan Williams), Twitter has morphed into one of the most influential channels for public, global, instant communications. Today virtually every significant website and mobile app has some form of Twitter integration, and it's rare to listen to a news or entertainment broadcast without hearing how you can "follow" or "connect" via the service. Twitter has 330 million monthly active users (MAUs)[76] and its influence (with tweets picked up in the news, published in media, and leveraged for activism) extends far beyond its base of regular users. Over 500 million tweets are sent each day—80 percent or more via smartphones.[77]

The site also allows for the direct posting of images, video captured and edited within the Twitter app, or through Periscope, a real-time video streaming and video archiving service. The microblog moniker is a bit of a misnomer. The service actually has more in common with Facebook's status updates and news feeds than it does with traditional blogs. But unlike Facebook, where most users must approve "friends" before they can see status updates, Twitter's default setting allows for asymmetrical following (although it is possible to set up private Twitter accounts and to block followers).

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Twitter leadership has described the service as communicating "The Pulse of the Planet."[78] Sure, there's a lot of inane "tweeting" going on, but for many, Twitter is a discovery engine; a taste-making machine; a critical source of market intelligence; a source of breaking news; a learning channel; a feedback source; an educational tool; a way to stay connected with family, friends, colleagues, and thought leaders; and an instantaneous way to plug into the moment's zeitgeist.

hashtags
A method for organizing tweets where keywords are preceded by the # character.

Users can classify comments on a given topic using **hashtags** (keywords preceded by the "#" or "hash" symbol), allowing others to quickly find related tweets (e.g., #iranelection, #oscars, #BringBackOurGirls, #sxsw). Hashtags were initially a user-created innovation that Twitter embraced, and that has been copied by several other social services. Any user can create a hashtag—just type it into your tweet (you may want to search Twitter first to make sure that the tag is not in use by an unrelated topic and that if it is in use, it appropriately describes how you want your tweet classified).

FIGURE 9.5 Bin Laden's Neighbor Accidentally Tweets the US Raid
Tweets (topmost is most recent) by Abbottabad, Pakistan-based IT consultant Sohaib Athar (Twitter handle @ReallyVirtual), who had no idea (1) that Osama Bin Laden was his neighbor and (2) that his tweets about the neighborhood disturbance were actually a live account of a US raid.



Source: J. O'Dell, "One Twitter User Reports Live from Osama Bin Laden Raid," *Mashable*, May 2, 2011.

Social media-savvy organizations also use Twitter as a business tool. Organizations have found Twitter useful for real-time promotions, for time-sensitive information, for scheduling and yield management, for customer engagement and support, for promotion, for intelligence gathering, for idea sourcing, and as a sales channel.

Consider the following commercial examples:

- Starbucks uses Twitter in a variety of ways. It has run Twitter-based contests and used the service to allow customers to request free samples of new products, such as its VIA instant coffee line. Twitter has also been a way for the company to engage customers in its cause-based marketing efforts, such as (Starbucks) RED, which supports (Product) RED. The firm has recruited staff via Twitter and was one of the first firms to participate in Twitter's advertising model featuring "promoted tweets." Starbucks even allows you to "Tweet a Coffee," sending a valid eGift card to anyone using the service.
- Despite Twitter shrinking its own commerce team and dropping its experiment with a "Buy" button, several firms have experimented with leveraging Twitter for sales. Amazon allows Twitter users to mark items for order using the hashtag #AmazonCart. Domino's has experimented with allowing users to order a pizza via hashtag or pizza emoji. And Chipotle used Twitter to give away free burritos in an effort to generate traffic after several disastrous health-related issues.
- Dell used Twitter to uncover an early warning sign indicating poor design of the keyboard on one of its portable computers. After a series of tweets from early adopters indicated that the apostrophe and return keys were positioned too closely together, the firm dispatched design change orders quickly enough to correct the problem when the next version of the product was launched just three months later.[79]
- Twitter is credited with having raised millions via Text-to-Donate and other fundraising as part of global disaster relief. Services now allow users to donate directly via tweeting a specific hashtag after linking the service to a payment method.[80]
- Twitter can be a boon for sharing time-sensitive information. The True Massage and Wellness Spa in San Francisco tweets last-minute cancellations to tell customers of an unexpected schedule opening. With Twitter, appointments remain booked solid. Gourmet food trucks are also using Twitter to share location and create hipster buzz. Los Angeles's Kogi Korean BBQ Taco Truck now has over 158,000 followers and uses Twitter to reveal where it's parked, ensuring long lines of BBQ-craving foodies. Of the firm's success, owner Roy Choi says, "I have to give all the credit to Twitter."[81]

Organizations are well advised to monitor Twitter activity related to the firm, as it can act as a sort of canary-in-a-coal mine uncovering emerging events. Users are increasingly using the service as a way to form flash protest crowds. Amazon.com, for example, was caught off-guard over a holiday weekend when thousands used Twitter to rapidly protest the firm's reclassification of gay

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and lesbian books (#amazonfail). Others use the platform for shame and ridicule. BP has endured withering ridicule from the satire account @BPGlobalPR (followed by roughly 200,000 people two months after the Deepwater Horizon spill).

Organic Reach and Advertising

Facebook posts are curated by the firm's algorithms, and not every post to a fan page is seen by people who have "liked" a page. In fact, Facebook's algorithms have continually decreased the reach of fan page posts, meaning that firms are reaching fewer and fewer of their fans (although Facebook will gladly sell firms ad products to improve reach).[82] For a long time, Twitter's timeline was chronological, showing all tweets of everyone you followed ending with the most recent post. However, Twitter has shifted to an algorithmic timeline that will first show tweets from people that you interact with as well as some of the more popular recent tweets from those you follow. Users can still scroll or change settings to see the old chronological timeline, but by surfacing popular posts, Twitter becomes even more of a virality machine, allowing popular tweets to catch fire as even more users see them.[83] Engaging users with something interesting? You may get retweeted, and the more tweets early on, the greater the likelihood that Twitter will feature the post that shows demonstrated interest. Savvy firms have realized that tweeting during televised events that have a high degree of Twitter chatter (e.g., awards shows, sporting events) increases the chances that followers will see a post and react to it, promoting the viral spread of a message. When the power went out in the New Orleans Superdome during Super Bowl XLVII, the fast-acting Oreo social-media team mocked up an image that garnered thousands of retweets and favorites and went on to be subsequently mentioned in hundreds of media outlets discussing game events.

FIGURE 9.6 A Clever Tweet from Oreo
Oreo's clever tweet during an unexpected power outage during Super Bowl XLVII created timely buzz while many fans were engaged on second screens.



Source: Twitter.

Twitter will also sell products in hopes of boosting organic sharing. The firm now allows top advertisers to create limited-time custom emojis that pop up in conjunction with a user hashtag. Examples have included a Game of Thrones Night King that popped up when tweeting #WinterIsHere, an at-the-time rare curly-haired emoji used in Dove's #LoveYourCurls campaign, a baby dragon for Doritos UK's #HeatWillCome effort to celebrate the availability of limited-time spicy varieties, and a beer + handing over car keys for Budweiser's anti-drunk-driving #GiveADamn campaign. The custom emojis don't come cheap, with many deals topping $1 million, however campaigns using bespoke emojis have reported a 420 percent increase over baseline organic sharing.[84] Twitter will also create its own custom emojis, fueling celebratory online sharing, such as the #PopeInUS emoji of a smiling Pope Francis that appeared during the pontiff's first visit to the United States.

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FIGURE 9.7 A Selection of Twitter's Bespoke Emojis
Custom emojis that show up in conjunction with tweeting a hashtag can cost upwards of $1 million, but can also fuel vitality as emoji-lovers seek to share enthusiasm for a cause, campaign, or brand.



Source: John Gallaugher

The bulk of Twitter's business is in advertising, and the firm offers mechanisms to promote tweets. Users don't have to be following a firm to see its ad, which can be served whenever a user visits Twitter, and the service offers extensive targeting. All ads are targeted as "promoted," but they appear in the user's Twitter stream—exactly in the screen space that users are focusing on. Advertisers can promote tweets to any user based on a host of criteria, including geography, language, keywords, interests, and device type, even matching e-mail addresses to those in their CRM (customer relationship management systems) to reach prospects they already know. Also, like Google, these ads are billed on pay per performance. Advertisers pay only when users engage by clicking on a tweet, retweeting a promotion, replying, favoriting, or following. The firm also offers promoted account products, charging only when action is taken (i.e., someone new follows the promoted account).

SDK

Software development kit. Tools that allow the creation of products or add-ons for a specific operating system or other computing platform.

Twitter's fast-growing MoPub service connects advertisers that use ad networks like Google's AdMob, Apple's iAd, and Facebook's Audience Network with firms that want to auction off ad space in their apps and services (and it can use Twitter data for better ad targeting).[85] This is great for Twitter since it leverages data to make money without running more ads on its own service.[86] Twitter also pioneered an innovative software development kit (**SDK**), which included a number of tools for app developers, including crash reporting and analytics, but the firm eventually sold these tools to Google, keeping a smaller SDK focused on Twitter's core offering.[87]

While promoted tweets and MoPub have been successful, video is an even bigger moneymaker for Twitter, accounting for more than half of all Twitter advertising revenue.[88] Twitter's video advertising products include *promoted video*, where advertisers pay Twitter to show their videos as ads inside a user's feed, and Amplify, which offers a pre-roll advertiser in front of a publisher's video clip (say an NBA highlight, or a big play from MLB). Twitter splits ad revenue, keeping about 30 percent and turning the rest over to the video content rightsholder. All major US and many European networks have signed up to share content with Twitter Amplify,[89] as well as professional sports leagues, including the NFL, NBA, MLB, and PGA,[90] and an automated service allows any Twitter

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advertiser to upload and promote video using Amplify.[91] Twitter also sells video sponsorships for its live streamed shows. Users can watch Major League Baseball games, Live Nation concerts, ESPN shows, and fan-focused "after shows," and content from Vice media and BuzzFeed (deal specifics vary by show and advertiser).[92]

Twitter and Platform Challenges

Twitter also shows the challenges many firms face when weighing the advantages of being an open platform rather than a walled garden. Twitter initially made its data available for free to other developers via **APIs** (application programming interfaces). Exposing data can be a good move, as it spawned an ecosystem of over one hundred thousand complementary third-party products and services that enhance Twitter's reach and usefulness (generating *network effects* from complementary offerings similar to other "platforms" like Windows, iPhone, and Facebook). But there are potential downsides to such openness. If users don't visit Twitter.com, that makes it difficult to count users, serve profiling technologies such as tracking cookies (see Chapter 17), collect additional data on service use, and make money by serving ads or offering promotions on the website. All this creates what is known as the "**free rider problem**," where others benefit from a service while offering no value in exchange.

APIs

Programming hooks, or guidelines, published by firms that tell other programs how to get a service to perform a task such as send or receive data. For example, Amazon.com provides APIs to let developers write their own applications and websites that can send the firm orders.

free rider problem

When others take advantage of a user or service without providing any sort of reciprocal benefit.

When users don't visit a service, it makes it difficult to spread awareness of new products and features. It can also create branding challenges and customer frustration. Twitter execs lamented that customers were often confused when they searched for "Twitter" in the iPhone App Store and were presented with scores of offerings but none from Twitter itself.[93] Twitter's purchase of the iPhone app Tweetie (subsequently turned into the free "Twitter for iPhone" app), its acquisition of TweetDeck, and the launch of its own URL-shortening service (limiting opportunities for bit.ly and others) allowed the firm to bring in-house efforts that might otherwise lead to "user leakage" to other services. Twitter has also blocked users of Instagram, Tumblr, and live-streaming app Meerkat (which competed with the firm's Periscope acquisition)[94] from easily searching for friends who are on Twitter, nixed an agreement that fostered tweet syndication and other sharing on LinkedIn, and disconnected the popular Web automation service IFTTT (If This Then That).[95] Why help other firms grow at the expense of time spent on Twitter?

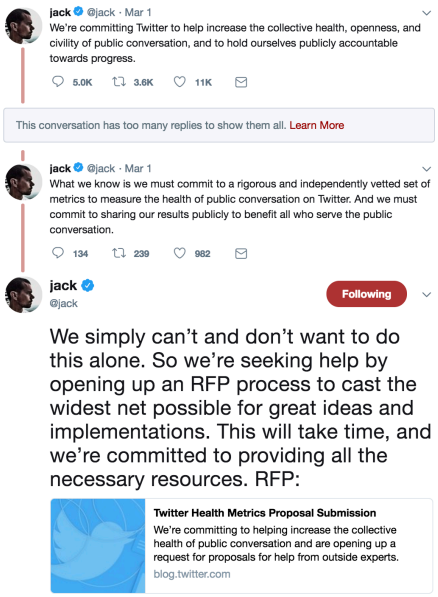
Tackling Trolls and Battling Bots

Twitter, like Facebook, has become a vehicle for foreign governments and purveyors of "fake news." In early 2018, Twitter alerted about 1.4 million US users that they may have retweeted, followed, or liked a propaganda account linked to the Russian government,[96] and the firm confirmed that as many as 50,000 automated "bots" were used with the express purpose of sowing confusion during the 2016 US presidential election.[97] The extent of foreign-fueled fake accounts continued well past the election, and has included Russian-linked troll-posts meant to exploit US voter fissures over gun rights following the Marjory Stoneman Douglas High School shooting in Parkland, Florida.[98] Examples of deceptive online Twitter personae include a 136,000-follower Twitter account @TEN_GOP, which appeared to be run by Republicans in Tennessee but is now known to have been a Russian troll account,[99] and the regularly resurfacing "Jenna Abrams," a Twitter handle that once had over 70,000 followers, but which Twitter concluded was linked to the Internet Research Agency, a Kremlin-linked troll farm based in St. Petersburg, Russia.[100]

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FIGURE 9.8 Civility on Twitter
Twitter CEO Jack Dorsey appealed to the firm's users to share ideas on improving civility of the Twitter public conversation.



Source: Twitter; https://twitter.com/jack/status/969234275420655616.

Even outside of government interference, Twitter has struggled with a troll problem that can, at times, make the network a hostile place. Says CEO Jack Dorsey: "We aren't proud of how people have taken advantage of our service, or our inability to address it fast enough."[101] The firm has regularly struggled to balance free speech and editorial neutrality with identifying and dealing with online abuse, and some activists have complained that Twitter's anti-harassment policies have disadvantaged conservative commentators. Some have left Twitter in favor of upstart networks perceived to be less restrictive, such as Gab.ai and Mastodon.[102] Dorsey has appealed to Twitter's users to submit suggestions for improving the "collective health, openness, and civility of the public conversation" on Twitter (see Figure 9.8). Twitter has also changed its algorithmic rankings software and leveraged machine learning tools to identify troll-like behavior and "bury" negative content instead of kicking accounts off the service. Flags for troll-like or bot behavior include accounts using lots of unrelated hashtags or repeated mentioning of accounts that don't follow them back. Once identified, the firm will lower the visibility of replies, particularly for popular hashtags. Algorithms are not perfect, but they can be significant if machine learning effectively identifies troll and bot patterns without requiring slower, more costly human moderators, and these services can be rolled out globally in any language.[103] Algorithmic filtering also comes with problems, though. For example, algorithms that bubble up only friendly tweets create an echochamber that risks reinforcing existing opinions rather than exploring ground for common understanding.[104]

Challenges: So How Big Is This Thing Gonna Be?

The firm's November 2013 IPO was well received, jumping 73 percent above offering price,[105] but in the months that followed, the stock sank. Wall Street is concerned that user growth hasn't matched rival social media sites. A 300 million plus users may sound impressive, but by mid 2015, Twitter was still far short of CEO Dick Costolo's reported goal of 400 million total users by year end 2013, and Costolo resigned shortly thereafter.[106] Some have claimed certain Twitter concepts—retweeting, finding accounts to follow, direct messaging—are confusing to new users, and more private messaging apps have proven to be the primary communication mechanism for many. Even new features, such as Twitter's live broadcasts and video programming content can be exceptionally difficult for users to surface. Several key executives have departed from the firm, including the company's head of engineering and its chief operating officer. While Twitter's subscriber growth has remained flat, daily usage is up and the firm posted its first ever profit at year end 2017.[107]

Microblogging does appear to be here to stay, and the impact of Twitter has been deep, broad, stunningly swift, and at times humbling in the power that it wields. But whether Twitter will be a durable, profit-gushing powerhouse remains to be seen. And beyond Twitter, several firms have commercialized microblogging services for internal corporate use. Salesforce.com's Chatter, Microsoft's Yammer, HipChat, and Slack are all services that have been billed as "Twitter for the Enterprise." Such efforts allow for Twitter-style microblogging that is restricted for participation and viewing by firm-approved accounts.

Key Takeaways

- While many public and private microblogging services exist, Twitter remains by far the dominant service.

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- Unlike status updates found on services like Facebook and LinkedIn, Twitter's default supports asymmetric communication, where someone can follow updates without first getting their approval. This function makes Twitter a good choice for anyone cultivating a following—authors, celebrities, organizations, and brand promoters.
- You don't need to tweet to get value. Many Twitter users follow friends, firms, celebrities, and thought leaders, quickly gaining access to trending topics.
- Twitter hashtags (keywords preceded by the # character) are used to organize "tweets" on a given topic. Users can search on hashtags, and many applications allow for tweets to be organized and displayed by tag.
- Organizations are leveraging Twitter in a variety of ways, including for real-time promotions, for time-sensitive information, for scheduling and yield management, for customer engagement and support, for promotion, for intelligence gathering, for idea sourcing, and as a sales channel.
- Like other forms of social media, Twitter can serve as a hothouse that attracts opinion and forces organizational transparency and accountability.
- Activists have leveraged the service worldwide, and it has also served as an early warning mechanism in disasters, terror, and other events.
- Twitter will surface tweets its algorithms think you'll be most interested in. Because of this, many feel Twitter is more friendly and conducive for organic media sharing. Twitter also sells ad products, including video advertisements and custom hashtag-linked emojis, to increase the reach of posts and to recruit new followers.
- Many organizations engage Twitter followers during major events, hoping to increase the likelihood that a post is seen and spread virally. Firms should use caution so as not to be perceived as exploiting tragedy or potentially sensitive events.
- Ad revenue is on the rise at Twitter. Short ads served in the tough-to-ignore stream of tweets are well suited for mobile offerings. Ad formats incorporating video and a platform for connecting advertisers with properties outside Twitter are novel mechanisms to leverage Twitter's strengths as a conversation platform and a data-driven targeting mechanism.
- Despite strong revenue growth, Twitter has only recently become profitable, and end-user growth has not kept pace with other social media offerings.
- Twitter used to make its data available via an API, and this helped the firm grow a rich ecosystem of Twitter-supporting products and services. But by making data available to third parties, firms may suffer from the free rider problem where others firms benefit from a service without providing much benefit back to the sponsor itself. Twitter's acquisitions (particularly of popular third-party clients that had used its API) and moves to block rival social efforts from using Twitter data have switched the firm from a platform sponsor to one that has aggressively taken control of its ecosystem.
- Like Facebook, Twitter has struggled with fake news, and its open, asymmetric nature makes Twitter an even stronger magnet for abusive Internet trolls. The firm has tried to improve the civility of online conversations by moving algorithmically identified negative posts further down in a user's stream, however some worry that this may also lead to a Twitter echo chamber, where users only hear voices that reinforce their own viewpoint. Others have complained that Twitter's policies excessively screen out conservative or right-leaning opinions.

Questions and Exercises

1. If you don't already have one, set up a Twitter account and "follow" several others. To get more from Twitter, consider installing the free TweetDeck or using the Twitter smartphone app. Follow a diverse group—corporations, executives, pundits, or other organizations. Do you trust that account holders are who they say they are? Why? Which examples do you think use the service most effectively? Which provide the weaker examples of effective Twitter use? Why? Have you encountered Twitter "spam" or unwanted followers? What can you do to limit such experiences? Be prepared to discuss your experiences with your class.

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2. Visit Twitter and record which hashtags are most active at this time. Are there other "trending topics" that aren't associated with hashtags? What do you think of the activity in these areas? Is there legitimate, productive activity happening? Have you tweeted to join a bandwagon found in a trending topic?
3. Search Twitter for topics, firms, brand names, and issues of interest to you. What do you think of the quality of the information you've uncovered on Twitter? Who might find this to be useful? You can target your search with greater detail using Twitter's "Advanced Search."
4. Search for examples of branded emoji campaigns (note that emojis associated with these campaigns may vanish after a period of time). What do you think of these campaigns? Have you or friends participated in these campaigns? If so, what was their motivation? Do you think they are successful, and are they worth the hefty price tag? What makes a good campaign vs. one that might be less successful?
5. Why would a person or organization choose to use Twitter over Facebook's status update or other services? Which (if either) do you prefer and why?
6. What do you think of Twitter's revenue prospects? Is the firm a viable independent service or simply a feature to be incorporated into other social media activity? Advocate where you think the service will be in two years, five, ten. Would you invest in Twitter? Would you suggest that other firms do so? Why?
7. How does Twitter Amplify appeal to content rightholders, to advertisers, and to Twitter? What advantages does this ad product offer to each?
8. Perform some additional research on Twitter's ad model. How have Twitter's attempts to grow revenues fared recently? How has user growth been trending? Has the firm's estimated value increased or decreased from the offer figures cited in this chapter? Why?
9. Assume the role of a manager for your firm. Advocate how the organization should leverage Twitter and other forms of social media. Provide examples of effective use, and cautionary tales, to back up your recommendation.
10. Some instructors have mandated Twitter for classroom use. Do you think this is productive? Would your professor advocate tweeting during lectures? What are the pros and cons of such use? Work with your instructor to discuss a set of common guidelines for in-class and course use of social media.
11. Follow this book's author at http://twitter.com/gallaugher. Tweet with this book's #BizTechBook hashtag if you run across interesting examples that you think would be appropriate for the next version of the book.

9.6 Prediction Markets and the Wisdom of Crowds

Learning Objectives

1. Understand the concept of the wisdom of crowds as it applies to social networking.
2. List the criteria necessary for a crowd to be smart.

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Many social software efforts leverage what has come to be known as the **wisdom of crowds**. In this concept, a group of individuals (the crowd often consists mostly of untrained amateurs), collectively has more insight than a single or small group of trained professionals. Made popular by author James Surowiecki (whose best-selling book was named after the phenomenon), the idea of crowd wisdom is at the heart of wikis and many other online efforts. An article in the journal *Nature* positively comparing Wikipedia to *Encyclopedia Britannica* lent credence to social software's use in harnessing and distilling crowd wisdom.[108]

wisdom of crowds

The idea that a group of individuals (the crowd), often consisting of untrained amateurs, will collectively have more insight than a single or small group of trained professionals.

prediction market

Polling a diverse crowd and aggregating opinions in order to form a forecast of an eventual outcome.

The crowd isn't always right, but in many cases where topics are complex, problems are large, and outcomes are uncertain, a large, diverse group may bring collective insight to problem solving that one smart guy or a professional committee lacks. One technique for leveraging the wisdom of crowds is a **prediction market**, where a diverse crowd is polled and opinions aggregated to form a forecast of an eventual outcome. The concept is not new. The stock market is arguably a prediction market, with a stock price representing collective assessment of the discounted value of a firm's future earnings. But Internet technologies are allowing companies to set up prediction markets for exploring all sorts of problems.

Consider Best Buy, where employees are encouraged to leverage the firm's Tag Trade prediction market to make forecasts, and are offered small gifts as incentives for participation. The idea behind this incentive program is simple: the "blue shirts" (Best Buy employees) are closest to customers. They see traffic patterns and buying cycles, can witness customer reactions firsthand, and often have a degree of field insight not available to senior managers at the company's Minneapolis headquarters. Harness this collective input and you've got a group brain where, as wisdom of crowds proponents often put it, "the we is greater than the me." When Best Buy asked its employees to predict gift card sales, the "crowd's" collective average answer was 99.5 percent accurate; experts paid to make the prediction were off by 5 percent. Another experiment predicting holiday sales was off by only 1/10 of 1 percent. The experts? Off by 7 percent![109]

In an article in the *McKinsey Quarterly*, Surowiecki outlined several criteria necessary for a crowd to be "smart."[110] The crowd must

- be *diverse*, so that participants are bringing different pieces of information to the table,
- be *decentralized*, so that no one at the top is dictating the crowd's answer,
- offer *a collective verdict* that summarizes participant opinions,
- be *independent*, so that each focuses on information rather than the opinions of others.

Google, which runs several predictive markets, underscored these principles when it found that predictions were less accurate when users were geographically proximate, meaning folks in the same work group who sat near one another typically thought too much alike.[111] Poorer predictive outcomes likely resulted because these relatively homogeneous clusters of users brought the same information to the table (yet another reason why organizations should hire and cultivate diverse teams).

Many firms run predictive markets to aid in key forecasts, and with the potential for real financial payoff. But University of Chicago law professor Todd Henderson warns predictive markets may also hold legal and ethical challenges. The US Securities and Exchange Commission may look askance at an employee who gets a heads-up in a predictive market that says a certain drug is going to be approved or fail clinical trials. If she trades on this information, is she an insider, subject to prosecution for exploiting proprietary data? Disclosure issues are unclear. Gambling laws are also murky, with Henderson uncertain as to whether certain predictive markets will be viewed as an unregulated form of betting.[112]

Publicly accessible prediction markets are diverse in their focus. The Iowa Electronic Market attempts to guess the outcome of political campaigns, corporate performance, and other world events, with mixed results. Farecast (now part of Microsoft's Bing knowledge engine) claims a 75 percent accuracy rate for forecasting the future price of airline tickets.[113] The Hollywood Stock Exchange allows participants to buy and sell prediction shares of movies, actors, directors, and film-related options. The exchange, now owned by investment firm Cantor Fitzgerald, has picked Oscar

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winners with 90 percent accuracy.[114] And at Nadex (formerly HedgeStreet), participants can make microbets on binary options (where outcomes are one of two options, such as true or false), wagering as little as ten dollars on the outcome of economic events, including predictions on the prices of homes, gold, foreign currencies, oil, and even the economic impact of hurricanes and tropical storms. Nadex is considered a market and is subject to oversight by the Commodity Futures Trading Commission.[115]

Blockchain for Better and Unrestricted Prediction Markets

It's been argued that prediction markets would be more accurate if there were motivation for more people to participate, and if those who believed an outcome with conviction (or even those with special, or even insider knowledge) could "put their money where there mind is" and invest in the likelihood of an outcome. The reason why this hasn't happened is that most nations consider this form of unrestricted financial commitment a form of gambling—participants essentially bet on an outcome, even if market owners call this "investing."[116] An entity running a centralized prediction market with wager-style payouts would be easy for a government to shut down; payments may be considered illegal—especially those paid across borders; and a central market would be a honeypot for hackers seeking to steal money or manipulate the outcome stored in one location.

Several developers feel that decentralization is the key to viable, large-scale prediction markets, and they're turning to blockchain technology to make this a reality. Efforts that include Augur, Gnosis, and Stox are among several that have raised significant cash (often through an initial coin offering or ICO) and are demonstrating technology to support blockchain-enabled prediction markets. Microsoft offers tools on its cloud platform, Azure, so that organizations can create their own blockchain-based prediction markets.[117]

Fees for transactions handled by blockchain vs. centralized markets are also lower, and since blockchains are peer-produced infrastructure (meaning participants collectively power the service instead of there being a single center), the cost to run such a market should be very low. And instead of a single authority verifying the outcome, the crowd will collectively verify the result, with participant reputation also gaining value with the accuracy of a reported outcome.[118] In the wild swings in valuation of "anything crypto," both Augur and Gnosis have seen the value of their market value (determined via cryptocurrency) push into the stratosphere—at times flirting with $1 billion.[119] It also remains to be seen just how widespread a difficult-to-regulate but nonetheless illegal prediction market would spread. The technology has the potential to upend sports betting and political prediction, and provide customer-driven market intelligence, if it lives up to the hype.

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Introduction to the Augur Platform

This animated introduction to the Augur platform covers many of the reasons why blockchain technology might build a more reliable, widely used, and accurate prediction markets.



View the video online at: http://www.youtube.com/embed/yegyih591Jo?rel=0

Key Takeaways

- Many social media efforts allow firms to tap the wisdom of crowds, identifying collective intelligence.
- Prediction markets tap crowd opinion with results that are often more accurate than the most accurate expert forecasts and estimates.
- Prediction markets are most accurate when tapping the wisdom of a diverse and variously skilled and experienced group, and are least accurate when participants are highly similar.
- Several efforts are attempting to use blockchain technology to create decentralized prediction markets. While critics state that such efforts amount to betting exchanges, a blockchain-based prediction market could be difficult for regulators to shut down, cheaper to run, and potentially more accurate than current centralized efforts.

Questions and Exercises

1. What makes for a “wise” crowd? When might a crowd not be so wise?
2. Find a prediction market online and participate in the effort. Be prepared to share your experience with your class, including any statistics of predictive accuracy, participant incentives, business model of the effort, and your general assessment of the appeal and usefulness of the effort.
3. Brainstorm on the kinds of organizations that might deploy prediction markets. Why might you think the efforts you suggest and advocate would be successful?
4. In what ways are legal issues of concern to prediction market operators?
5. Research the current state of blockchain-based prediction markets. How far have these efforts come in providing useful markets to organizations, and incentivized markets that attract participants? Would you participate in one? Why or why not? What firms, organizations, entities could benefit from such markets? Which ones might see these as threats?
6. Find a product that will allow you to set up your own prediction market. Work with your class to identify a test and try to recruit a large and diverse group to make the prediction before the semester ends. How did this turn out? Tweet interesting results using the hashtag #BizTechBook.

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9.7 Crowdsourcing

Learning Objectives

1. Understand the value of crowdsourcing.
2. Identify firms that have used crowdsourcing successfully.

crowdsourcing

The act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call.

The power of Web 2.0 also offers several examples of the democratization of production and innovation. Need a problem solved? Offer it up to the crowd and see if any of their wisdom offers a decent result. This phenomenon, known as **crowdsourcing**, has been defined by Jeff Howe, founder of the blog crowdsourcing.com and an associate editor at *Wired*, as "the act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call."[120]

Can the crowd really do better than experts inside a firm? At least one company has literally struck gold using crowdsourcing. As told by Don Tapscott and Anthony Williams in their book *Wikinomics*, mining firm Goldcorp was struggling to gain a return from its 55,000-acre Canadian property holdings. Executives were convinced there was gold "in them thar hills," but despite years of efforts, the firm struggled to strike any new pay dirt. CEO Rob McEwen, a former mutual fund manager without geology experience who unexpectedly ended up running Goldcorp after a takeover battle, then made what seemed like a Hail Mary pass—he offered up all the firm's data, on the company's website. Along with the data, McEwen ponied up $575,000 from the firm as prize money for the Goldcorp Challenge to anyone who came up with the best methods and estimates for reaping golden riches. Releasing data was seen as sacrilege in the intensely secretive mining industry, but it brought in ideas the firm had never considered. Taking the challenge was a wildly diverse group of "graduate students, consultants, mathematicians, and military officers." Eighty percent of the new targets identified by entrants yielded "substantial quantities of gold." The financial payoff? In just a few years a $100 million firm grew into a $9 billion titan. For Goldcorp, the crowd coughed up serious coin.

Israeli firm Waze has used crowdsourcing to build a better map. The firm's growing community of over 50 million users shares anonymous, live driving data by default. This helps build extremely accurate maps of real-time traffic flow. Another 70,000 plus in the Waze community actively edit maps for increased accuracy.[121] Google won the bidding war for the firm, reportedly beating out interest from both Apple and Facebook. The eventual acquisition price? $1 billion. Apparently there's not just wisdom in the crowds; there's also big bucks!

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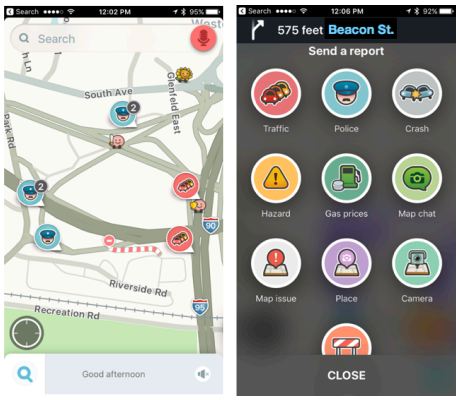
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Nine of the world's top ten brands have engaged in some form of crowdsourcing. In Germany, McDonald's challenged consumers to build a burger recipe, culminating in the launch of the Pretzelnator.[122] Netflix famously offered anonymous data to any takers, along with a one-million-dollar prize to the first team that could improve the accuracy of movie recommendations by 10 percent. Top performers among the over thirty thousand entrants included research scientists from AT&T Labs, researchers from the University of Toronto, a team of Princeton undergrads, and the proverbial "guy in a garage" (and yes, that was his team name). Frustrated for nearly three years, it took a coalition of four teams from Austria, Canada, Israel, and the United States to finally cross the 10 percent threshold. The winning team represented an astonishing brain trust that Netflix would never have been able to harness on its own.[123]

Other crowdsourcers include Threadless.com, which produces limited run t-shirts with designs users submit and vote on. Marketocracy runs stock market games and has created a mutual fund based on picks from the 100 top-performing portfolios. Just under seven years into the effort, the firm's m100 Index reports a 75 percent return versus 35 percent for the S&P 500. The St. Louis Cardinals baseball team is even crowdsourcing. The club's One for the Birds contest calls for the fans to submit scouting reports on promising players, as the team hopes to broaden its recruiting radar beyond its classic recruiting pool of Division I colleges.

FIGURE 9.9 Waze Map App

Waze has used crowdsourcing to build a better map app. Over 50 million users contribute real-time traffic data from their smartphones, while more than 70,000 actively edit maps. Google was so impressed it bought the firm for $1 billion.



Source: Waze app.

There are several public markets for leveraging crowdsourcing for innovation, or as an alternative to standard means of production. Waltham, Massachusetts-based InnoCentive allows "seekers" to offer cash prizes ranging from $10 to $100,000. Over 250,000 "solvers" have registered to seek solutions for tasks put forward by seekers that include Dow Chemical, Eli Lilly, and Procter & Gamble.[124] Among the findings offered by the InnoCentive crowd are a biomarker that measures progression of ALS. Amazon.com has even created an online marketplace for crowdsourcing called Mechanical Turk. Anyone with a task to be completed or problem to be solved can put it up for Amazon, setting their price for completion or solution. For its role, Amazon takes a small cut of the transaction. And alpha geeks looking to prove their code chops can turn to Topcoder, a firm that stages coding competitions that deliver real results for commercial clients, such as ESPN. Topcoder contests have attracted roughly 300,000 participants from 200 countries.[125] And Kaggle allows firms to create data-science–focused competitions, post problems, and offer rewards and prizes. Facebook, GE, Allstate, Caterpillar, and Merck are among the firms that have run Kaggle contests—some paying upwards of $100,000 for solutions. Google was so impressed by Kaggle that it purchased the firm in 2017.[126]

Not all crowdsourcers are financially motivated. Some benefit by helping to create a better service. Facebook leveraged crowd wisdom to develop versions of its site localized in various languages. Facebook engineers designated each of the site's English words or phrases as a separate translatable object. Members were then invited to translate the English into other languages, and rated the translations to determine which was best. Using this form of crowdsourcing, 1,500 volunteers cranked out Spanish Facebook in a month. It took two weeks for 2,000 German speakers to draft Deutsch Facebook. How does the Facebook concept of "poke" translate around the world? The Spaniards decided on "dar un toque," Germans settled on "anklopfen," and the French went with "envoyer un poke."[127] Vive le crowd!

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Walmart Finds Big Data Experts from Crowdsourced Contests

Data science is hot! Often rated tops in "Best Job" rankings, analytics is a popular career because jobs are plentiful and talent is scarce. In one survey, more than half of executives said their ability to exploit analytics was hindered by a difficulty in finding the right talent.

Walmart came up with a novel solution—run a contest and hire the winner! Walmart turned to Kaggle (now part of Google) and set up a contest, providing a sample of historical sales data with potential influencing factors, including promotions, clearance sales, and price roll backs. Candidates were asked to build models that use these factors to forecast sales across various departments. A senior technology recruiter at Walmart has said: "The Kaggle competition created a buzz about Walmart and our analytics organization. People always knew that Walmart generates and has a lot of data, but the best part was that this let people see how we are using it strategically." Walmart coupled recruiting efforts with a Twitter hashtag-fueled #lovedata campaign touting the retail giant as a great place for data geeks to build a career.[128]

The contest surfaced several deeply skilled analysts, including Naveen Peddamail, now a senior statistical analyst working in the firm's Data Cafe project, which helps managers gain easier access to insights from over 40 petabytes of data.[129]

Key Takeaways

- Crowdsourcing tackles challenges through an open call to a broader community of potential problem solvers. Examples include Goldcorp's discovering of optimal mining locations in land it already held, Facebook's leverage of its users to create translations of the site for various international markets, and Netflix's solicitation of improvements to its movie recommendation software.
- Several firms run third-party crowdsourcing forums, among them InnoCentive for scientific R&D, TopCoder for programming tasks, Kaggle for data science, and Amazon's Mechanical Turk for general work.

Questions and Exercises

1. What is crowdsourcing? Give examples of organizations that are taking advantage of crowdsourcing and be prepared to describe these efforts.
2. What ethical issues should firms be aware of when considering crowdsourcing? Are there other concerns firms may have when leveraging this technique?
3. Assume the role of a manager or consultant. Recommend a firm and a task that would be appropriate for crowdsourcing. Justify your choice, citing factors such as cost, breadth of innovation, time, constrained resources, or other factors. How would you recommend the firm conduct this crowdsourcing effort?
4. Visit Kaggle.com and examine the current contests that are on offer. Note that the site also has learning resources so that anyone can gain analytics skills. Do these resources seem useful to you? What can firms gain from using a site like Kaggle?

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9.8 Get SMART: The Social Media Awareness and Response Team

Learning Objectives

1. Illustrate several examples of effective and poor social media use.
2. Recognize the skills and issues involved in creating and staffing an effective social media awareness and response team (SMART).
3. List and describe key components that should be included in any firm's social media policy.
4. Understand the implications of ethical issues in social media such as "sock puppetry" and "astroturfing" and provide examples and outcomes of firms and managers who used social media as a vehicle for dishonesty.
5. List and describe tools for monitoring social media activity relating to a firm, its brands, and staff.
6. Understand issues involved in establishing a social media presence, including the embassy approach, openness, and staffing.
7. Discuss how firms can engage and respond through social media, and how companies should plan for potential issues and crises.

For an example of how outrage can go viral, consider Dave Carroll.[130] The Canadian singer-songwriter was traveling with his band, Sons of Maxwell, on a United Airlines flight from Nova Scotia to Nebraska when, during a layover at Chicago's O'Hare International Airport, Carroll saw baggage handlers roughly tossing his guitar case. The musician's $3,500 Taylor guitar was in pieces by the time it arrived in Omaha. In the midst of a busy tour schedule, Carroll didn't have time to follow up on the incident until after United's twenty-four-hour period for filing a complaint for restitution had expired. When United refused to compensate him for the damage, Carroll penned the four-minute country ditty "United Breaks Guitars," performed it in a video, and uploaded the clip to YouTube (sample lyrics: "I should have flown with someone else or gone by car…'cuz United breaks guitars"). Carroll even called out the unyielding United rep by name. Take that, Ms. Irlwig! (Note to customer service reps everywhere: you're always on.)

The clip went viral, receiving 150,000 views its first day and five million more by the next month. Well into the next year, "United Breaks Guitars" remained the top result on YouTube when searching the term "United." No other topic mentioning that word—not "United States," "United Nations," or "Manchester United"—ranked ahead of this one customer's outrage.

While not all customers have the musical chops to film a catchy customer protest song, nearly everyone is armed with a video recording phone. United has continued to be a punching bag of poor service as chronicled by the social sharing crowd. Events include video of a passenger being forcibly dragged from a plane, with vitality spreading to all major mainstream news outlets and resulting in UAL stock taking a $600 million haircut.[131]

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American Airlines Flight Attendant Suspended After Altercation With Passenger

This segment from Complex News highlights passenger-captured incidents at United and American Airlines. Social media heightens the bar of customer expectations and amplifies the impact of negative customer service incidents.

View the video online at: http://www.youtube.com/embed/8y2L-0KpXno?rel=0

Scarring social media posts don't just come from outside the firm. Earlier that same year employees of a Domino's Pizza outlet in Conover, North Carolina, created what they thought would be a funny gross-out video for their friends. Posted to YouTube, the resulting footage of the firm's brand alongside vile acts of food prep was seen by over one million viewers before it was removed. Over 4.3 million references to the incident can be found on Google, and many of the leading print and broadcast outlets covered the story. The perpetrators were arrested, the Domino's storefront where the incident occurred was closed, and the firm's president made a painful apology (on YouTube, of course).

Even billionaire founders need to pay attention. A video captured by a dash cam and posted by an Uber driver showed Uber founder (and CEO at the time) Travis Kalanick berating the driver who took issue with some of the firm's recent changes. Shortly after the incident, Kalanick wrote an apology letter to his staff, stating he was "embarrassed" by his behavior, that he must "grow-up," and that "This is the first time I've been willing to admit that I need leadership help and I intend to get it."[132] The incident only strengthened the perception that Kalanick's personality was unsuited to lead the category defining firm, and within months he was out as CEO.

Not all firms choose to aggressively engage social media. But your customers are there and they're talking about your organization, its products, and its competitors. Your employees are there, too, and without guidance, they can step on a social grenade with your firm left to pick out the shrapnel. Today, nearly everyone will carry the Internet in their pocket. Phones and MP3 players are armed with video cameras capable of recording every customer outrage, corporate blunder, ethical lapse, and rogue employee. Social media posts can linger forever online, like a graffiti tag attached to your firm's reputation. Get used to it—that genie isn't going back in the bottle.

SMART

The social media awareness and response team. A group tasked with creating policies and providing support, training, guidance, and development expertise for and monitoring of a firm's social media efforts.

As these incidents show, social media will impact a firm whether it chooses to engage online or not. An awareness of the power of social media can shape customer support engagement and crisis response, and strong corporate policies on social media use might have given the employees a heads-up on the impact of their actions. Given the power of social media, it's time for all firms to get **SMART**, creating a social media awareness and response team. While one size doesn't fit all, this section details key issues behind SMART capabilities, including creating the social media team, establishing firmwide policies, monitoring activity inside and outside the firm, establishing the social media presence, and managing social media engagement and response.

Creating the Team

Firms need to treat social media engagement as a key corporate function with clear and recognizable leadership within the organization. Social media is no longer an ad hoc side job or a task delegated to an intern. When McDonald's named its first social media chief, the company announced that it was important to have someone "dedicated 100 percent of the time, rather than someone who's got a day job on top of a day job."[133] Firms without social media baked into employee job functions often find that their online efforts are started with enthusiasm, only to suffer under

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a lack of oversight and follow-through. One hotel operator found franchisees were quick to create Facebook pages, but many rarely monitored them. Customers later notified the firm that unmonitored hotel Facebook pages contained offensive messages—a racist rant on one, paternity claims against an employee on another.

Organizations with a clearly established leadership role for social media can help create consistency in firm dialogue; develop and communicate policy; create and share institutional knowledge; provide training, guidance, and suggestions; offer a place to escalate issues in the event of a crisis or opportunity; and catch conflicts that might arise if different divisions engage without coordination.

While firms are building social media responsibility into job descriptions, also recognize that social media is a team sport that requires input from staffers throughout an organization. The social media team needs support from public relations, marketing, customer support, HR, legal, IT, and other groups, all while acknowledging that what's happening in the social media space is distinct from traditional roles in these disciplines. The team will hone unique skills in technology, analytics, and design, as well as skills for using social media for online conversations, listening, trust building, outreach, engagement, and response. As an example of the interdisciplinary nature of social media practice, consider that the social media team at Starbucks (regarded by some as the best in the business) is organized under the interdisciplinary "vice president of brand, content, and online."[134]

Also note that while SMARTs (social media teams) provide leadership, support, and guidance, they don't necessarily drive all efforts. GM's social media team includes representatives from all the major brands. The idea is that employees in the divisions are still the best to engage online once they've been trained and given operational guardrails. Says GM's social media chief, "I can't go in to Chevrolet and tell them 'I know your story better than you do, let me tell it on the Web.'"[135] Similarly, the roughly fifty Starbucks "Idea Partners" who participate in MyStarbucksIdea are specialists. Part of their job is to manage the company's social media. In this way, conversations about the Starbucks card are handled by card team experts, and merchandise dialogue has a product specialist who knows that business best. Many firms find that the social media team is key for coordination and supervision (e.g., ensuring that different divisions don't overload consumers with too much or inconsistent contact), but the dynamics of specific engagement still belong with the folks who know products, services, and customers best.

Responsibilities and Policy Setting

In an age where a generation has grown up posting shoot-from-the-hip status updates and YouTube is seen as a fame vehicle for those willing to perform sensational acts, establishing corporate policies and setting employee expectations are imperative for all organizations. The employees who don't understand the impact of social media on the firm can do serious damage to their employers and their careers.

Many experts suggest that a good social media policy needs to be three things: "short, simple, and clear."[136] Fortunately, most firms don't have to reinvent the wheel. Several firms, including Best Buy, IBM, Intel, The American Red Cross, and Australian telecom giant Telstra, have made their social media policies public.

Most guidelines emphasize the "three Rs": representation, responsibility, and respect.

- *Representation.* Employees need clear and explicit guidelines on expectations for social media engagement. Are they empowered to speak on behalf of the firm? If they are, it is critical that employees transparently disclose this to avoid legal action. US Federal Trade Commission rules require disclosure of relationships that may influence online testimonial or endorsement. On top of this, many industries have additional compliance requirements (e.g., governing privacy in the health and insurance fields, retention of correspondence and disclosure for financial

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services firms). Firms may also want to provide guidelines on initiating and conducting dialogue, when to respond online, and how to escalate issues within the organization.

- *Responsibility.* Employees need to take responsibility for their online actions. Firms must set explicit expectations for disclosure, confidentiality and security, and provide examples of engagement done right, as well as what is unacceptable. An effective social voice is based on trust, so accuracy, transparency, and accountability must be emphasized. Consequences for violations should be clear.
- *Respect.* Canadian communications firm Mitel reminds employees that respect includes the firm, its customers, and its competitors.[137] Best Buy's policy explicitly states participants must "honor our differences" and "act ethically and responsibly." Many employees can use the reminder. Sure customer service is a tough task and every rep has a story about an unreasonable client. But there's a difference between letting off steam around the water cooler and venting online. Virgin Atlantic fired thirteen of the airline's staffers after they posted passenger insults and inappropriate inside jokes on Facebook.[138]

Policies also need to have teeth. Remember, a fourth "R" is at stake—reputation (both the firm's and the employee's). Violators should know the consequences of breaking firm rules, and policies should be backed by action. Best Buy's policy simply states, "Just in case you are forgetful or ignore the guidelines above, here's what could happen. You could get fired (and it's embarrassing to lose your job for something that's so easily avoided)."

Despite these concerns, trying to micromanage employee social media use is probably not the answer. At IBM, rules for online behavior are surprisingly open. The firm's code of conduct reminds employees to remember privacy, respect, and confidentiality in all electronic communications. Anonymity is not permitted on IBM's systems, making everyone accountable for their actions. As for external postings, the firm insists that employees not disparage competitors or reveal customers' names without permission and asks that any employee posts from IBM accounts or that mention the firm also include disclosures indicating that opinions and thoughts shared publicly are the individual's and not Big Blue's.

Some firms have more complex social media management challenges. Consider hotels and restaurants where outlets are owned and operated by franchisees rather than the firm. McDonald's social media team provides additional guidance so that regional operations can create, for example, a Twitter handle (e.g., @mcdonalds_cincy) that handles a promotion in Cincinnati that might not run in other regions.[139] A social media team can provide coordination while giving up the necessary control. Without this kind of coordination, customer communication can quickly become a mess.

Training is also a critical part of the SMART mandate. GM offers an intranet-delivered video course introducing newbies to the basics of social media and to firm policies and expectations. GM also trains employees to become "social media proselytizers and teachers." GM hopes this approach enables experts to interact directly with customers and partners, allowing the firm to offer authentic and knowledgeable voices online.

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Tweets from the Untrained

Followers of Kenneth Cole, founder, chairman, and chief creative officer of the eponymous fashion label, know when he has tweeted via the corp—Cole signs these tweets with his initials KC. But it looks like KC could have used a bit of SMART training when he offered up a meant-to-be-lighthearted quip comparing Egypt's historic Mubarak-ousting protests (where several citizens were killed and injured) to enthusiasm for his firm's "new spring collection." Although the tweet was quickly deleted, screenshots (see below) linger forever, and the media widely reported on the big brand's insensitive gaffe.

FIGURE 9.10 Kenneth Cole #Cairo Tweet



Source: Twitter.

Several firms have ended up with social media egg on their faces after attempting to capitalize on trending topics and major news events. Some refer to commercial communication linked to tragic events as the social media "ambulance chasing trap."[140] Memorials for 9/11,[141] http://www.washingtonpost.com/business/technology/atandt-removes-apologizes-for-911-tribute-tweet/2013/09/11/6d8f8806-1b06-11e3-a628-7e6dde8f889d_story.html; Superstorm Sandy,[142] http://www.businessinsider.com/the-9-biggest-brand-fails-exploiting-hurricane-sandy-2012-11?op=1; Pearl Harbor Day,[143] http://www.usatoday.com/story/money/business/2013/12/07/spaghettios-apologizes-for-pearl-harbor-tweet/3904843; and The Boston Marathon bombing[144] http://marketingland.com/epicurious-becomes-latest-brand-to-suffer-social-backlash-from-tragedy-related-tweets-40257 are just a few examples that have garnered public ridicule and made brands appear callous, opportunistic, and insensitive. At a South by Southwest panel on social media crises, reporter Neal Mann of *The Wall Street Journal* stated flat-out that many journalists are on alert to "identify and exploit" gaffes committed in the name of organizations. The schadenfreude also offers compelling coverage as a teachable moment, warning professionals what not to do. As Professor Jerry Kane of Boston College states, "Just because a topic is trending does not mean it's necessarily a good opportunity to promote a brand."[145]

Even though gaffes can be scary, well-trained employees engaging online can prove to be a valuable asset. Adobe realized that the collective reach of the firm's employees on LinkedIn was more than seven times greater than those connected with Adobe brand pages, plus 91 percent of the engagements employees were having regarding Adobe on LinkedIn were with people who weren't connecting with the firm's brand pages. Dispatching employees to indiscriminately spam contacts with firm propaganda is not the approach to take. But Adobe trains employees on social judgment, assessing sample social media conversations, and helping employees understand best approaches in situations where online advocacy makes sense. If you believe in a firm, its products, and its benefits, this can be natural, and persuasive.[146]

Training should also cover information security and potential threats. Social media has become a magnet for phishing, virus distribution, and other nefarious online activity. Over one-third of social networking users claim to have been sent malware via social networking sites (see Chapter 17). The social media team will need to monitor threats and spread the word on how employees can surf safe and surf smart.

Since social media is so public, it's easy to amass examples of what works and what doesn't, adding these to the firm's training materials. The social media team provides a catch point for institutional knowledge and industry best practice; and the team can update programs over time as new issues, guidelines, technologies, and legislation emerge. A savvy team will use tools such as wikis and blogs to capture and share findings.

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The social media space introduces a tension between allowing expression (among employees and by the broader community) and protecting the brand. Firms will fall closer to one end or the other of this continuum depending on compliance requirements, comfort level, and goals. Expect the organization's position to move. Firms will be cautious as negative issues erupt; others will jump in as new technologies become hot and early movers generate buzz and demonstrate results. But it's the SMART responsibility to avoid knee-jerk reaction and to shepherd firm efforts with the professionalism and discipline of other management domains.

sock puppets

A fake online persona created to promote a particular point of view, often in praise of a firm, product, or individual. Be aware that the use of undisclosed relationships in endorsements is a violation of US Federal Trade Commission rules.

astroturfing

Engineering the posting of positive comments and reviews of a firm's product and services (or negative ones of a firm's competitors). Many ratings sites will penalize firms that offer incentives for positive feedback posts.

Astroturfing and Sock Puppets

Social media can be a cruel space. Sharp-tongued comments can shred a firm's reputation, and staff might be tempted to make anonymous posts defending or promoting the firm. Don't do it! Not only is it a violation of FTC rules, IP addresses and other online breadcrumbs often leave a trail that exposes deceit.

Whole Foods CEO John Mackey fell victim to this kind of temptation, but his actions were eventually, and quite embarrassingly, uncovered. For years, Mackey used a pseudonym to contribute to online message boards, talking up Whole Foods stock and disparaging competitors. When Mackey was unmasked, years of comments were publicly attributed to him. The *New York Times* cited one particularly cringe-worthy post where Mackey used the pseudonym to compliment his own good looks, writing, "I like Mackey's haircut. I think he looks cute!"[147]

Fake personas set up to sing your own praises are known as **sock puppets** among the digerati, and the practice of lining comment and feedback forums with positive feedback is known as **astroturfing**. Do it and it could cost you. The firm behind the cosmetic procedure known as the Lifestyle Lift was fined $300,000 in civil penalties after the New York attorney general's office discovered that the firm's employees had posed as plastic surgery patients and wrote glowing reviews of the procedure.[148]

Review sites themselves will also take action. TripAdvisor penalizes firms if it's discovered that customers are offered some sort of incentive for posting positive reviews. The firm also employs a series of sophisticated automated techniques as well as manual staff review to uncover suspicious activity. Violators risk penalties that include being banned from the service.

Your customers will also use social media to keep you honest. Several ski resorts have been embarrassed when tweets and other social media posts exposed them as overstating snowfall results. There's even an iPhone app skiers can use to expose inaccurate claims.[149] Firms including MTV and Chipotle have faked a hack on their social media accounts to gain attention, and were later ridiculed when this was discovered. Be warned—customers aren't keen on feeling duped.[150]

So keep that ethical bar high. Corner-cutters beware—you never know when technology will get sophisticated enough to reveal wrongdoings.

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Monitoring

online reputation management

The process of tracking and responding to online mentions of a product, organization, or individual. Services supporting online reputation management range from free Google Alerts to more sophisticated services that blend computer-based and human monitoring of multiple media channels.

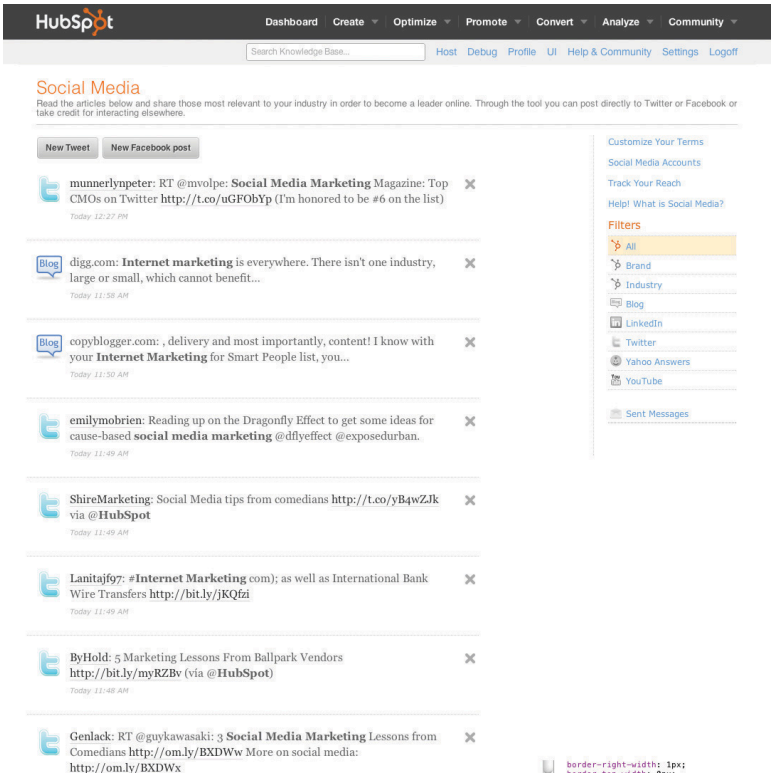
Concern over managing a firm's online image has led to the rise of an industry known as **online reputation management**. Firms specializing in this field will track a client firm's name, brand, executives' names, or other keywords, reporting online activity and whether sentiment trends toward the positive or negative.

But social media monitoring is about more than managing one's reputation; it also provides critical competitive intelligence, it can surface customer support issues, and it can uncover opportunities for innovation and improvement. Firms that are quick to lament the very public conversations about their brands happening online need to embrace social media as an opportunity to learn more.

Resources for monitoring social media are improving all the time, and a number of tools are available for free. All firms can take advantage of Google Alerts, which flags blog posts, new Web pages, and other publicly accessible content, regularly delivering a summary of new links to your mailbox (for more on using Google for intelligence gathering, see Chapter 18). Link-shortening service bit.ly provides tools to track and graph sharing and click-through. Twitter search and Twitter clients like TweetDeck can display all mentions of a particular term. And more advanced commercial tools, such as SalesForce Radian6, HubSpot, and Hootsuite, monitor a wide variety of social media mentions, provide metrics for ongoing campaigns and practices, and gauge sentiment and spot opportunities for sales leads or customer service.

FIGURE 9.11 Hubspot Social Media Tracker

Tools such as those provided by HubSpot (depicted here) track social media mentions by keyword or phrase. Savvy organizations can mine comments for competitive intelligence, insight, and product ideas or to coordinate follow-up and thoughtful customer service.



Source: Hubspot.

Facebook provides a summary of page activity to administrators (including stats on visits, new fans, wall posts, etc.), while Facebook's Audience Insights tool measures user demographics, exposure, actions, and response behavior relating to a firm's Facebook pages and ads. TripAdvisor

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provides an analytics dashboard enabling vendors to track their most important visitors, competitors and market trends,[151] and you'll find similar dashboards at sites such as Pinterest and Yelp, among others.

Monitoring should also not be limited to customers and competitors. Firms are leveraging social media both inside their firms and via external services (e.g., corporate groups on Facebook and LinkedIn), and these spaces should also be on the SMART radar. This kind of monitoring can help firms keep pace with employee sentiment and insights, flag discussions that may involve proprietary information or other inappropriate topics, and provide guidance for those who want to leverage social media for the firm's staff—that is, anything from using online tools to help organize the firm's softball league to creating a wiki for a project group. Social media are end-user services that are particularly easy to deploy but that can also be used disastrously and inappropriately, so it's vital for IT experts and other staffers on the social media team to be visible and available, offering support and resources for those who want to take a dip into social media's waters.

Establishing a Presence

embassy

In the context of social media, an established online presence where customers can reach and interact with the firm. An effective embassy approach uses a consistent firm name in all its social media properties.

Firms hoping to get in on the online conversation should make it easy for their customers to find them. Many firms take an **embassy** approach to social media, establishing presence at various services with a consistent name. Think facebook.com/starbucks, twitter.com/starbucks, youtube.com/starbucks, instagram.com/starbucks, pinterest.com/starbucks, and so on. Corporate e-mail and websites can include icons linking to these services in a header or footer. The firm's social media embassies can also be highlighted in physical space such as in print, on bags and packaging, and on store signage. Firms should try to ensure that all embassies carry consistent design elements, so users see familiar visual cues that underscore they are now at a destination associated with the organization.

As mentioned earlier, some firms establish their own communities for customer engagement. Examples include Dell's IdeaStorm and MyStarbucksIdea. Not every firm has a customer base that is large and engaged enough to support hosting its own community. But for larger firms, these communities can create a nexus for feedback, customer-driven innovation, and engagement.

Customers expect an open dialogue, so firms engaging online should be prepared to deal with feedback that's not all positive. Firms are entirely within their right to screen out offensive and inappropriate comments. Noting this, firms might think twice before turning on YouTube comments (described as "the gutter of the Internet" by one leading social media manager).[152] Such comments could expose employees or customers profiled in clips to withering, snarky ridicule. However, firms engaged in curating their forums to present only positive messages should be prepared for the community to rebel and for embarrassing cries of censorship to be disclosed. Firms that believe in the integrity of their work and the substance of their message shouldn't be afraid. While a big brand like Starbucks is often a target of criticism, social media also provides organizations with an opportunity to respond fairly to that criticism and post video and photos of the firm's efforts. In Starbucks' case, the firm shares its work investing in poor coffee-growing communities as well as efforts to support AIDS relief. A social media presence allows a firm to share these works without waiting for conventional public relations (PR) to yield results or for journalists to pick up and interpret the firm's story. Starbucks executives have described the majority of comments the company receives through social media as "a love letter to the firm." By contrast, if your firm isn't prepared to be open or if your products and services are notoriously subpar and your firm is inattentive to customer feedback, then establishing a brand-tarring social media beachhead might not make sense. A word to the self-reflective: Customer conversations will happen online even if you don't have any social media embassies. Users can form their own groups, hashtags, and forums. A reluctance to participate may signal that the firm is facing deeper issues around its product and service.

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While firms can learn a lot from social media consultants and tool providers, it's considered bad practice to outsource the management of a social media presence to a third-party agency. The voice of the firm should come *from* the firm. In fact, it should come from employees who can provide authentic expertise. Starbucks' first Twitter feed was managed by a former barista, while the firm's director of environmental affairs tweets and engages across social media channels on the firm's green efforts.

Engage and Respond

Having an effective social media presence offers "four Ms" of engagement: it's a *megaphone* allowing for outbound communication; it's a *magnet* drawing communities inward for conversation; and it allows for *monitoring* and *mediation* of existing conversations.[153] This dialogue can happen privately (private messaging is supported on most services) or can occur very publicly (with the intention to reach a wide audience). Understanding when, where, and how to engage and respond online requires a deft and experienced hand.

Many firms will selectively and occasionally retweet praise posts, underscoring the firm's commitment to customer service. Highlighting service heroes reinforces exemplary behavior to employees who may be following the firm online, too. Users are often delighted when a major brand retweets their comments, posts a comment on their blog, or otherwise acknowledges them online—just be sure to do a quick public profile investigation to make sure your shout-outs are directed at customers you want associated with your firm. Escalation procedures should also include methods to flag noteworthy posts, good ideas, and opportunities that the social media team should be paying attention to. The customer base is often filled with heartwarming stories of positive customer experiences and rich with insight on making good things even better.

Many will also offer an unsolicited apology if the firm's name or products comes up in a disgruntled post. You may not be able to respond to all online complaints, but selective acknowledgment of the customer's voice (and attempts to address any emergent trends) is a sign of a firm that's focused on customer care. Getting the frequency, tone, and cadence for this kind of dialogue is more art than science, and managers are advised to regularly monitor other firms with similar characteristics for examples of what works and what doesn't.

Many incidents can be responded to immediately and with clear rules of engagement. For example, Starbucks issues corrective replies to the often-tweeted urban legend that the firm does not send coffee to the US military because of a corporate position against the war. A typical response might read, "Not true, get the facts here" with a link to a Web page that sets the record straight.

Reaching out to key influencers can also be extremely valuable. Prominent bloggers and other respected social media participants can provide keen guidance and insight. The goal isn't to create a mouthpiece, but to solicit input, gain advice, gauge reaction, and be sure your message is properly interpreted. Influencers can also help spread accurate information and demonstrate a firm's commitment to listening and learning. In the wake of the Domino's gross-out, executives reached out to the prominent blog Consumerist.[154] Similarly, Kaiser Permanente leveraged advice from well-known health care bloggers in crafting its approach to social media.[155]

However, it's also important to recognize that not every mention is worthy of a response. The Internet is filled with PR seekers, the unsatisfiably disgruntled, axe grinders seeking to trap firms, dishonest competitors, and inappropriate groups of mischief makers commonly referred to as *trolls*. One such group hijacked *Time* magazine's user poll of the World's Most Influential People, voting their twenty-one-year-old leader to the top of the list ahead of Barack Obama, Vladimir Putin, and the pope. Prank voting was so finely calibrated among the group that the rankings list was engineered to spell out a vulgar term using the first letter of each nominee's name.[156]

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To prepare, firms should "war game" possible crises, ensuring that everyone knows their role, and that experts are on call. A firm's social media policy should also make it clear how employees who spot a crisis might "pull the alarm" and mobilize the crisis response team. Having all employees aware of how to respond gives the firm an expanded institutional radar that can lower the chances of being blindsided. This can be especially important as many conversations take place in the so-called deep Web beyond the reach of conventional search engines and monitoring tools (e.g., within membership communities or sites, such as Facebook, where only "friends" have access).

In the event of an incident, silence can be deadly. Consumers expect a response to major events, even if it's just "we're listening, we're aware, and we intend to fix things." When director Kevin Smith was asked to leave a Southwest Airline flight because he was too large for a single seat, Smith went ballistic on Twitter, berating Southwest's service to his thousands of online followers. Southwest responded that same evening via Twitter, posting, "I've read the tweets all night from @ThatKevinSmith—He'll be getting a call at home from our Customer Relations VP tonight."

In the event of a major crisis, firms can leverage online media outside the social sphere. Homeopathic cold remedy Zicam countered blog posts citing inaccurate product information by running Google ads adjacent to these links, containing tag lines such as "Zicam: Get the Facts."[157]

Review sites such as Yelp and TripAdvisor also provide opportunities for firms to respond to negative reviews. This can send a message that a firm recognizes missteps and is making an attempt to address the issue (follow-through is critical, or expect an even harsher backlash). Sometimes a private response is most effective. When a customer of Farmstead Cheeses and Wines in the San Francisco Bay area posted a Yelp complaint that a cashier was rude, the firm's owner sent a private reply to the poster pointing out that the employee in question was actually hard of hearing. The complaint was subsequently withdrawn and the critic eventually joined the firm's Wine Club.[158] Private responses may be most appropriate if a firm is reimbursing clients or dealing with issues where public dialogue doesn't help the situation. One doesn't want to train members of the community that public griping gets reward. For similar reasons, in some cases store credit rather than reimbursement may be appropriate compensation.

Who Should Speak for Your Firm? The Case of the Cisco Fatty

Using the Twitter handle "TheConnor," a graduating college student recently offered full-time employment by the highly regarded networking giant Cisco posted this tweet: "Cisco just offered me a job! Now I have to weigh the utility of a fatty paycheck against the daily commute to San Jose and hating the work." Bad idea. Her tweet was public and a Cisco employee saw the post, responding, "Who is the hiring manager. I'm sure they would love to know that you will hate the work. We here at Cisco are versed in the Web." Snap!

But this is also where the story underscores the subtleties of social media engagement. Cisco employees are right to be stung by this kind of criticism. The firm regularly ranks at the top of *Fortune*'s list of "Best Firms to Work for in America." Many Cisco employees take great pride in their work, and all have an interest in maintaining the firm's rep so that the company can hire the best and brightest and continue to compete at the top of its market. But when an employee went after a college student so publicly, the incident escalated. The media picked up on the post, and it began to look like an old guy picking on a clueless young woman who made a stupid mistake that should have been addressed in private. There was also an online pile-on attacking TheConnor. Someone uncovered the woman's true identity and posted hurtful and disparaging messages about her. Someone else set up a website at CiscoFatty.com. Even Oprah got involved, asking both parties to appear on her show (the offer was declined). A clearer social media policy highlighting the kinds of issues to respond to and offering a reporting hierarchy to catch and escalate such incidents might have headed off the embarrassment and helped both Cisco and TheConnor resolve the issue with a little less public attention.[159]

We're now deep into a revolution that has rewritten the rules of customer-firm communication. There are emerging technologies and skills to acquire, a shifting landscape of laws and expectations, a minefield of dangers, and a wealth of unexploited opportunities. Organizations

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that professionalize their approach to social media are ready to exploit the upside—potentially stronger brands, increased sales, sharper customer service, improved innovation, and more. Those that ignore the new landscape risk catastrophe and perhaps even irrelevance.

Key Takeaways

- Customer conversations are happening and employees are using social media. Even firms that aren't planning on creating a social media presence need to professionalize the social media function in their firm (consider this a social media awareness and response team, or SMART).
- Social media is an interdisciplinary practice, and the team should include professionals experienced in technology, marketing, PR, customer service, legal, and human resources.
- While the social media team provides guidance, training, and oversight, and structures crisis response, it's important to ensure that authentic experts engage on behalf of the firm. Social media is a conversation, and this isn't a job for the standard PR-style corporate spokesperson.
- Social media policies revolve around "three Rs": representation, responsibility, and respect. Many firms have posted their policies online so it can be easy for a firm to assemble examples of best practice.
- Firms must train employees and update their knowledge as technologies, effective use, and threats emerge. Security training is a vital component of establishing social media policy. Penalties for violation should be clear and backed by enforcement.
- While tempting, creating sock puppets to astroturf social media with praise posts violates FTC rules and can result in prosecution. Many users who thought their efforts were anonymous have been embarrassingly exposed and penalized. Customers are also using social media to expose firm dishonesty.
- Many tools exist for monitoring social media mentions of an organization, brands, competitors, and executives. Google Alerts, Twitter search, TweetDeck, Twitrratr, bit.ly, Facebook, and Foursquare all provide free tools that firms can leverage. For-fee tools and services are available as part of the online reputation management industry (and consultants in this space can also provide advice on improving a firm's online image and engagement).
- Social media are easy to adopt and potentially easy to abuse. The social media team can provide monitoring and support for firm-focused efforts inside the company and running on third-party networks, both to improve efforts and prevent unwanted disclosure, compliance, and privacy violations.
- The embassy approach to social media has firms establish their online presence through consistently named areas within popular services (e.g., facebook.com/starbucks, twitter.com/starbucks, youtube.com/starbucks). Firms can also create their own branded social media sites using tools such as Salesforce.com's "Ideas" platform.
- Social media provides "four Ms" of engagement: the megaphone to send out messages from the firm, the magnet to attract inbound communication, and monitoring and mediation—paying attention to what's happening online and selectively engage conversations when appropriate. Engagement can be public or private.
- Engagement is often more art than science, and managers can learn a lot by paying attention to the experiences of others. Firms should have clear rules for engagement and escalation when positive or negative issues are worthy of attention.

Questions and Exercises

1. The chapter provides several examples of how customers and employees can embarrass a firm. Find other examples of customer-and-employee social media incidents that reflected negatively on an organization. What happened? What was the result? How might these incidents have been prevented or better dealt with?

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2. Hunt for examples of social media excellence. List an example of an organization that got it right. What happened, and what benefits were received?
3. Social media critics often lament a lack of ROI (return on investment) for these sorts of efforts. What kind of return should firms expect from social media? Does the return justify the investment? Why or why not?
4. What kinds of firms should aggressively pursue social media? Which ones might consider avoiding these practices? If a firm is concerned about online conversations, what might this also tell management?
5. List the skills that are needed by today's social media professionals. What topics should you study to prepare you for a career in this space?
6. Search online to find examples of corporate social media policies. Share your findings with your instructor. What points do these policies have in common? Are there aspects of any of these policies that you think are especially strong that other firms might adopt? Are there things in these policies that concern you?
7. Should firms monitor employee social media use? Should they block external social media sites at work? Why or why not? Why might the answer differ by industry?
8. Use the monitoring tools mentioned in the reading to search your own name. How would a prospective employer evaluate what they've found? How should you curate your online profiles and social media presence to be the most "corporate friendly"?
9. Investigate incidents where employees were fired for social media use. Prepare to discuss examples in class. Could the employer have avoided these incidents?
10. Use the monitoring tools mentioned in the reading to search for a favorite firm or brand. What trends do you discover? Is the online dialogue fair? How might the firm use these findings?
11. Consider the case of the Cisco Fatty. Who was wrong? Advise how a firm might best handle this kind of online commentary.

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CHAPTER 10

The Sharing Economy, Collaborative Consumption, and Efficient Markets through Tech

10.1 Introduction

Learning Objectives

1. Recognize firms often categorized as part of the "sharing economy" or participating in "collaborative consumption."
2. Gain a sense of market size, impact, investment, and business valuation in these sectors.

In recent years, technology has enabled staggeringly diverse groups of product and service providers to connect with consumers, offering far greater reach and efficiency than traditional markets. Many of these new tech-fueled marketplaces are allowing millions of users to turn to private individuals—in effect, strangers instead of corporations—to meet some kind of demand. These efforts are also enabling a generation of "citizen suppliers" to go into business for themselves. Product owners are becoming providers of rentals, offering up their rooms (Airbnb), cars (Turo), boats (Boatsetter), and power tools (Zilok). Others are empowering a whole new class of micro-entrepreneurs with possessions and skills to provide personal services. Car rides (Uber, Lyft), pet sitting (Rover), meal prep (Feastly), home services (Care.com, Angie's List, Handy), freelance business services (Upwork), and errand runners (TaskRabbit) are just some of the segments getting a high-octane, tech-fueled boost. Some firms are buying inventory and renting it out (Rent the Runway with dresses, Zipcar with autos, Chegg with textbooks). These firms are moving whole categories of products from something an individual owns outright to something that is "collaboratively consumed," wherein an individual takes possession of an item for a period of time, then returns it for use by others. Consumers are even collaborating as financiers, pooling capital to back projects (Kickstarter, GoFundMe, Indiegogo) and provide loans (LendingClub, Prosper, Kiva). Most of these Internet-enabled market makers can trace their roots back to once-pioneering, now massively influential firms like eBay and craigslist, which empowered all sorts of individual sellers and service providers.[1]

Author Rachel Botsman coined the term "collaborative consumption" to describe these efforts.[2] Economist Thomas Friedman, author of *The World Is Flat*, prefers the phrase "sharing economy."[3] Still others may refer to the "collaboration economy," "peer-to-peer commerce," or even "re-commerce."[4] Many have lamented that these terms lack clear definitions.[5] Trying to bring pre-

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cision to the term, Boston College sociologist Juliet Schor says the sharing economy can involve the recirculation of goods, increased utilization of durable assets, exchange of services, or the sharing of productive assets.[6] A great start, but even this is tricky. Is a public library part of the sharing economy? Airbnb is a poster child for the effort, but why don't traditional bed and breakfasts get the same respect? Tech analyst Dan Schutzer adds that much of what we call "sharing economy" standouts differ from earlier efforts in that their efficiency is enhanced through streamlined coordination and broader reach by leveraging the Internet.[7] Even as we struggle for a precise definition, it's worth examining what's happening across this group of provider-pooling, tech-powered marketplaces. These firms fuel more efficient matching of supply and demand, lower costs, enable more efficient resource use, and provide a level of reach and services heretofore unavailable.

Today, billions of dollars in commerce is flowing through these marketplaces. Some are currently addressing smaller, niche markets. For example, the market for hourly car-sharing services (e.g., Zipcar or Turo) is thought to be just one-sixtieth the size of the market for traditional car rentals (e.g., Hertz, Enterprise, and Zipcar parent Avis). However, others are building Goliaths. For example, as of 2018, taxi-alternative Uber was far larger than any cab firm on the planet, operating in over 630 cities in 76 countries,[8] and fast-growing Airbnb had more than five million property listings in 81,000 cities, far more than Hilton, the biggest hotel chain on earth, has hotel rooms.[9] Given the potential for disruption, some very deep-pocketed investors are placing massive bets on the upstarts. Several sharing economy firms have gone public (e.g. Care.com, Chegg, Grubhub, HomeAway, LendingClub). Zipcar went public and was acquired by Avis, also for about half a billion dollars. Profitable Airbnb has raised $4.4 billion and is valued at $31 billion.[10] The number two car sharing service, Lyft, has raised $4.3 billion at an $11 billion valuation, $1.5 billion in 2017, alone. In a sign of a changing future for traditional car makers, General Motors backed Lyft with more than half a billion dollars, as has Google parent Alphabet (especially noteworthy since Google was an early backer of Uber).[11] Lyft will need it. Industry-leader Uber has raised more than $21 billion, although its recent woes led to a "down-round," valuing the firm at $48 billion, down from $70 billion[12]—a figure still more than double the value of *the entire rental car market*.[13] China's Didi Chuxing and consumers are solidly on board with the revolution. Some 44 percent of US Internet users have participated in the sharing economy, while 22 percent have offered goods or services.[14]

Despite the excitement, not all marketplaces are raging successes. There has been an inevitable consolidation of smaller players as leaders reach for scale. Boatbound was acquired by Boatsetter, DogVacay was rolled into Rover. And many others never got the traction required for a market to become efficient and a truly useful alternative. We'll look at what makes a good marketplace and why many seemingly good ideas have struggled.

Some Examples of Firms Often Characterized as Part of the "Sharing Economy" or "Collaborative Consumption"

- RGoods:
  - Pre-owned: eBay, craigslist (peer-to-peer supplied); thredUP (firm-owned inventory).
  - Loaner products: Zilok (peer-to-peer supplied); Rent the Runway, Chegg (firm-owned inventory).
  - Custom products: Etsy, CustomMade.
- Services:
  - Professional services: Upwork, crowdSPRING.
  - Personal services: Angie's List, Handy, TaskRabbit.
  - Delivery: DoorDash, Grubhub, Instacart, Postmates (self-employed drivers for restaurant or grocery delivery), Drizly (drivers and alcohol inventory owned by suppliers).

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- Transportation:
  - Transportation Services: Uber, Lyft, Didi (cars supplied by drivers).
  - Loaner vehicles: Turo (peer-to-peer supplied), Zipcar (firm-owned inventory).
- Office space:
  - Office space: LiquidSpace, ShareDesk (peer-to-peer supplied inventory).
  - Places to stay: Airbnb, HomeAway, Couchsurfing (peer-to-peer supplied inventory).
- Money and finance:
  - Money lending: LendingClub, Kiva, Prosper (peer-to-peer loans).
  - Crowdfunding: Kickstarter, GoFundMe, Indiegogo (peer-to-peer capital).

Key Takeaways

- The sharing economy is allowing firms to pool resources, products, and services in ways that create new markets and market opportunities.
- Citizen suppliers are offering services and renting out their own goods, while other firms are taking possession of inventory to organize resale or rental markets.
- Definitions of the sharing economy are imprecise, but a common set of dynamics, which we'll explore in this chapter, underpin market competition and growth.

Questions and Exercises

1. Which firms are the biggest players in the sector often referred to as "the sharing economy" or "collaborative consumption"? Have you used any of these firms? What was your experience like? Would you use them again or recommend them to a friend? Why or why not?
2. Research this segment and identify firms that should be considered part of the sharing economy but that aren't mentioned. What do you think of the prospects for the firm or firms you've identified? Why do you think they'll succeed or fail?

10.2 Boom Times and Looming Challenges in the Sharing Economy

Learning Objectives

1. Identify the factors that have contributed to the rise of the sharing economy.
2. Understand the competitive factors that influence success in marketplaces that support collaborative consumption.

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Share On! Factors Fueling the Rise of Collaborative Consumption

Several factors have come together to create a perfect storm for market disruption in market making. A prolonged, worldwide economic recession and stagnant wages have boosted consumer interest in low-cost alternatives to conventional products and services, and it encouraged a whole new class of laypeople to try their hand at offering services for hire. Need money? Rent out your spare room, your truck, the belt sander in your basement, find a market for your crafts or handyman skills, or run an errand in your free time.

While inviting strangers into your home, lending them your stuff, or hiring them for personal services might creep out an earlier generation, apps and social technologies help allay fears by collecting and sharing ratings (of both buyers and suppliers), ensuring payment, and offering increased scheduling convenience. Many of the services also have an environmental benefit by fostering reuse and diminished consumption.

Winning in Electronic Markets

All of these efforts are two-sided markets, and network effects are in effect. Showing up early gives firms a head start in the race to create a critical mass of buyers that will attract sellers and vice versa. Early players gain scale, brand, and financial resources to help expand and reinforce assets for competitive advantage. Want to start a sharing economy marketplace? As in any market effort, understand that value needs to be realized on both sides of the transaction equation. Suppliers without buyers or buyers without suppliers is a lopsided recipe for failure.

As an example of the benefits of an early lead, consider Uber vs. Lyft. Uber started in 2009, Lyft in 2012. Early on, late-moving Lyft struggled to gain the required critical mass of drivers to attract riders, and vice versa.[15] While Uber's troubles have provided a boost to Lyft, the pink-logo'd ride-hailing service is still far behind Uber. The #deleteUber protests lifted Lyft from 10 percent to 19 percent of the US market, but Uber remains comfortable at an 81 percent share.[16] Without Uber's constant negative press, it's unlikely that Lyft would have seen comparable growth.

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FIGURE 10.1 Lyft Branding
Lyft drivers use their own automobiles, but initially branded their participation by attaching pink mustaches to their car grills.



Source: Scott Kirsner—Twitter@scottkirsner.

Marketplaces are especially attractive to citizen-suppliers who want to make use of expensive items they've purchased but that are not regularly used. Technology allows exchange operators to coordinate a peer-to-peer supply, substituting information for real estate and other types of expensive inventory that traditional firms usually own outright. Airbnb doesn't own its hotel rooms; Uber and Lyft don't own cars. And in most cases, citizen-suppliers have already paid for the assets they use to earn money in the sharing economy. Capital investment, utilities, and maintenance are just some of the costs that sharing economy upstarts save over their competitors.

For some marketplaces, end users simply can't be relied on to consistently manage inventory and logistics. In these cases, successful "collaborative consumption" efforts own inventory to ensure quality and gain more control over the customer experience. Rent the Runway meticulously oversees its dress inventory, packing product for delivery, running a massive in-house garment cleaning effort, and retiring dresses that are noticeably worn. The goal is to ensure that an experience with the firm will bring customers a "Cinderella moment" filled with delight, rather than disappointment.[17] While some startups have attempted to allow women to rent dresses to others, none has achieved anything close to the scale of Rent the Runway's nine million members.[18] And used clothing marketplace thredUP started as a peer-to-peer firm where consumers sold to each other similar to eBay, but it has since evolved into an online consignment store that curates and warehouses inventory, provides high-quality photography of items for sale, and attentively packages goods for delivery. All this is meant to raise the bar and create a used-clothing purchase experience that rivals new item retail while saving customers big bucks.[19]

Highly fragmented markets are especially ripe for rollup in electronic marketplaces. Lots of suppliers in a traditional market mean customer search costs are high. But ratings in marketplaces help you quickly size up high-quality providers and make a lower-risk choice. Why look at the Yellow Pages when Handy can show you five-star plumbers, all vetted in background checks with insurance verified? Once a critical mass of buyers turns to a market as a first choice for shopping, the supply side knows they've got to show up, but suppliers can also use these markets to lower

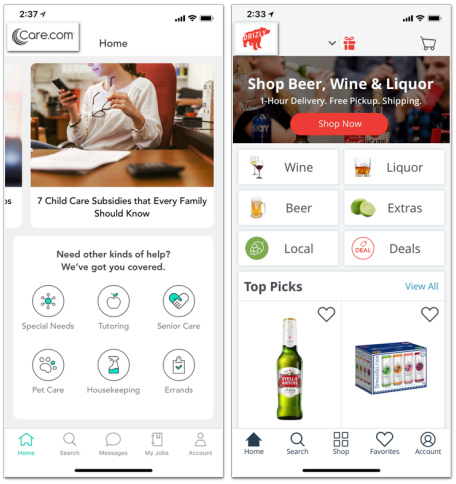
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other costs. Directories like Angie's List and Etsy also take the place of conventional advertising, marketing, or storefronts, so suppliers reduce overhead and marketplaces offer margins that traditional firms can't match.[20]

FIGURE 10.2 Uniting Fragmented Markets

Uniting fragmented markets: The smartphone app for Care.com pools citizen-suppliers for services such as child care, elder care, pet care, and home cleaning. Drizly allows independent liquor stores to collaborate to create a nationwide network for local alcohol delivery.



Source: Care.com; Drizly.com.

In highly fragmented markets, marketplaces oftentimes extend the value chain by getting between suppliers and customers that would otherwise connect directly. This is contrary to what we think of when disintermediation removes organizations from the distribution channel in order to increase efficiency, but if the network offers value through search and discovery, use of otherwise underutilized assets, scheduling, payment, reputation management and more, then a longer value chain can be a more efficient one. Publicly traded Care.com screens fragmented networks of providers of child care, elder care, pet care, and home upkeep services. Alcohol delivery app Drizly doesn't actually employ any drivers, nor does it take possession of any hooch (saving it from liquor industry regulation). Instead it simply connects those looking for a booze delivery with an existing yet underutilized network of drivers working for independent (and highly fragmented) liquor stores.[21] While not quite a network of citizen-suppliers, the same economics are at work here. The fragmented, small, independent suppliers are brought together by Drizly's market-making app to create what looks like a unified national brand, and this brings in new customers who seek the app-tap convenience of adult beverages brought right to their doorstep.

While Drizly rolls up the fragmented market for booze, ClassPass founder Payal Kadakia built her firm to do much the same for fitness classes. Customers pay a cancel-any-time monthly fee and can choose and schedule yoga, spin, Pilates, and more from a host of over 8,500 providers in fifty cities worldwide. Customers get choice, while providers bring in new customers and get a cut of ClassPass revenue while helping keep instructors and facilities full. By mid 2016, ClassPass, the leader in this space, was generating $150 million in revenue, was valued at $400 million, and poached a VP from Amazon.com to be the firm's CTO.[22]

FIGURE 10.3

ClassPass provides choice and variety for fitness customers.



Source: Image courtesy of ClassPass.

Social Media for Virality and Trust Strengthening

Word of mouth sharing and the virality offered by social media accelerate the growth of sharing economy marketplaces. Firms that can turn customers into brand ambassadors can see lower advertising and customer acquisition costs. One survey reported that 47 percent of participants in the sharing economy learned about the services they used via word of mouth.[23] Uber has proved inherently viral. Every seven riders attracts one new Uber user.[24] The firm regularly offers customers discounts for sharing Uber coupons to attract friends as new riders. Such programs aren't simply a subsidy to recruit customers, they are a trust-conveying **social proof** endorsement from an acquaintance that states "getting rides from a stranger isn't scary—I do it and here's money so you can try it, too!" Another factor that fuels virality? A satisfied customer base. One study found that 91 percent of sharing economy participants would recommend the last service they used to a friend or colleague.[25]

social proof

The positive influence created when someone finds out that others are doing something.

Lyft provides another good example of using social media to instill trust between drivers and customers. Both parties link to Lyft through their Facebook accounts.[26] Profile photos pop up as part of ride requests, so you know who you're going to be meeting. And both drivers and passengers rate each other. Drivers can skip fares with deadbeat ratings, while passengers get an endorsement that they're not about to step into a car driven by a sketchy rip-off artist, or worse.[27] Payment is guaranteed through the app. Consumers get an audit trail to call out any driver who tries to scam

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them or makes them feel uncomfortable, while drivers are ensured a fare won't pull the "no-cash dash," leaving them without pay for services. By leveraging technology this way, a service like Lyft can offer both parties in a transaction the kind of security that goes way beyond what one would get from a conventional taxi operation.

Online provider ratings can provide a lot more insight than you'd get when stepping into a conventional cab, or responding to a Yellow Pages ad, but online ratings aren't perfect. Boston College's Juliet Schor, who studied the sharing economy for the MacArthur Foundation, discovered evidence that some highly rated TaskRabbit suppliers leveraged the corresponding large volume of service requests to farm out their work to subcontractors, while taking a cut for themselves (such market-making within the market is against TaskRabbit terms of service).[28]

Crowdsourced ratings can also reflect the crowd's bias and reinforce discrimination. Allegations in an Uber driver forum suggest that college students rate older drivers lower, male riders give lower ratings to female drivers who don't respond to their flirtatiousness, drivers with disabilities also experience lower ratings, and black drivers have a lower acceptance rate than whites. A working paper published by Harvard researchers reports bias in Airbnb, claiming that after controlling for factors like location, rental characteristics, and quality, non-black Airbnb hosts in New York City were still able to charge 12 percent more than their black counterparts,[29] and black hosts received a larger penalty for having a poor location when compared to comparable non-black hosts.[30] Fighting this bias is tricky. Lyft doesn't track race or gender out of "a desire to be non-intrusive," but the firm will monitor things like request denials. To prevent drivers from denying rides to minority neighborhoods, many ride-sharing firms also don't share passenger destinations until the passenger has accepted the ride or even is in the vehicle.[31]

Share Everything? The Myth of the Market for Your Neighbor's Power Drill

An Airbnb founder once praised the model of rental firm Zilok, stating: "There are 80 million power drills in America that are used an average of thirteen minutes. Does everyone really need their own drill?"[32] A compelling argument that was often repeated in the media during the early years of the sharing economy, but it turns out there were a lot of problems when it came to actually building a business on neighborhood rentals.

Maintaining "**liquidity**" in the market—meaning a reliable supply of goods at a fair, market-rate price, requires a critical mass of both providers and consumers. These participants only show up if there is a strong value proposition—usually involving clear convenience and price advantages. Is there enough pain in buying a power drill? It's not that expensive, you know where to get it, and owning one can be a time saving for last-minute needs like furniture assembly or picture hanging. You can get a drill on Amazon for $30 and, in many markets, get it delivered in an hour. Does that trump tracking a product down, traveling to meet a stranger, and having to return it? Could there be a better model conveying more convenience (e.g., stop at the local hardware store and rent select items from their inventory)? And are there cultural implications, as well? Does renting to the person down the street make you seem stingy, given that neighborhood culture may be to just lend items?

liquidity

A liquid market is an efficient market with enough transaction volume to attract a reliable supply of goods at fair, market-rate prices. Cash from reliable economies is often considered to be the most "liquid" asset.

It seemed that lots of people liked the **elevator pitch** idea, but not enough people used it. SnapGoods and NeighborGoods had more suppliers that wanted to offer rental products than consumers interested in renting them. Focus also seemed a problem. SnapGoods had some successful categories (e.g., photo equipment, electronics) but not enough to become known as the go-to-place when you need "that thing."[33] Oftentimes hearing that you've got a "good idea" isn't enough to build a good business. Verification of product-market fit (see the Rent the Runway chapter) is critical for all innovators—from large corporations to garage startups.

elevator pitch

A quickly conveyed business pitch. The term's origin is: "imagine you're unexpectedly in an elevator with an investor, potential employee, etc., and you've got a chance to sell them on your idea."

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Can You Share Nice? Challenges of Safety and Regulation

Instilling trust doesn't mean that firms are without safety issues, and participants in the sharing economy are continuing to evolve their policies as a result. Airbnb has had rare incidents where guests have trashed homes or otherwise misbehaved, and Uber comes under criticism in those extremely rare circumstances where drivers commit crimes or get into injurious or even fatal accidents.

Participating in the sharing economy raises questions for insurers. Will firms pay out if there is a "sharing economy" incident with a supplier, or will they try to refuse, saying, in effect, "your policy doesn't cover operating a business." Homes, cars, and other insured items will experience more use, wear, and tear, likely a greater risk for the insurer, than if the insured item was only for personal use. Some sharing economy firms offer service providers additional coverage and protection guarantees, but the environment is still fluid. Some governments have explored additional insurance regulation for sharing economy participants.[34] Attempts to further regulate the industry could arise from legislator concern, or lobbying from the insurance industry or entrenched incumbents threatened by sharing economy competition.

Many local firms also benefit from taxes and regulatory fees from industries threatened by the sharing economy, and groups opposed to new, rival efforts can represent very powerful lobbies. Firms usually pay for the right to operate a cab service within a municipal district. In New York City, companies need a so-called medallion, an operating privilege that can cost over $1 million for a single vehicle.[35] Firms that have made this kind of investment don't want to see new competitors, especially if newcomers don't have to shell out for the same expenses. Thousands of cab drivers in major European cities snarled traffic to protest Uber and other ride-sharing services,[36] and Seattle's city council has voted to limit ride-sharing services.[37] Most large cities also tax and regulate hotels and other industries that these new models threaten. Airbnb has actually offered to pay $21 million in annual taxes to New York City, and has even sponsored a NY state bill to allow it to collect taxes. But opposition threatened by sharing economy firms is strong. Taxi and hotel owners represent powerful lobbies, and they'd love to see competition from the sharing economy go away. Hotel unions fear the growth of non-union jobs. Neighborhood associations are concerned that family homes are now located side-by-side to operating commercial properties that bring a large group of unknown, non-neighbors into their apartment buildings, condo complexes, and neighborhoods. Tenant lobbies worry that Airbnb encourages buying apartments as investment properties, contributing to a lack of affordable housing (San Francisco passed legislation to limit Airbnb-style short-term rentals to properties owned by permanent residents, and for no more than 90 days a year.[38] Similar rules are in place in many other popular cities, including Paris, Seattle, and New York, prompting Airbnb to voluntarily limit).[39]

The road to citizen-led finance has also been filled with obstacles. Leading peer-to-peer lending sites Prosper and Lending Club shut down for a period of time to work with the SEC and develop an oversight plan, which eventually involved securitizing loans made on the site so that they could be bought and sold on the open market,[40] and requiring both companies to make their financials public, even when they were privately held.[41] It's also worth noting that a good thing for consumers might be a great thing for institutions, as well. While Prosper and Lending Club were founded on the vision of peer-to-peer finance fueled by an army of citizen lenders, the reality is now that much of the money in these systems comes from hedge funds, other big institutional investors, and the wealthy.[42]

Another major concern for firms in the sharing economy is uncertainty around the ability of these firms to continue to consider their workers as independent contractors and not employees. An administrator for the US Deptment of Labor wrote: "When employers improperly classify employees as independent contractors, the employees may not receive important workplace protections such as the minimum wage, overtime compensation, unemployment insurance, and work-

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ers' compensation. Misclassification also results in lower tax revenues for government and an uneven playing field for employers who properly classify their workers."[43] The CEO of Homejoy shut down the sharing economy home cleaning firm, claiming that pending lawsuits had made it difficult for his firm to raise additional capital (the firm had already raised over $40 million from investors, including Google Ventures).[44] Other sharing economy firms, including Instacart (grocery delivery) have moved to reclassify independent contractors as employees.[45] The issue has gained the attention of state and federal agencies and presidential candidates, and raises the specter of class action lawsuits. Any move from independents (so called 1099 workers after the US tax form they fill out) to firm employees (that are issued a W-2 form) won't come cheap. A reclassification could raise wages by 20 percent, add upwards of 14 percent more for workers' compensation premiums that employers are required to pay, and employers will need to provide health care contributions.[46]

Not all authorities are opposed. Boston's mayor has voiced support for Uber, seeing it as a safe and popular service among citizens and city visitors.[47] Boston-area mass transit has reached out to Uber to improve transportation for people with disabilities, saving the state a potential $47 million a year,[48] and the city entered a data-sharing agreement with Uber to gain insight on travel patterns to support transportation policy and city planning goals.[49] Colorado and California have passed legislation largely supportive of ride-sharing services, while requiring some regulation to ensure public safety.[50] With a mixed regulatory reception in many markets, sharing economy innovators should recognize that even though they can build "an app for that," it doesn't mean that technology efforts will be allowed to circumvent incumbent protections, and we're likely to see a wide variation in support and regulation for years to come.

pivot

Altering a product offering, business model, or target market in hopes that the change will lead to a viable business.

WePay Winning Big: Processing Payments and Taming the Crowd through "Social" Security

Bringing together buyers and sellers can seem like a great business, but dealing with payment collection can cause migraine-inducing challenges. Credit card firms often take 3 percent or more from any transaction that accepts plastic, so many firms view payments as a despised, margin-narrowing expense.[51] Firms that run their own payments platforms also risk attack from hackers, vulnerabilities from software bugs and security crises, a complex regulatory environment, and more. Payments are rarely a source of competitive advantage in a marketplace—everyone needs to collect money—so firms are anxious to shed payment responsibility if they can.

On top of all this, processing payments in marketplace environments can prove especially challenging. Suppliers want to get up and running, accepting payments right away, but fraud is common. Crooks have been known to set up bogus storefronts or service providers and use stolen credit cards to "buy" from their own fake shops, in effect laundering money through these marketplaces. New merchant verification can be a slow, multistep process and has often resulted in inappropriately frozen merchant accounts (a complaint frequently made against payment leader PayPal).[52]

WePay is a firm that has stepped up to offer simple payment solutions that specifically target the challenges of buyer/seller platform operators. The firm's hundreds of clients include sharing economy standouts like service provider Care.com, goods marketplace CustomMade, and crowdfunding site GoFundMe. WePay combats challenges in several ways: first, the firm's Veda fraud-fighting technology analyzes social profiles to get clients up and running with payments in a streamlined process, far faster than rivals.[53] By linking to social media accounts (Facebook, LinkedIn, Yelp, TripAdvisor), WePay can gain a fast read on whether founders and businesses are legitimate. It's extremely difficult to fake any history accrued over time. WePay has also been processing payments since 2008 and has transaction history from hundreds of thousands of customers currently sending billions of dollars a year through the firm's systems.[54] Each transaction adds to the firm's "big data" smarts used to separate the stand-up vendors from the sketchy. The firm's machine learning technology continually update the firm's fraud models to adapt to new patterns it uncovers, spotting fraud with two to three times more efficiency than using a rules engine of known fraud types.[55] WePay makes adding payment capabilities to any site as easy as embedding a YouTube video, with a cut-and-paste of pregenerated code. The firm initially started as a group payments tool where clubs and friends could pool cash for purchases, but servicing

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businesses proved a much more lucrative market, with less support and other overhead needed for a focused group of high-volume clients. That **pivot** proved a winner. WePay now powers payments on eight of the top fifteen crowdfunding sites and is seeing growth balloon as new US regulations make crowdfunding more attractive. Early on, founders Bill Clerico and Rich Aberman took WePay through the elite Y Combinator accelerator program (where the Airbnb team also gained mentors and connections). The duo have been named to *BusinessWeek*'s Best Young Tech Entrepreneurs list, and their firm has been named a "Top Five" financial technology company by *Forbes*. WePay's growing model and marketplace smarts led to its acquisition by JP Morgan Chase in a deal that can ultimately be valued above $400 million.[56]

Key Takeaways

- Recession, wage stagnation, social media, environmental concerns, and the proliferation of smartphones are some of the factors that have helped fuel a rise in collaborative consumption.
- Two-sided network effects are at work in collaborative consumption marketplaces, and in order to be successful, firms must offer value to both buyers and suppliers.
- Firms that move early may get a jumpstart on the creation of key assets, such as network effects, brand, scale, and financial resources.
- Marketplaces allow suppliers to leverage underutilized assets, while marketplace operators can reduce overhead associated with conventional transactions by eliminating storefronts, utilities, staff, capital expense, and more.
- Some firms may choose to take control of inventory to maximize quality and customer experience.
- Fragmented markets are especially well-suited for rollup in electronic marketplaces.
- While we often talk about disintermediation that shrinks a distribution channel, channel-extending intermediaries such as sharing economy exchanges, can position themselves between buyers and sellers, but add value for both parties. Suppliers gain reach and encourage discovery at a lower marketing spend, consumers see search costs lowered, and both sides can benefit from services such as scheduling and payment. Consumers see dramatically lowered search costs.
- Virality can lower advertising and customer acquisition costs, increase reputation, and lower the perception of risk.
- While crowdsourced participant ratings and social profiles can help improve trust, this technology can also reinforce bias and discriminatory tendencies of the crowd. Some firms audit data to try to uncover and address bias. Others hold back key information, such as destination information, if rides to a minority neighborhood might cause some suppliers to deny service to certain customers.
- Although incidents are rare, safety of the public and safety of service providers remains a concern in the sharing economy.
- Insurers may be reluctant to cover individuals or assets (homes, autos, or other high-value possessions) if they are being used commercially, instead of for standard, personal use as specified in most policies. As a result, some sharing economy firms have stepped up to offer their own supplemental insurance and safety coverage.
- Many entrenched interests will challenge the legality of the sharing economy and lobby for its regulation or curtailment.

Questions and Exercises

1. Consider sharing economy markets like ridesharing and home rental. Have you or friends used the leading firms in these industries? Have you used firms that aren't the leaders? Why or why not?

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2. Make a list of products that many people own, but that are underutilized. Are there sharing economy startups for these categories? If so, conduct some research to try to determine how they're doing. If not, do you think a market should be established? Why or why not? What challenges might such marketplaces face?
3. Give examples of firms that provide supply through peer-to-peer efforts, and collaborative consumption firms that take ownership of inventory.
4. Why do some collaborative consumption firms choose to take possession of inventory rather than allow the "crowd" to provide it peer-to-peer style?
5. Why do many collaborative consumption marketplaces work well in fragmented markets? What advantages do they offer buyers and sellers over traditional mechanisms of dealing with fragmented markets?
6. It sounds counterintuitive to gain efficiencies by adding a firm to the distribution channel, but how are some collaborative consumption marketplaces thriving as channel-extending intermediaries? Give examples and discuss the value they add to both sides.
7. Why is social media important for many collaborative consumption efforts? Give examples of efforts that are effectively using social media for growth and success.
8. What sorts of legal risks are sharing economy firms exposed to? Conduct research online and identify examples of incidents that have put firms, customers, or suppliers at risk. Do you think these incidents will occur with greater or less frequency in sharing economy firms vs. traditional rivals? Why or why not?
9. Why do you suppose San Francisco passed a law to limit homeowners to cap Airbnb (and similar) property rental to 90 days or less?
10. What can sharing economy firms do to reduce safety risks? Give examples of best practices.
11. Social profiles and crowdsourced ratings can improve trust, but they can also create opportunities for fraud and discrimination. Give examples of where this technology may have negative ethical implications, and discuss how the provider of a sharing economy marketplace can minimize risks and discriminatory bias. Research the extent of this problem, firm attempts to address these problems, and whether you feel they have been successful or not. Is there more that firms or governments should do? If so, what ideas might help?
12. Give examples of the kinds of entrenched interests that will lobby against expansion of the sharing economy? Why are each of these groups opposed to sharing economy efforts?
13. How do crooks try to use sharing economy marketplaces to commit fraud? How can social media help combat online fraud?

10.3 Future Outlook: Established Players Get Collaborative

Learning Objectives

1. Identify and give examples of how large firms are investing in, partnering with, and building their own collaborative consumption efforts.
2. Gain insight into the advantages of collaborative consumption firms for traditional industry players, and enhance brainstorming skills for identifying possibilities for other firms.

While the sharing economy has risen more rapidly than many expected, larger firms have also stepped up with investment, partnerships, and experiments of their own, underscoring a broad belief in the power and importance of the space. The following are some examples.

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Google parent Alphabet has invested over a quarter of a billion dollars in Uber,[57] and $1 billion in rival Lyft.[58] Toyota has made a strategic investment in Uber and struck a leasing deal. GM has invested half a billion dollars in Lyft, Volkswagen has invested $300 million in ride-sharing firm Gett, and Apple has invested $1 billion into the "Uber of China," Didi Chuxing[59] (a move made just a short time before Uber sold its China business to Didi). Sharing economy standout, Rent the Runway, has also scored an investment by Condé Nast, the publisher behind *Vogue, Lucky, Glamour,* and other designer-friendly media properties, and the firm has collaborated with Neiman Marcus,[60] underscoring its evolution into an important industry partner. While some designers were originally worried that the service would cannibalize sales, many now realize that Rent the Runway has opened up a whole new tier of customers. An affinity with a designer gained from renting a more daring dress for a special occasion often translates into purchasing a staple, like a black cocktail dress, at a later date. Rent the Runway's social media engagement of its customer base also provides partners with valuable insights they'd otherwise not have access to.[61]

Other innovative partnerships include Walgreens and TaskRabbit, which have worked together on drug store deliveries.[62] TaskRabbit's army of odd-job soldiers was seen by Ikea as such a match for its assembly-required furniture that it bought the company.[63] IBM also has also worked with collaborative commerce firm, Deliv. IBM offers software that powers many large retailers, and it works with Deliv to make same-day delivery services available to its clients, as well.[64] A W Hotel in New York City has partnered with the workspace sharing site Desks Near Me to offer business traveler guests access to places to work while in Manhattan.[65] And Marriott is hoping for a bit of the Airbnb magic with its homesharing partnership with London-based Hostmaker.[66]

Some experiments will fail to achieve desired results. General Motors canceled its OnStar-enabled partnership with car-sharing service RelayRides (now called Turo). But other automakers continue to explore their options. GM and Toyota give discounts on new-car purchases to Uber drivers; Mercedes Benz has invested in car-sharing service, car2go;[67] and Avis saw enough value in Zipcar to acquire the firm.

And expect some firms to enter as outright competitors. Amazon Home Services marketplace will put licensed professionals as well as small-time citizen service suppliers within the same massive discovery engine where millions search for physical products.[68]

While just a few years old, the sharing economy has accelerated in a wave of network effect–fueled technology efficiency and service enhancement that will impact industries for years to come. Hopefully this chapter has helped expose what's happening, why, and how managers can think about planning for a space where new electronic marketplaces empower and shift power from smartphone to supply chain.

Key Takeaways

- Google and Condé Nast are among the large firms that have taken an investment stake in collaborative consumption startups.
- Ikea, Walgreens, IBM, and the W Hotel are just a few firms that have enhanced customer offerings by partnering with sharing economy pioneers.
- Firms as diverse as auto manufacturers and Amazon are plotting independent collaborative consumption efforts as well.

Questions and Exercises

1. Which collaborative consumption firms have Google, Ikea, and Condé Nast invested in? Why are these firms potentially attractive to their corporate investors?

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2. Give examples of traditional firms that have partnered with collaborative consumption players. What does each hope to gain from the partnership?
3. Name traditional firms that have experimented with their own collaborative consumption efforts. Conduct additional research online. Are these efforts successful, failed, or is it too early to tell? What do you think of future prospects?

10.4 Airbnb—Hey Stranger, Why Don't You Stay at My Place?

Learning Objectives

1. Understand how Airbnb has built a multibillion-dollar sharing economy firm.
2. Recognize the appeal the firm has for suppliers and consumers.
3. Identify sources of competitive advantage and additional challenges as the firm continues to grow.
4. Understand how technology can build trust, even in an area as sensitive as selling stays in private homes.

Brian Chesky, a graduate of the Rhode Island School of Design, had recently moved in with a friend in San Francisco and he couldn't make rent. Brainstorming on ideas, Chesky and his roomie, RISD classmate Joe Gebbia, realized an industrial designers conference was in town, and that all of the hotel rooms were booked solid. Sensing opportunity, the two inflated three air mattresses and offered each one up for $80 a night. The duo earned enough to cover rent, and in the process, took their first step toward the creation of a multibillion-dollar hospitality industry empire.[69]

Airbnb is now the poster child for the sharing economy. Put a single room or your entire property online, and you can become a citizen hotelier. A third cofounder, Nathan Blecharczyk, joined as CTO, the team gained admission to the elite Y Combinator startup finishing school, and Airbnb has since attracted several rounds of capital to fuel its meteoric growth. The firm's backers include Sequoia Capital, the storied Silicon Valley venture firm that invested in Apple, Cisco, Google, Oracle, and YouTube, among many others. Airbnb has raised over 4.4 billion dollars so far, is valued at more than $31 billion, is profitable (earning an estimated roughly $100 million in 2017),[70] and *Forbes* declared the firm's founding triumvirate as "The First Sharing Economy Billionaires."[71]

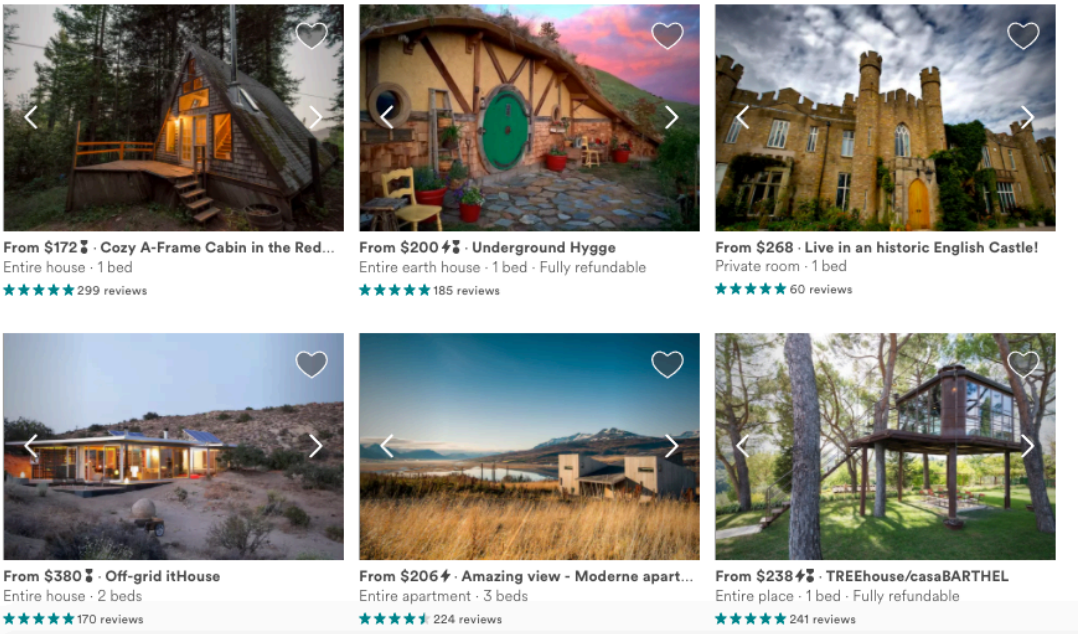
A guest checks into Airbnb every two seconds,[72] and over 200 million have stayed with Airbnb so far.[73] The guest-to-listing ratio is eleven to one.[74] With listings in 81,000 cities and 192 countries, there is no other single hotel group that approaches the firm's worldwide reach.[75]

Airbnb has rallied the sharing economy to produce the longest accommodations tail in the lodging industry. According to founders, the firm's listings include over 600 castles, dozens of yurts, caves, tepees, water towers, clock towers, private islands, lighthouses, trains, environmentally friendly "green" homes, igloos, glass houses, and more. Some of the exotic, high-end tree houses listed on Airbnb have six-month or more waiting lists for occupancy (but browse around, there are hundreds of tree houses offered through the site).[76] Want to stay in a home Charles Dickens, John Steinbeck, or Jim Morrison used to live in? Airbnb can set you up.

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FIGURE 10.4 Unique Airbnb Properties
A sampling of some of the more unique properties available for rent on Airbnb.



Source: Airbnb.com.

Airbnb adds big value to both the supply and buy side of a transaction, and it's one of the few large players that can take a cut on each end of the deal. It charges guests a fee that varies by property and other factors that can scale from zero to 20 percent, and hosts a 3 percent fee, paid after the first night.[77] During major events when hotels are booked to capacity, private citizens have turned on a money spigot courtesy of Chesky, Gebbia, and Blecharczyk, simultaneously saving travelers bacon at political conventions, festivals, inaugurations, Olympics, and more. Airbnb was the largest short-term rental site of its kind in China before it even had any staff there. Such are the viral and ultralean dynamics of winning sharing economy marketplaces. You might even consider Airbnb a platform that nurtures an ecosystem of sharing economy value-added services. All sorts of citizen-suppliers are finding work, from before an Airbnb listing is posted to after guests leave. This includes listing photographers, key-exchange coordinators, in-home chefs, house cleaners, and taxi-replacing ride-sharing services.[78]

Trust is essential for the sharing economy to work, especially on a service based on the intimacy of inviting strangers into your home. As a result, no one is anonymous on Airbnb. Guest identity is verified via a two-step process. The site is integrated with Facebook, and users can also share their LinkedIn profiles. Airbnb examines the length an online profile has been up and makes sure it matches additional information provided by the user, such as a driver's license and passport. IDs are only used to verify identity and the site stores this data securely. Verified identities should also discourage bad apples, who are booted out of the system from trying to reapply with new accounts.[79] Transacting parties are otherwise on their own to work out the exchange of keys and other access information, but communication has to happen through Airbnb. Airbnb also arranged for high-quality photography of many early listings (in some cases the founders showed up to photograph sites themselves, using the opportunity to further interview property listers for feedback on their service). Chesky has even lived out of Airbnb rentals full time to gather more field intelligence.[80] Collective insight helped hone the firm's product-market fit in a way that delighted both renters and customers and gave the firm an early edge, and sometimes that's all you need to get the dynamo of two-sided network effects churning in your favor. As *Inc.* magazine reports, "improvements and refinements helped Airbnb do something previous sharing companies hadn't managed—to acquire an aura of style, respectability, safety, and trustworthiness."[81]

Negative incidents have occurred, and they've gotten the firm lots of unwanted press. Some hosts have returned to find their homes trashed after guests threw raucous parties, a terms-violat-

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ing tactic favored by some high school and college students.[82] In another incident, New York-based comedian Ari Teman reports renting his home to someone who self-described as arranging wedding accommodations for a brother and sister-in-law, only to return to furniture damage and the discovery that his house had been used for a ticket-selling sex party that had attracted some fifty creepy strangers to his place.[83] An incident like this is never good news, but when it happens to a big-city comedian, it goes viral and becomes a top trending story on social media. In the unlikely event of an incident, the firm offers a $1 million guarantee for hosts, secure payment guarantees, and 24/7 support phone service backed up by a staff of six hundred in the firm's customer service and trust and safety departments. Despite headline-grabbing anomalies, the firm reports that significant property damage claims ($1,000 or greater) are reported only 0.004 percent of the time.[84]

Airbnb is able to monitor transactions and communication at a fairly deep level. Reservations, payment, communication between host and guest, and subsequent reviewers are all handled through the firm's technology platform. In addition to helping with verification and transaction auditing, the firm monitors to see if hosts are trying to arrange a stay and payment outside of the system (scanning communication for the names of alternate electronic payment methods like "Western Union"). The firm's technology also hunts for signals of fake positive reviews, money laundering, and other scams, and when suspicious activity is flagged, human monitors can take a closer look and follow up, as needed.

At Airbnb, Big Data is a Big Deal

Data also plays a critical role in Airbnb's success, and as an early mover with worldwide reach and climbing customer base, Airbnb has an incredible trove to mine. The firm tracks more than 15 billion events through website and apps and handles over 15 petabytes of data each day. The firm has over 150 employees working on the data science team. Says the firm's chief data scientist: "Airbnb is a data informed company. We think data is the voice of our customers."[85]

Data helps in helping hosts set prices and tweak offerings for optimal occupation. It helps guests find the best match and mines their input for new products and offerings. Many insights happen through machine learning, where software builds technology models and reveals insights that might not be readily apparent to the analyst. More on the impact of big data and machine learning will be covered in the "Data Asset" chapter, highlighting the application and impact of additional concepts introduced in that chapter in the callout titled: "Airbnb: Better Pricing Through Data."

A Phenomenal Start, but Not Without Challenges

It's worth noting that in many areas where Airbnb operates, providers of the service are breaking the law. Many municipalities prohibit people from running a business, hostel, or hotel in a residential area or property not zoned for business. Health and safety laws governing hotels usually require things like sprinkler systems, exit signs, and clean towels. And of course, many Airbnb rentals exchange services outside conventional lodging taxes that hotel guests pay.[86] Malibu, New Orleans, and San Francisco are among the cities that have investigated Airbnb for violations. Barcelona has fined the firm. The New York state attorney general claims Airbnb's unpaid tax bill tops $33 billion. New York City has sued owners of the site's highest volume listers, going after them for running illegal hotels out of apartment buildings they owned.[87]

Despite operating outside the law, it looks like many cities are looking to rewrite legislation for efforts that ultimately offer many benefits, including added income for local property owners,

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additional capacity during major events and the high travel season, a bulwark against hotel price gouging, and a mechanism to widen travel and ultimately bring in the economic benefit of more tourist dollars. Portland, Oregon, and San Francisco (home town of Airbnb) are among the cities that have already legalized sharing economy property listings in exchange for tax revenue and other concessions.[88]

Competition looms and includes the publicly traded HomeAway as well as a host of international copycats. Several hotel firms have also experimented with homesharing, including Marriott, Accor Hotels, and Hyatt, and travel sites like Booking.com and TripAdvisor now incorporate homestays into their search.[89] While hotel firms can integrate loyalty programs into their offerings and help skittish first-time renters feel more comfortable by working with a familiar firm, helping newbies get on line may ultimately help Airbnb grow its market. Airbnb has that ultimate marketplace advantage: a two-sided network effect keeps property listers and guests coming back to an experienced, trusted source likely to offer more choice than competitors.

Key Takeaways

- Airbnb empowers citizen hoteliers who make rooms, properties, or other accommodations available online.
- The firm has arranged over 200 million guest stays in some 81,000 cities and 192 countries. Many accommodations are truly unique, offering consumers a long tail of lodging options.
- The firm verifies the identity of both parties, monitors all communications between property listers and guests, provides twenty-four-hour support, and additional insurance coverage, all in an effort to reduce transaction friction stemming from a lack of trust.

Questions and Exercises

1. How do Airbnb's total number of accommodations compare to the room count for Hilton?
2. How does Airbnb ensure safety and encourage trust among transacting parties? What role does technology play in trust assurance?
3. How does the firm limit the likelihood that it will be ripped off by unscrupulous operators?
4. What sort of legal trouble has Airbnb run into? Put yourself in the shoes of city lawmakers. List the pros and cons of allowing Airbnb or other property-sharing services to operate in your city. Would you allow these services? Why or why not? If you would approve the service, would you extract concessions or write laws that force some changes that impact how Airbnb and its partners do business?
5. Visit Airbnb and browse properties at a vacation destination you'd like to visit and listings in the area where you live. Would you rent a stay through Airbnb? Why or why not? Would you make your own property available? Why or why not?
6. How might Airbnb be considered a platform? Diagram the ecosystem that would surround an Airbnb transaction and identify various sharing economy firms that could provide services to help property listers or their guests. Could Airbnb create additional businesses by facilitating these transactions? Do some additional research—does Airbnb partner with any specific sharing economy firms?

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10.5 Uber's Wild Ride: Sharing Economy Success, and Lessons From a Fallen Founder

Learning Objectives

1. Understand the appeal of Uber both to drivers and consumers.
2. Discuss how Uber leverages technology to radically improve on the service and cost structure of traditional cab and limo services.
3. Understand the implications of executive behavior and harmful corporate culture on the firm, its hiring prospects, investors, and customers.
4. Recognize how technology also empowers a data-driven enterprise that crafts strong and deepening competitive advantage over time.

Just four years after Travis Kalanick cofounded Uber, the San Francisco-based car service was operating in 633 cities in 76 countries worldwide. How's that for productivity achieved in what is basically the time it takes to earn an undergraduate degree![90] The firm has already offered a high-end "black car" service, the passenger-sharing Uber Pool, the low-end taxi-competing UberX and an SUV service (UberXL) and has experimented with all sorts of promotions. At times over the past few years you could order a helicopter ride via the Uber app, call over a boat, arrange for Christmas tree delivery, cool off your home with an air conditioner delivery, order an ice cream truck, or summon forth a car full of puppies for a cuddle fix. Uber had raised over $21 billion so far,[91] and boasts a private valuation of over $70 billion.[92] Uber did publish 2017 revenues, a figure that came in at about $7.5 billion—a figure large enough that if Uber were a public company, it'd rank 367 on the *Fortune* 500 list.[93] Still, even though Uber keeps about 20 percent of each transaction,[94] the firm lost $4.5 billion that same year. States Bloomberg's Eric Newcomer, "There are few historical precedents for the scale of its loss."[95]

From Rebel to Revulsion: When Uber Behavior Became Hostile and Required Big Change

In Silicon Valley, a place known for lionizing the brash disruptor, Uber was perhaps the firm seen as most brazenly pugilistic. The firm defied local laws in many cities where it launched, and Uber founder Travis Kalanick (known as TK inside the firm) talked trash to many who challenged his legitimacy. Uber was a godsend to customers who often felt underserved and mistreated by a far-less-than reliable taxi industry. So early missteps were often tolerated or ignored by the Uber-loyal.

Problems began piling up, with strikes by drivers, protests by the taxi industry, and aggressive political push-back, among them. Horrendous cases of driver-perpetrated sexual assault hurt a firm often seen as much safer than taking a conventional taxi. Dishonesty began to be seen as an Uber cultural trait. This included accusations of the theft of self-driving car tech by an Uber employee who previously worked at what is now Waymo, the division of Google-parent Alphabet thought to be the leader in this space. Rival Lyft also accused Uber of unethical behavior, including calling and canceling Lyft rides to crater the efficiency of its smaller rival. Uber has also been the subject of a US Justice Department investigation of it's "Greyball" software, which detected and canceled rides from investigators and regulating authorities,[96] and an additional investigation focused on bribing officials abroad in violation of the US Foreign Corrupt Practices Act.[97]

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An employee's blog post detailing a culture hostile to women and minorities and her personal experiences dealing with unwanted sexual advances from a manager (who was not seriously disciplined) made Uber seem, to many, like a testosterone-fueled bad frat with funding. Some employees wondered if Uber's bad rep would become a career liability, while prospective employees would think twice about whether this kind of environment was really a smart career move, and the kind of workplace where they'd feel valued and given a chance to thrive.

A brash, take-no-prisoners attitude was helpful early on. But at some point an ethically challenged subculture emerged, and brashness crossed into harassment. Kalanick became a liability. As the face of Uber, his became the face of arrogance, hubris, and offensiveness. A dash cam recording showing him berate a driver made him look like an over-privileged one-percenter dismissive of the drivers that ultimately deliver on the promise of a push-button ride.

The firm hired the law firm of former US Attorney General Eric Holder to investigate Uber's toxic culture and to provide a blueprint for change. Twenty employees were fired as a result of separate investigations of harassment, discrimination, and retaliation. Board member Arianna Huffington was increasingly called on to show the firm was taking allegations seriously. Kalanick announced he was taking an indefinite leave of absence. Shortly after, he formally relinquished his role as CEO. After an exhaustive search, where apparently several candidates (including highly-sought-after female executives) turned down the position,[98] Uber eventually hired the former CEO of travel site Expedia, Dara Khosrowshahi. Yet the firm's woes continued when, just months after Khosrowshahi's appointment, it was revealed that Uber had been hacked a year earlier, exposing personal data on 57 million riders and drivers, that it paid $100,000 to the two hackers in exchange for them destroying the data, and it revealed information about the breach to potential backer Softbank at least a month before revealing the information to the public.[99] Softbank did invest in Uber, but the ride-sharing firm's torrent of troubles significantly shifted buying power, with Softbank eventually investing at a 30 percent discount over Uber's prior valuation,[100] although Uber's valuation months later was back up to $72 billion.[101]

It's unclear just how damaging the fallout has been in markets where Uber was already dominant. In the US, Lyft still remains very much in Uber's rear-view mirror (even at Lyft's generous 35 percent self-estimate,[102] let alone the 19 percent others have arrived at[103]). Employee and investor concerns may have proven even more significant in tilting Travis from the CEO chair. Network effects may make customers stick with a firm, even if they'd rather not remain, but talent and the fundraising wallet may be far stronger in pushing a firm to recognize and deal with repellent behavior.[104]

Softbank Acquires Stake in Uber at Discounted Valuation

Panel discusses the large investment discount Softbank received when investing in Uber, following the firm's multiple problems, and the new CEO's delayed disclosure of a data breach.



View the video online at: //www.youtube.com/embed/1WjgP8lmA_A?rel=0

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Uber also wants you to know it's a job creator. The firm has claimed it is minting over 50,000 new jobs a month (nearly all are drivers, who are considered independent contractors and not Uber employees).[105] The bar for drivers is high—each undergoes a rigorous county, federal, and multi-state background check that looks back the maximum length of time allowed by law.[106] And while cars are supplied by drivers, only certain late-model cars are allowed in Uber's fleet,[107] and only then after a company inspection (no smoke-billowing clunkers here).[108] Those who make the cut can do much better than their conventional taxi industry counterparts. It was once reported that the median annual salary for a San Francisco-based UberX driver working at least forty hours a week was $74,191; in New York City the figure was $90,766. The average Big Apple cabbie makes just $30,000 a year.[109] Some have questioned whether average driver earnings are really that high, and study results vary widely,[110] but with taxi drivers paying $70 to $140 a day in fees even if they earn no fares,[111] estimates consistently show that Uber drivers make more.[112] Further, job satisfaction among Uber drivers hovers around 80 percent. Nearly half of Uber drivers have a college degree (about two times that of the overall work force),[113] with most drivers reporting that they use Uber income to supplement earnings, not as their primary salary.[114] Uber claims it's also improving the environment, reducing DUI rates and making cities more appealing by reducing parking and road congestion,[115] although other studies claim Uber is actually clogging streets and stealing customers from public transportation.[116]

Uber isn't just taking away the current taxi market; it's expanding the overall market for metered consumer transportation. Many people who would not otherwise take a cab are now out on the town in an Uber. This is an effort that grows the economic pie. An Uber-commissioned study claims the firm's impact on the US economy tops $2.8 billion a year.[117]

product-market fit

A key concept in entrepreneurship and new product development that conveys the degree to which a product satisfiesmarket demand. Successful efforts should be desired by customers, and scale into large, profitable businesses.

While Uber services are often comparable to conventional cab rates, the real draw is trust and convenience. Instead of standing in potentially bad weather, competing with curb-straddling rivals trying to hail a cab for an indeterminate length of time, or phoning a surly human dispatcher who may or may not answer the phone after putting you on hold, Uber customers simply summon their ride with the tap of a smartphone app. A map shows the cab's approach and an alert tells you when your driver has arrived, so you can stay sheltered until it's time to leave. Riders can also set their pickup and dropoff destination to get a fare quote for their trip, eliminating the fear many travelers have that an unscrupulous cabbie will overcharge them on an unnecessarily scenic route to their destination. Out of cash, fearful your driver can't make change, or worried that the credit card machine or fare meter in the cab might not work? No problem with Uber. All payment is handled through the app. The app even allows fare-splitting among passengers who share a ride. Says one Uber driver, "No one ever gets in my car and says, 'Gee, I wish I were taking a cab.'"[118] Drivers use their own app to screen and accept fares. Drivers and riders rate each other, keeping both sides of the two-sided market satisfied. City drivers prefer Uber's phone-delivered dispatches to the taxi alternative of having to hunt for fares by driving around, scanning sidewalks.[119] Entrepreneurs would describe Uber as a stellar example of **product-market fit**, the magic that happens when market need, weaknesses, and pain-points are satisfied by a customer-embraced solution far superior to what is currently being offered. Chapter 2 "Strategy and Technology: Concepts and Frameworks for Understanding What Separates Winners from Losers" discussed that brand is built through customer experience. From a service perspective Uber beats conventional cabs on almost all metrics (with big advantages offered to both drivers and passengers). Alternatives simply cannot compete. For example, in January 2016 San Francisco's largest taxi company filed for bankruptcy. Prior to Uber and other ride-sharing services, this taxi company was a municipal monopoly that faced no competition.[120]

Uber runs a lean cost of doing business by eliminating human dispatchers, eliminating the capital cost of a fleet (cars are owned by drivers, not Uber), and working around the expensive "medallion" system that grants cab rights in major cities worldwide. In addition to the firm's own screening techniques, customer feedback also reduces the cost associated with auditing driver quality and provides a continual evaluation of performance. Drivers who fall below 4.7 stars on a five-point scale risk being fired.[121]

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Customers do regularly complain of one downside—surge pricing. Uber pricing operates on a supply and demand scale. If there's a big event in town or some other condition where driver supply doesn't meet demand, Uber will raise prices using a "surge pricing" multiple. One particularly bad New York City snowstorm caused the surge pricing multiple to shoot as high as 8.25 times the normal rate. You'll see this before summoning your car, so riders shouldn't be surprised by a big bill. The firm states the goal isn't to gouge the consumer, rather it's to send a signal to potential drivers to hop in their cars, satisfy pent-up demand, and make a quick buck.[122] Price setting occurs where supply and demand meet, so more drivers should lower prices. If you leave the stadium after the game gets out, don't expect a standard Uber fare, but if you can grab a drink and wait a few minutes, you'll likely see prices fall closer to normal over time. Dynamic pricing helps Uber's first customer commitment—to offer a reliable service (i.e., make sure you've got a ride). Competitive pricing is important, but first up is making sure there are enough rides for those willing to pay for the service. Without surge pricing, the real alternative is no service. Uber has since agreed to cap surging during emergencies at a price that is below the three highest-priced non-emergency days during the preceding two months. During record snowfall in the northeast, this resulted in major city price caps just below three times the normal rate, but it remains to be seen if this will be enough to put drivers on the road when they are most needed. Uber has also stated that during a disaster or state of emergency, the firm will donate all of its proceeds earned in the area during that period to the American Red Cross.[123]

Tragedy, but Tech Raises the Safety Bar

No system can keep out all negative incidents in a worldwide firm this big, and a company that grows so quickly with such public fascination will likely see an amplification of any bad press. While a criminal cabbie or taxi-caused pedestrian fatality would likely not gain worldwide media attention, all eyes are on Uber and any negative incident seems to make headlines. And there have been horrendous incidents: accusations of price gouging during an Australian hostage standoff, a rape in India, a kidnapping and sexual assault in Boston, a driver hitting and killing a child in San Francisco.[124] All horrific, and certainly not incidents to be shunted aside as a cost of doing business. But amidst tragedy, a closer look shows that technology actually helps Uber keep a high safety bar, and to continue to raise that bar even higher. Committing a crime and taking risks as an Uber driver is incredibly stupid. The app knows who you are at all times, knows who you've picked up and where you took them, and these digital eyes are always on you, with bad performance exposed and customers (and drivers) empowered to shine a spotlight on what might have been previously hidden. Collectively, this offers a safety bar conventional cabs simply don't offer. Uber continues to invest in new technologies, exploring voice recognition and biometrics to further strengthen driver verification,[125] and implementing a panic button linked to emergency services, and a setting that allows loved ones to monitor your ride.[126]

Driven by Data

While participants in the sharing economy drive Uber cars, data drives Uber's growth and success. To pull off the firm's goal of getting you a ride within minutes of an app tap, Uber employs a team of mentally muscular mathematicians who have earned PhDs in data-crunching fields that include nuclear physics, astrophysics, and computational biology (true to cliché, some members of the data team have had prior careers and training as actual rocket scientists).[127] The staff constantly optimizes algorithms powering a whole host of activities: determining how many drivers the firm needs, identifying when and how to alert drivers of projected demand, pointing a subset of drivers to locations to best meet demand, setting dynamic pricing, and more.

Uber's founder has called this "really fun, sexy math."[128] The firm supplements its own rich and growing trove of data with traffic-influencing feeds such as weather forecasts, and staff in each city closely track special events that could impact expectations (conventions, parades, large university

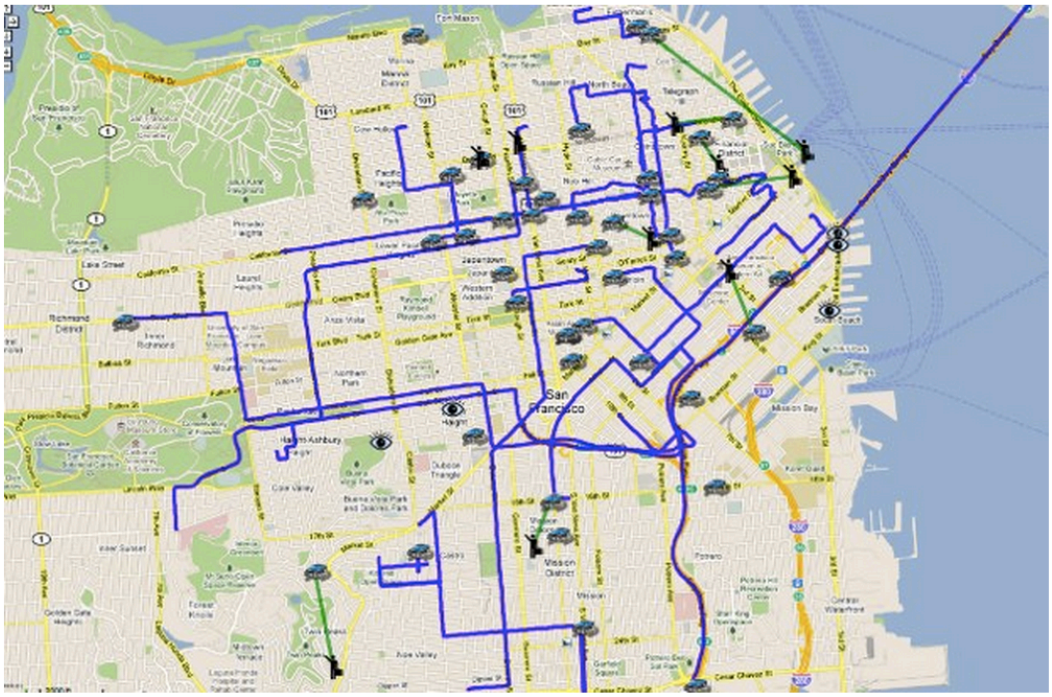
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commencements, a packed stadium for the home team). The latter, human element is vital, since even the best math and richest data set can't predict with perfect accuracy.

A visitor to an Uber office may get a glimpse of the "God View," a software system showing tiny car icons crawling around a map of the city, and little cartoon eyeballs scattered about, representing every location where a customer is looking at the Uber app.[129] Uber also produces "heat maps" of demand, using mathematical precision to coax additional demand from its driver pool. Information is offered in targeted release; you don't want to give this to every driver at once, or you'll create an imbalance as too many cars rush to cash in on surge pricing, leaving the rest of the city underserved. Data even helps the firm expand into new cities. Each time a user opens an app, even if it's in a location Uber hasn't operated in before, data is collected showing user interest. According to the firm, "we take this into account when we're working out which cities to dominate next." And the firm is prepared when they arrive, stating "we can build a prediction of where our cars need to be before we even get there."[130]

FIGURE 10.5 Uber's "God View"
Uber's so-called "God View" shows every Uber car operating in a city, and every user looking at the Uber app.



Source: Uber Blog, http://blog.uber.com/2011/05/16/uberdata-mapping-san-francisco-new-york-and-the-world/.

Uber's massive data haul allows it to cut prices and attract drivers to power continued growth and expansion. Some markets have seen as many as six Uber price cuts in two years. One effort made simultaneous price cuts in 48 cities, while also offering income guarantees for drivers (they need to keep both sides of the two-sided network happy). Uber can make these kinds of bold moves because its massive database reliably reveals supply and demand curves at different price points, demonstrating price elasticity and pointing strongly to how markets behave as pricing changes. Uber upped the ante even more when it introduced Uber Pool, a car pooling service that gives you a cheaper ride if you share the car with someone else who's also headed in the same direction. Cheaper fares mean users will ride more, and even at lower prices, drivers will come out ahead if demand keeps them busy and constantly earning.[131]

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Want to see animated and video examples of Uber data visualization? Visit this blog post from Uber Engineering: https://eng.uber.com/data-viz-intel/.

APIs to Expand Reach

One way of making Uber appear as if it's everywhere in the physical world is embedding Uber everywhere in the digital world. Uber offers an API (application programming interface) that is essentially a published guideline on how other developers can embed Uber into their own apps. The service launched with eleven partners, including OpenTable, United Airlines, TripAdvisor, and Hyatt Hotels. Made a dinner reservation? Summon an Uber. Flight arrived? Skip the airport cab line and take an Uber with a United app tap. A new initiative, Uber Health, offers APIs for integration into health care products allowing, for example, a doctor's office to schedule a ride for a patient at the time they make an appointment—a big deal for providers given that no-shows top 3.6 million a year and can be as high as 30 percent in some areas.[132] Other ride-sharing services can do this, too, but if you're a firm looking for a partner, you're going to choose the top firm rather than clog your app with every available choice. Once again, network effects help solidify a firm as a winning platform. And as we've pointed out earlier, data and the algorithms that refine their accuracy are improved over time, so as an early player, Uber simply has more smarts than anyone else operating in this space. Strategists, be aware that the firm that uses tech to build assets for competitive advantage early may also see these assets significantly strengthened over time.

How Big Can This Thing Get?

Analysts differ on whether Uber is worth its current valuation. That's not uncommon. Facebook, Google, and other tech giants have had their fair share of pundits and analysts who cried "bubble." But Uber's dominance is by no means a given. Regulatory concerns, the maintenance of a quality service, and the uncertainty of expanding in global markets where competitors exist are all challenges the firm will face. The firm's bubble-crying doubters include the data experts at the well-known FiveThirtyEight blog (known for their poll-besting accuracy in US presidential election predictions).[133] The Uber true believers include *Business Insider*, which claims Uber is on its way to being "the next $100 billion company."[134]

Uber's mission statement is "Transportation as reliable as running water, everywhere for everyone."[135] The firm is doubling in size every six months with its current offerings, but the firm is looking to a future with expansion way beyond taxi rides. Uber's former CEO has stated that he sees the firm as essentially a "software platform for shipping and logistics."[136] Uber investor Shervin Pishevar describes the firm's potential, saying: "Uber is creating a digital mesh—a power grid which goes within the metropolitan areas. After you have that power grid running, in everyone's pockets, there's lots of possibility of what you could build like a platform. Uber is incorporated in the empire-building phase."[137]

The firm has experimented with several offerings, including a bike messenger service, a restaurant delivery service, and a same-day retail delivery service.[138] In addition to Google's big investment in Uber, another backer is someone else who knows a lot about serving customer demand by getting things from one location to the other, Amazon founder and CEO Jeff Bezos. The Google investment (now, really an Alphabet investment, but Google was the firm's name when it first backed TK) has become more interesting, as several Uber moves seem as if they may point to areas where the firms might compete. Uber is expanding same-day delivery even as Google does the

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same through Google Express. While Uber is incorporated into Google maps, Uber also bought the mapping firm deCarta, a company once used by Google, and which has sold services to major industry players including BlackBerry, Verizon, OnStar, eBay, and Samsung.[139] And while Google famously has a self-driving car initiative (now known as Waymo) that has seen several generations of test vehicles put thousands of miles on the road, Uber has begun to test its own self-driving car technology developed at Uber's Advanced Technology Center in Pittsburgh, partnering heavily with advanced robotics experts from Carnegie Mellon University.[140] The relationship was further strained with accusations that an Uber employee stole Waymo intellectual property and brought it to Uber. While no one would call Google and Uber direct rivals today, it is an interesting development given the history of Google's former close partnership with Apple, and its unraveling. Android caused then-Google CEO Eric Schmidt to leave Apple's board, Siri favored Bing, Apple created its own Maps and dropped YouTube from the pre-installed iPhone apps. And Uber's experiments have it reach for the sky, literally. The firm has shown a prototype vertical take-off and landing vehicle that's a cross between a helicopter and prop plan. Bullish plans are for tests in 2020, commercial deployment in 2023, and autonomous piloting in a decade.

First Look at UberAir

A look at plans for UberAir, including current vehicle prototypes and animations of the hoped-for end product, as well as an interview with CEO Dara Khosrowshahi discussing autonomous vehicles in the wake of a recent, fatal crash, and reshaping firm culture following a string of negative events.



View the video online at: http://www.youtube.com/embed/-XFbyWAUwp4?rel=0

As for fighting regulation, San Francisco provides just one example of the Uber leader's iron-willed determination. When the city's transportation agency sent the firm, then known as UberCab, a cease-and-desist letter, stating it was running an unlicensed taxi service, the firm dropped "Cab" from its name, but vehemently argued that it was simply a software firm that connected drivers and riders.[141] Uber continued offering rides to a largely tech-centric following, a constituency San Francisco pols don't want to alienate if they want to remain in elected office. The California Public Utilities Commission eventually voted to create a permanent category of "Transportation Network Companies," encompassing Uber and rivals.[142] Uber is also threatened by governments worldwide that are pressuring the firm to reclassify its drivers from contractors (also known as 1099 workers, for the US tax form used by the self-employed) to firm employees (who file a W-2 tax form). The change would be a big deal for Uber, and many other sharing economy firms. *Recode* estimates that reclassifying its drivers as employees would cost Uber an extra $209 million in California alone, roughly 10 percent of the company's net revenue.[143]

When you have such loyal customers and strong product-market fit, you can enlist an army to help you bend legislators to make way for progress. Uber fans have firehosed Washington, DC,

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officials with more than 50,000 e-mails in support of allowing the service to operate in the nation's capital. In Denver, an Uber rally attracted hundreds of supporters.

In markets as varied as Chicago, Mexico City, Paris, and Delhi, cabbies have protested, and many governments have been antagonistic toward the firm.[144] While Uber has flouted regulation, effectively operating illegally in many markets, it has also worked with local officials to be legitimate and has a stated goal of becoming explicitly legal everywhere it operates.[145] Uber has improved in areas of concern such as making sure that wheelchair-accessible vehicles are available (a standard taxi firms are held to). The firm went legit in New York City by complying with restrictions imposed by the local Taxi and Limousine Commission, even as it tries to change local rules.[146] And on top of claims that Uber boosts the economy and quality of life, the firm can also offer big data insights to cozy up as a government ally. An Uber partnership with the city of Boston provides data analysis to better understand commuting patterns and inform decisions on road construction and street maintenance. Pothole got fixed? Maybe you've got Uber to thank.[147]

Uber's global expansion leverages corporate-provided technology, learning, and data insights, but teams in new markets act as ground-floor entrepreneurs. Kalanick says the firm's growth teams are "parachuting in with machetes," doing what needs to be done to attract drivers, raise customer awareness, kickstart usage, work with local legislators, and otherwise build the supply and demand side of the market from scratch.[148] Uber is growing, but the world's two most populous markets present challenges. In China, local competition already had an estimated 90 percent of the market. To compete, Uber has paid Chinese drivers more in bonuses than they collect in fares, trying to subsidize their way to a strong network effect. In China, Uber also faced a nation with strict regulation often considered among the hardest for US tech firms to crack (Google left, eBay was crushed, and Facebook still hasn't been allowed in).[149] In August 2016, Uber threw in the towel on a business estimated to be losing $1 billion a year, announcing that it was backing out of China, selling its in-country business to Didi, the nation's largest ride-sharing service. As a business subject to two-sided network effects, the lead firm in a market is almost certainly to continue dominance. All else equal, app users favor a service with more drivers, while drivers need more app users to make more money. Kalanick had spent a lot of time in China, and the firm's retreat from the market is likely a disappointment, but it may not be a loss. The deal made Uber the largest shareholder in Didi's business, Uber gets a Didi board seat, and Didi gets a seat on Uber's board, plus invests $1 billion in Uber's global business outside China.[150]

In India, Uber's second-biggest market in terms of cities served, the firm faced an outright ban in Delhi. Said the firm's head of expansion in India, "We have no intention of stepping away."[151] Indian growth during this period had been climbing at a rate of about 40 percent a month, with huge additional promise in a nation with low car ownership and a rising middle class. Expansion continues with customized local products, including one targeted at three-wheeled auto-rickshaws popular throughout South Asia. While resisting shutdown, Uber has simultaneously applied for an official radio-dispatched-taxi license and has been in repeated talks with authorities drafting national legislation for ride summoning services.[152] Still, India is behind local leader Ola, which operates in over three times as many cities as Uber India.[153] Gaining brand, scale, and network effects are easy when you show up first. But arrive late and local rivals may have built advantages leaders enjoy elsewhere.

The map of relationships and alliances in ride-sharing is pretty complicated: Didi first invested in and partnered with Uber-competing Lyft. Uber's largest investor, Softbank, has also invested in Didi (China), Grab (Singapore/SE Asia), Ola (India), and 99 (Brazil), and Uber continues to compete heavily with the later three firms.

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Who Is Competing with Uber?

This video looks at ride-sharing around the world, including regional leaders and the complicated web of inter-firm investment.



View the video online at: http://www.youtube.com/embed/g1dTjROL8Uc?rel=0

(Under)estimating the Market for Disruption

Figuring out how big Uber will be, and how much it's worth, is a challenge. Uber has been hemorrhaging cash, even as it expands worldwide. Management claims that this is wise spending as the firm engages in a marketshare land-grab that may cement the leadership of the eventual winner. While the firm has a low cost structure, startup costs are high, including heavy ad campaigns, efforts to subsidize new drivers to keep them on the road until customer growth catches up, and a fare war with competitors has also hurt the bottom line. Still, Uber says it has been profitable in the US and Canada, and that it deliberately diverts profits to promising markets to fuel growth. [154]

Many have suggested Uber is way overvalued because investors think it's worth more than the entire taxi industry.[155] Uber may indeed be overvalued—time will tell—but comparing Uber to the historical taxi industry misses key points about how a novel and disruptive new player grows the market with increased demand. A cheaper service with faster car arrival times (five minutes or less) and assured payment, trust, and convenience are causing expansion into markets underserved by conventional taxis, and are prompting users to ride with Uber far more than they did with taxis or limos. Uber investor Bill Gurley points to several examples prompting increased usage: Uber replacing Mom's minivan to shuttle kids to practices and events, Uber helping adult children transition elderly parents to give up driving but not give up on being able to get about town, Uber becoming the smart choice for a couple that wants to enjoy a bottle of wine with dinner, and Uber creating a genuine alternative to car ownership in cities and suburbs.[156]

A blog post by Professor Angel Lozano of UPF in Barcelona provides a powerful historical example of failing to see a bigger market when none existed previously: "In 1980, McKinsey & Company was commissioned by AT&T (whose Bell Labs had invented cellular telephony) to forecast cell phone penetration in the United States by 2000. The consultant's prediction of 900,000 subscribers was less than 1 percent of the actual figure: 109 million. Based on this legendary mistake, AT&T decided there was not much future to these toys. A decade later, to rejoin the cellular market, AT&T had to acquire McCaw Cellular for $12.6 billion. By 2011, the number of subscribers worldwide had surpassed 5 billion and cellular communication had become an unprecedented technological revolution."[157]

Is the firm on a luxury lift to a $100 billion future, or is it an overvalued expectations wreck-in-waiting about to hit the wall of reality? Leverage what you've learned about network effects and the sharing economy to make your own predictions. Buckle up—it's sure to be a wild ride!

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Key Takeaways

- Uber has garnered the largest single investment in tech startup history and by mid-2018 had been valued at over $70 billion. Investors include Google, which has incorporated Uber's service into Google Maps. Later estimates have the firm valued at $50 billion.
- Uber's toxic culture and a series of negative incidents garnered press attention but hadn't led to mass customer defection. However competition for talent became more challenging as some wondered if Uber was a career liability. Investor pressure eventually led Kalanick to step down, highlighting the importance of auditing firm behavior and culture and acting with improvements before more harm is done.
- Uber's woes led to the firm raising funds at a far less favorable rate than earlier investment rounds.
- Uber's advantages over traditional taxi services include scheduling, service speed, reliability, increased trust, ease of payment, and car availability.
- The firm's disruptive model is creating growth that is outpacing the size of the taxi industry. Despite bad press, Uber's technology should offer far more safety and security than the conventional taxi industry, and the company continues to invest in furthering safety intiatives.
- Surge pricing is controversial, but surge prices are clearly communicated before users commit to a ride. Surge pricing is used by Uber to help maintain supply/demand equilibrium. It is hoped that higher surge prices attract more drivers to the Uber system, and that prices will eventually flatten out.
- Uber leverages data to power the firm's operational model, alert drivers, improve service, set pricing, and even identify possible cities to enter.
- APIs have allowed Uber to become a platform, expanding its reach through partnerships that make Uber available in other apps and software products.
- Expansion to large markets such as China and India are complicated by regulations and by early-moving local rivals. Showing up late allows competitors to create assets such as brand, scale, and network effects that are difficult to overcome.
- Analysts differ on Uber's valuation, but some speculate the firm may be laying the groundwork for expansion into a variety of logistics businesses.

Questions and Exercises

1. What do you think Google sees in Uber? Do you think the firm should have invested in Uber? Why or why not?
2. Is Uber good for the economy or bad? Justify your answer.
3. How might Uber impact cities? Impact car ownership? Should municipalities embrace Uber? Ban it? Regulate it? Have local authorities acted on ride-sharing services like Uber? Do you think their action was appropriate? Develop recommendations for your region and present it to the class.
4. Lyft has tried to compete with Uber by undercutting the firm's surge pricing. Will this tactic work? Why or why not?
5. How does Uber ensure rider and passenger quality? As a rider or passenger, how would you feel about these efforts? How does this change the service dynamic compared with traditional cab rides?
6. How does Uber cut costs compared with traditional taxi and limo fleet operators?
7. How does Uber leverage data in its service? What aspects of the firm's operations are improved through data analytics? Does this provide the firm with sustainable competitive advantage? Why or why not?
8. What is uberPOOL? What will need to happen for this to be a "win" for both customers and drivers? Why does Uber management think it can pull this off?
9. Uber has been described as creating a "mesh" that may serve as a utility for urban areas. If Uber is able to grow to scale, what other kinds of businesses might Uber expand into?

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What firms would be threatened by this, and which firms might consider Uber to be a good partner?

10. If you haven't already, watch the video in this chapter on UberAir and feel free to conduct additional research. What do you think of this idea? What are the factors that will make this difficult? What use-cases might find this useful? Would you bet on UberAir being available by the firm's 2023 predicted launch? Do you think there will be autonomous flying vehicles by 2028?
11. What do you think of Uber's plans for autonomous vehicles (self-driving cars)? Would you feel safe riding in one that did not have a backup human driver? Do you think autonomous vehicles will make roads more or less safe? Why?
12. Why do some think Uber deserves a valuation in excess of the entire taxi and limo market? Do you feel this is justified? Why or why not?
13. Why has Uber received bad press? Is the coverage fair? What could the firm have done to prevent some of this coverage? Is the firm doing enough? Why or why not? Do you feel safe riding in an Uber or Lyft? Do you feel more or less safe in a traditional taxi?

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CHAPTER 11

Facebook: Platforms, Privacy, and Big Business from the Social Graph

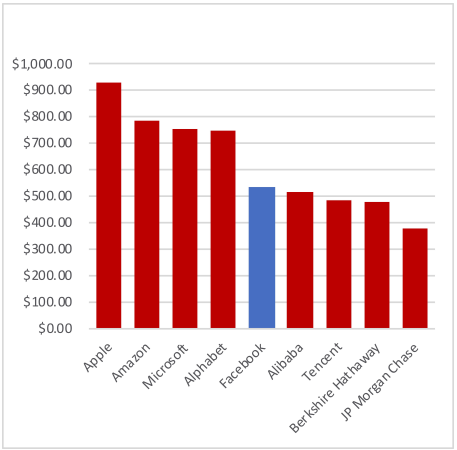
11.1 Introduction

Learning Objectives

1. Be familiar with Facebook's origins, rapid rise, and rocky first-year performance as a public company.
2. Understand how Facebook's rapid rise has impacted the firm's ability to raise venture funding and its founder's ability to maintain a controlling interest in the firm.

It's hard not to be awed by what Mark Zuckerberg has created. An effort launched from his college dorm is now a species-level phenomenon.[1] Even after deleting a jaw-dropping half-billion fake accounts,[2] roughly one in every five people on the planet has a Facebook account—an amazing track record given that Facebook is technically banned in China (taking about 20 percent of the world population off the table).[3] Want to connect to customers? Facebook is increasingly the place to be. The firm's daily traffic is three times larger than the viewership of the Super Bowl.[4] Facebook accounts for the largest share of the most popular activity (social networking) on the most widely used computing devices (smartphones). The firm's growing arsenal of apps accounts for 30 percent of US mobile Internet use. And even after a brutal year of bad press following controversies over fake news and abuse of user data,[5] as of this writing it is the fifth most valuable public company on Earth.[6] Outside the US, global growth is on a tear, with over 85 percent of Facebook users coming from abroad,[7] and Zuckerberg, through his philanthropic effort Internet.org, is determined to put the entire planet online.

FIGURE 11.1 Largest Firms by Market Cap
Facebook is among the most valuable firms on the planet.



Source: Public data, May 25, 2018.

The Rise of Facebook and Growing Concerns

Facebook founder Mark Zuckerberg looked like a social media pioneer from the start. Consider this: During the weeks he spent working on Facebook as a Harvard sophomore, he didn't have time to

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study for a course he was taking, "Art in the Time of Augustus," so he built a website containing all of the artwork in class and pinged his classmates to contribute to a communal study guide. Within hours, the wisdom of crowds produced a sort of custom CliffsNotes for the course, and after reviewing the Web-based crib sheet, he aced the test. Turns out he didn't need to take that exam, anyway. Zuck (that's what the cool kids call him)[8] dropped out of Harvard later that year.

IPO

Initial public stock offering, the first time a firm makes shares available via a public stock exchange, also known as "going public."

By the age of twenty-three, Mark Zuckerberg had graced the cover of *Newsweek*, been profiled on *60 Minutes*, and was discussed in the tech world with a reverence previously reserved only for the late Steve Jobs and the Google guys, Sergey Brin and Larry Page. Zuckerberg went on to be named *Time*'s "Person of the Year," and *The Social Network*, a (mostly fictionalized) account of Facebook's founding,[9] was a box-office smash, nominated for a Best Picture Academy Award. Facebook's controversial 2012 public offering valued the firm at over $100 billion, and the $16 billion raised in the offering made it (at the time) the biggest tech **IPO** in history and the third biggest IPO ever.[10] Zuckerberg's net worth topped $19 billion.[11]

Post IPO many analysts were concerned Facebook wouldn't realize its growth potential, and the stock began to fall. No longer. 2017 revenues were over $40 billion. Profits were nearly $16 billion (to put that in perspective, Disney's 2017 profits—tallying everything from theme parks to Pixar, Star Wars, and Marvel movies to ABC and ESPN—didn't even hit $9 billion). Mobile was an early concern—the firm made no money on mobile at the time of its IPO. Today mobile brings in over 90 percent of Facebook advertising revenue,[12] and Facebook's stock has gone up alongside Zuck's ability to prove his firm can mint cash.

acqui-hire

referring to "acquiring" a firm as a way to "hire" talent.

Yet despite growth and rosy outlook, concerns loom. Facebook, a firm that has built its reputation on desktop dominance, has deftly transitioned to a firm focused on mobile apps, but here the competitive dynamics differ significantly. Privacy concerns seem a constant source of woe for the firm, and Facebook has seen increased criticism as a platform exploited by a range of bad guys, from small-time scammers to nefarious national interests. Zuckerberg himself has testified that the platform has been used for harm.[13] Facebook was built on public sharing (at times controversially pushing consumers toward public sharing as default) but one of the most significant mobile competitors, fast-growing Snapchat is based on private sharing and disappearing posts.[14] Amid the stunning speed of social media evolution, Facebook continues to relentlessly hunt for innovations showing both patience with new efforts and a high tolerance for failure. And the firm is spending billions on acquisitions, bringing emerging competitors and high-potential platforms into the Facebook fold. Facebook also finds that in a voraciously competitive high-end technical job market, the firm no longer has the promise of a massive IPO pay day as a recruiting lure. As a result, the firm has become one of Silicon Valley's most aggressive practitioners of the **acqui-hire**—acquiring startups as a means of securing new talent.[15] Can Facebook balance concerns over user privacy and security with the potential for delivering products that are both lucrative for the firm and valued by its customers? Zuckerberg has built a colossus, but as the boy wonder enters his 30s, does Facebook have what it takes to remain one of the global Internet's most successful and influential firms?

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Why Study Facebook?

Trying to distinguish the reality from the hype is a critical managerial skill. In Facebook's case, there are a lot of folks with a vested interest in figuring out where the firm is headed. If you want to work there, are you signing on to a firm where your *stock options* and *401k* contributions are going to be worth something or worthless? If you're an investor, should you **short** the firm or increase your holdings? Would you invest in or avoid firms that rely on Facebook's business? Should your firm rush to partner with Facebook? Does Facebook deserve your firm's ad dollars and staff attention ahead of other methods of consumer engagement? If you're a banker, examining the strengths and weaknesses of Facebook may help you make better decisions on whether or not you'd extend a firm like this credit. Should you offer it better terms to secure its growing business, or worse terms because you think it's a risky bet? Let's look at the fundamentals with an eye to applying what we've learned about tech industry strategy, competition, and competitive advantage. No one has a crystal ball, but we do have some key concepts that can guide our analysis. There are a lot of broadly applicable managerial lessons that can be gleaned by examining Facebook's successes, missteps, and continuing evolution. Studying the firm provides a context for understanding network effects, platforms, partnerships, issues in the rollout of new technologies, privacy, ad models, the business value of social media, the differences between desktop and mobile markets, and more.

short

Short selling is an attempt to profit from a falling stock price. Short sellers sell shares they don't own with an obligation of later repayment. They do so in the hope that the price of sold shares will fall. They then repay share debt with shares purchased at a lower price and pocket the difference (spread) between initial share price and repayment price.

Zuckerberg Rules

Many entrepreneurs accept startup capital from venture capitalists (VCs), investor groups that provide funding in exchange for a stake in the firm and often (especially in early-stage investments), a degree of managerial control (this may be in the form of a voting seat or seats on the firm's board of directors). Typically, the earlier a firm accepts VC money, the more control these investors can exert (earlier investments are riskier, so VCs can demand more favorable terms). VCs usually have deep entrepreneurial experience and a wealth of contacts and can often offer important guidance and advice, but strong investor groups can oust a firm's founder and other executives if they're dissatisfied with the firm's performance.

At Facebook, however, the firm's extraordinary early growth left potential investors salivating to back a firm perceived as being less risky but carrying the potential of a huge upside. Early backers ceded control; at a time when Facebook's board had only five directors, Zuckerberg appointed three of them. When Facebook filed to go public, Zuckerberg's ownership stake stood at 28 percent, but Facebook created two classes of shares, ensuring that Zuckerberg maintains a majority of voting rights in the public company and virtually guaranteeing that his control of the firm continues, regardless of what investors say. Maintaining this kind of control is unusual (although not unprecedented—Google's founders have a similar ownership and voting structure).[16] Zuckerberg's influence is a testament to the speed with which Facebook expanded. When investors' demand to get in on "the next big thing" remains high, a firm's owner can extract extraordinary terms for the privilege of coming along for the ride. It also empowers Zuckerberg to make bold, long-term, potentially money-losing bets with less shareholder scrutiny than a typical public company. As *Slate* puts it, Facebook is "conducting an experiment in corporate dictatorship nearly without precedent for such a large and high-profile company." All hail Emperor Zuckerberg![17]

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Facebook's Copilot

Don't let Zuck get all the credit. While Facebook's founder is considered the firm's visionary, chief operating officer Sheryl Sandberg is often depicted as the person who runs the place: the coach, the seasoned mentor, the drill sergeant, and the voice of experience in a workforce that skews remarkably young despite its vast, global influence. With her successful track record at Facebook she can add another powerful descriptor: billionaire.[18]

Regularly named to *Fortune* magazine's "Most Powerful Women in Business" list, Sandberg came to Facebook from Google (before that, she was chief of staff to US Treasury secretary Larry Summers). In just three years, she's helped steer Facebook to almost unimaginable heights. Users increased tenfold, she's helped devise an advertising platform that has attracted the world's largest brands, she's developed a sales organization that can serve a customer base ranging from the *Fortune* 100 to mom-and-pop stores, and she's helped the firm through several crises, all while turning a profit and pushing revenue higher.

Sandberg, a Harvard grad, left the school with a geeky legacy akin to Zuckerberg's. When she was a student conducting economics research she ran so much data on Harvard's network that she choked the system. Zuckerberg would have much the same impact more than a decade later.[19]

Sheryl Sandberg is a powerful speaker and a leading advocate for increasing the ranks of women in senior management, and her book on the topic, *Lean In*, became a bestseller.[20]



Sheryl Sandberg Speaks



View the video online at: //www.youtube.com/embed/18uDutylDa4?rel=0

Key Takeaways

- Facebook was founded by a nineteen-year-old college sophomore and eventual dropout.
- It is currently the largest social network in the world with usage rates that would be the envy of most media companies.

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- Despite the firm's rapid growth and initially high stock market valuation, Facebook faces several challenges, including generating more revenue from its customer base, growing advertising, monetizing mobile, transitioning to a mobile-centric world where competitive conditions differ, protecting user privacy, potential for abuse, and competing with a slew of new competitors, some challenging Facebook's openness edict—all amid rising personnel and infrastructure costs.
- The firm's rapid growth and high user engagement allowed Facebook's founder to demand and receive an exceptionally high degree of control over the firm—even as the firm went public.

Questions and Exercises

1. Who started Facebook? How old was he then? Now? How much control does the founding CEO have over his firm? Why?
2. Why was Zuckerberg able to demand and receive control of Facebook, even as the firm went public? What strategic factors were at work in Facebook's rise that gave the founder such leverage?
3. Who is Facebook's COO? What are their role, responsibilities, and accomplishments?
4. Firms' values fluctuate over time. How much is Facebook "worth" today? Has the firm's value gone up or down since this writing? Why? Was investing in Facebook at IPO a move that paid off or that has resulted in losses? Look for business press stories and analyst quotes at or shortly after the time Facebook went public. Did analysts get it right or wrong? Why? Looking back at how Facebook has performed, what are some key takeaways that you might use as a manager when sizing up firms, competitiveness, and technology evolution?
5. Some have stated that Facebook's appeal is waning. Has your Facebook use remained more, less, or the same over time? What trends do you observe in others (parents, older or younger friends and relatives)? What other services occupy your non-Facebook social media time, and how does your usage of these services compare with the time you spend on Facebook? Which of these services do you think you'll be using five years from now? Do you think new services are a threat to Facebook? Why or why not?
6. Snapchat has also reportedly received lucrative buyout offers (including reportedly rejecting a $3 billion offer from Facebook). Do you think Snapchat was wise to resist Facebook and become an independent public firm? Defend your answer.
7. Why study Facebook? Who cares if it succeeds? Why is it useful for managers and management students to study Facebook?

11.2 Lengthening Leaders, Quick Catch-Ups, and the Challenging Rise of Mobile

Learning Objectives

1. Identify the two strategic resources that are most critical to Facebook's competitive advantage and why Facebook was able to create resources with such strength.

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2. Explain the concept of the "social graph," and explain how Facebook created a social graph stronger than that of its rivals.
3. Understand the role of features such as news feeds in reinforcing these strategic resources.
4. Recognize that Facebook's power in desktop services has allowed it to encroach on and envelop other Internet businesses.
5. Understand how mobile service offerings differ from desktop efforts and recognize that the dynamics that allowed Facebook to dominate on the desktop are substantially different than mobile.
6. Examine several of Facebook's recent acquisitions and the competitive motivations behind these purchases.
7. Understand the concept of the "deep Web" and why some feel this may one day give Facebook a source of advantage vis-à-vis Google.
8. Understand the basics of Facebook's infrastructure and the costs required to power an effort of such scale.

Facebook's mission, as stated by Zuckerberg, is "to make the world more open and connected."[21] From a social network initially targeted at college students, Facebook has become a relentlessly advancing and evolving force, occupying large swaths of user time and expanding into all sorts of new markets.

The Social Graph and Why Facebook's Is So Strong

social graph

The global mapping of users and organizations and how they are connected.

At the heart of Facebook's appeal is a concept Zuckerberg calls the **social graph**, which refers to Facebook's ability to collect, express, and leverage the connections between the site's users, or as some describe it, "the global mapping of everyone and how they're related."[22] Think of everything that's on Facebook as a node or endpoint that's connected to other stuff. You're connected to other users (your friends), photos about you are tagged, comments you've posted carry your name, you regularly declare your preferences and things that you "like," you're a member of groups, you're connected to applications you've installed—Facebook links them all.[23]

Facebook was established in the relatively safe cocoon of American undergraduate life and was conceived as a place where you could reinforce contacts among those who, for the most part, you already knew. The site was one of the first social networks where users actually identified themselves using their real names. Since "friending" (which is a link between nodes in the social graph) required both users to approve the relationship, the network fostered an incredible amount of trust. Today, many Facebook users post their cell phone numbers and their birthdays, offer personal photos, and otherwise share information they'd never share outside their circle of friends. Trust is one of Facebook's most distinguishing features—bringing along with it a degree of safety and comfort that enabled Facebook to become a true social utility and build out a solid social graph consisting of verified relationships.

network effects

Also known as Metcalfe's Law, or network externalities. When the value of a product or service increases as its number of users expands.

There is also a strong **network effect** to Facebook (see Chapter 8). People are attracted to the service because others they care about are more likely to be on Facebook than anywhere else online. And that large user base has also attracted all sorts of firms and organizations looking to connect with Facebook's masses. Without the network effect, Facebook wouldn't exist. And it's because of the network effect that another smart kid in a dorm can't rip off Zuckerberg in any market where Facebook is the biggest player. Even an exact copy of Facebook would be a virtual ghost town with no social graph.

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The **switching costs** for Facebook are also extremely powerful. A move to another service means recreating your entire social graph. The more time you spend on the service, the more you've invested in your graph and the less likely you are to move to a rival.

switching costs

The cost a consumer incurs when moving from one product to another. It can involve actual money spent (e.g., buying a new product) as well as investments in time, any data loss, and so forth.

Facebook Feed: Viral Sharing Accelerated

While the authenticity and trust offered by Facebook was critical, offering news feeds concentrated and released value from the social graph. With feeds, each time you perform an activity on Facebook—make a friend, upload a photo, join a group—the feed offers the potential to blast this information to all of your connections. Corporations love feeds, too! Firms and products that you "Like" on Facebook can post messages that may appear in your news feed (where you can like and comment on their posts and share the messages virally), making Facebook a key channel for continued customer engagement. The evolving "Like" button now allows users to share "reactions" including "wow," or that they are "sad" or "angry," which each interaction adding to Facebook's data asset and offering deeper insight on users and posts.

Facebook continues to refine feeds, including categorizing sharing in several ways. You can find updates on the "news feed" that Facebook actively curates by default. A "timeline" on your personal page offers a sort of digital scrapbook of content that a user has shared online. Not everyone see every post to their feed. Like Google, Facebook uses a secret and constantly refined algorithm that attempts to identify what you're most interested in, while cutting "spammy" content. Facebook's engineering manager for news feed estimates that there are as many as "100,000 individual weights in the model" that determines if you'll see a post.[24] Some of the more significant factors include the past interest of a given user in the content's creator, a post's performance among other users, performance of past posts by the content creator, the type of posts a given user prefers (e.g., status, link, photo, etc.), and the recency of the post. And don't beg for likes or reshares. That'll get your post punished, decreasing its reach.[25] Users can also tweak their news feed settings, and opt to see posts based on recency rather than algorithmically determined "Top Stories." An awareness of key factors and "dos and don'ts" is critical to any organization looking to use Facebook for engagement. And of course, Facebook will gladly allow you to advertise to extend a post's reach. (Not surprisingly, as Facebook has significantly cut the organic reach of brand page postings, the firm's "Promoted Post" ad business has increased).[26] Facebook's feed has also borrowed a page from Twitter, introducing hashtags, which will help users discover conversation and encourage more public sharing of posts and other content.[27] The optional Facebook "Subscribe" feature also mimics Twitter's "Follow," allowing asymmetrical sharing where a user can view a person's updates in his or her feed without having to be friended back.

Facebook rules as kingmaker, opinion catalyst, and traffic driver, so media outlets are eager to be friends. While in the previous decade news stories would carry a notice saying "Copyright, do not distribute without permission," today's newspapers display Facebook icons alongside every copyrighted story, encouraging users to "share" the content on their profile pages. Great for Facebook, but a sharp elbow to Digg.com and Del.icio.us, which have both seen their link sharing appeal free-fall, even though they showed up first.[28] Facebook beats rivals in driving traffic to newspaper sites,[29] and it's also way ahead of Twitter and Pinterest in overall social traffic referrals.[30] Games firms, music services, video sites, daily deal services, publishers, and more all integrate with Facebook, hoping that posts to Facebook will spread their services virally.

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Facebook's Dominance on the Desktop

envelopment

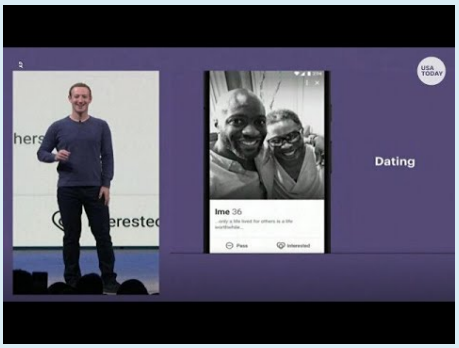
A strategy whereby a firm with a significant customer base adds a feature to an existing product or service and eliminates the need for any rival, stand-alone platforms. Think Apple adding video to cameras, crushing the market for the Flip cam.

Facebook has gradually turned on features that have allowed the firm to leverage its massive user base to encroach on a wide swath of Internet services. But even as we tally Facebook's successful **envelopment** of new product categories, there is increasing evidence that mobile presents new challenges where the old "turn on a feature and dominate" dynamics at play on the desktop simply aren't as strong.

First, let's look at desktop Facebook's past ability to envelop markets. In photos, Google, Yahoo!, and one-time standout MySpace all spent millions to acquire photo-sharing sites (Picasa, Flickr, and Photobucket, respectively). But to become the Web's leading photo-sharing service, Facebook didn't acquire anyone. The site simply turned on a substandard photo-sharing feature and quickly became the biggest photo-sharing site on the Web. Facebook users now post over 350 million photos each day.[31] When Facebook turned on chat, it became the first-choice communication service for many in its growing customer base, displacing instant messaging platforms that had massive early leads and millions of subscribers.[32] As mentioned earlier, Facebook's feed crushed the appeal of independent link-sharing services like Digg and Del.icio.us. Video is huge on Facebook, too. The firm serves as many views a day (4 billion) as YouTube,[33] and followed Twitter's Periscope with its own Facebook Live video streaming tool, even paying celebrities and media companies to create and share content on the site.[34] Facebook even wants to be your better address book, business directory, and phone dialer. Facebook has a craigslist rival in its Marketplace feature, a workplace collaboration tool in Workplace by Facebook, and Mark and Cheryl will even play cupid with a new Dating feature, which, at launch, sent shares of Match.com plummeting.[35] While many of the firm's experiments have failed (remember the Facebook phone? Didn't think so.)[36] or did not achieve traction as initially hoped, they underscore Facebook's innovation culture, and the firm's relentless drive to experiment with new opportunities for social engagement. As Facebook is able to insert itself into new markets and envelop markets owned by other firms, we see a key advantage to Facebook's central role in the lives of consumers. Network effects, switching costs, and the firm's influence in catalyzing the spread of new products and services allow the company to quickly apply its installed base in key markets. Budding entrepreneurs beware: Are you building a *business* with sustainable advantage or a *feature* that will one day be wiped out by similar technology built into Facebook?

Facebook Dating

Zuck plays matchmaker, launching Facebook Dating at the firm's annual f8 conference. Note how he discusses privacy and how connections are made.



View the video online at: http://www.youtube.com/embed/YvQvZultgjM?rel=0

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Facebook Takes on Search

deep Web
Internet content that can't be indexed by Google and other search engines.

Google, watch your back, Facebook is tinkering there, as well. Google indexes some Facebook content, but since much of Facebook is private, accessible only among friends, most Facebook activity represents a massive blind spot for Google search. Sites that can't be indexed by Google and other search engines are referred to as the **deep Web**. Early experiments incorporating Facebook with Microsoft Bing have been canceled,[37] but any search that prompts a user to start at Facebook instead of Google is a revenue and data collection opportunity for Zuck and not Sundar (Pichai, CEO of Alphabet's Google division).

Facebook has introduced Graph Search, intending to evolve search beyond the keyword. With Graph Search, Facebook allows users to draw meaning from the site's social graph and to find answers from social connections. Planning an outdoorsy getaway and looking for ideas from friends you trust? Use Graph Search to collect photos of friends at National Parks. Some have claimed Graph Search could become a primary source for job placement, travel info, dating, and more[38]—all areas where Facebook has, to some extent, experimented.

Mark Zuckerberg Explains Graph Search

In this video, Mark Zuckerberg and other Facebook staff discuss the firm's Graph Search product. To try the product, visit https://www.facebook.com/about/graphsearch.



View the video online at: http://www.youtube.com/embed/U94DTrjAvuA?rel=0

Graph Search results are based in part on the connections in your social graph, but you also have access to your past posts as well as any information that the billion-plus member Facebook community chooses to make public. Consider this when selecting your privacy settings. There's an active Tumblr account showing embarrassing Graph Search results.[39] Perhaps more seriously, critics have demonstrated how Graph Search could be used by foreign governments to uncover, say, members of China's banned Falun Gong movement or identify gays and lesbians in nations where homosexuality is outlawed and punishable.[40]

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Why Mobile Is Different and in Some Ways Better than the Desktop

Facebook has been able to envelop all sorts of desktop services by simply adding a feature to its browser-based product, but with the rise of mobile, Facebook's dominance no longer looks like a given. It lost an early leadership into mobile photo sharing to Instagram. WhatsApp grew to be the worldwide leader in messaging clients for mobile, while others such as WeChat, Line, and KakaoTalk enjoy hundreds of millions of users in different locations throughout the world. Gaming firms, which once flocked to the Facebook platform as a fast path to riches, now see a more promising future in developing mobile apps. Deep-pocketed Facebook spent serious coin to acquire Instagram and WhatsApp, but they can't acquire everyone. The savvy manager can learn from Facebook's mobile challenges to understand how mobile differs from the desktop.

And mobile *is* different. Many of the winner-takes-all dynamics of social on the desktop Web, which Facebook had leveraged so astutely to weave its way deeper into the lives of its users, do not appear to apply on mobile. Ben Evans, a partner at the venture firm Andreessen Horowitz, writes what many consider to be a must-read tech industry weekly newsletter (sign up at ben-evans.com). He points out that there are at least four areas where the competitive dynamics of smartphone apps differ from browser-based desktop services:

- Smartphone apps can access a user's address book. This makes it easier to rebuild the social graph for a new mobile service.
- Smartphones apps can access a phone's media library and can often plug into cloud storage. This makes it easier to share photos and video than on desktop services.
- Smartphone apps can use push notifications, a huge benefit for increasing engagement. While new standards now allow some degree of desktop notification, these are often so disruptive that they are ignored or shut off. Desktop services have long relied on e-mail notifications or hoped users remembered to return to a Web site, but mobile push notifications instantly say, "Hey, there's something new here for you to pay attention to within our great app that you signed up for," and offer single-tap reentry into a service.
- Smartphone apps also get an icon on the home screen. A constant visual reminder for a service, often with a compelling notification badge that motivates a compulsion to check things out so the badge goes away. Single-tap access is also far better than bookmarking or typing in a URL.
- While a desktop site can crush a new competitor by adding a feature as a new menu item or icon, on mobile there isn't the screen real estate for this—another reason mobile seems to favor single-purpose, specialized apps.[41]
- And we can add another advantage: authentication. Many firms have begun to offer "sign-on with mobile" as an alternative to using passwords. Many think this is an even more secure way to sign in since it's attached directly to a device that follows the user and which many users additionally lock with a passcode.

While many considered mobile platforms to be more limiting than the desktop—the screen size was smaller, typing was more difficult on a mobile device—there are plenty of things that a smartphone can do better than a laptop or desktop. As Evans states, "there's an old computer science saying that a computer should never ask you a question that it should be able to work out the answer to; a smartphone can work out much more."[42] The always-with-you phone can share a you-identifying phone number and tell your location via GPS, iBeacons or other location-based service. Sensors, your address book, and usage patterns can reveal more. Are you in a store? Is there a deal close by? Where are you usually at this time of day? Is there anything close by that you may be interested in? Are you sitting, walking, or running? What is the weather and traffic like where you're headed? Who are your friends and should we contact them? Services like Apple Pay and Google Pay allow not only one-click payment, but also one-click form fill-out, making buying easier on mobile.

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Custom keyboards, emoji, voice input, and other methods for creative and streamlined input came first and often work better via mobile. And APIs supplied to mobile app developers may be able to reveal or request even more. The savvy innovator doesn't lament what is lost with the desktop, they recognize all of the new that can be done in mobile and set to work building disruptive businesses.

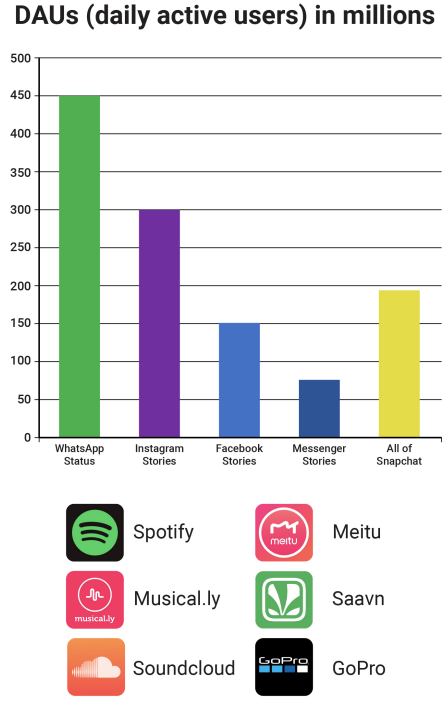
Snapping Snapchat's Lead with Stories

Facebook has paid close attention to rivals, and has matched certain features with aplomb. Perhaps the best example is the firm's co-opting of Snapchat Stories—a firm that defined the category with its launch in October 2013. Facebook, Instagram, Messenger, and WhatsApp (called Statuses) all now offer time-limited, ephemeral posts, with three of them using the Stories name. Facebook put its Snapchat clone above the newsfeed in March 2017. WhatsApp Statuses launched a month earlier. Instagram Stories led this Stories onslaught the prior August.[43] By mid-2018, Instagram and WhatsApp Story features weren't just larger than Snapchat Stories, they were larger than *all of Snapchat's daily active user* (DAU) base, and Facebook Stories were bigger than the last reported Snapchat DAU figure.[44] Only after perfecting the feature did Facebook begin running advertising in Stories. But going a step further, Facebook has also opened Stories up to vetted third-party apps, with initial partners including Spotify, SoundCloud, Musical.ly, GoPro, selfie-editor Meitu, and Indian music app Saavn.[45] Savvy tech strategists recognize this as a platform play—moving beyond feature and offering a service that third parties build on and make even more valuable (more on Facebook's platform moves in the next section). Snap had once been considered a potential Facebook rival, with reports claiming that young people were "abandoning Facebook",[46] but rather than hitting an Instagram-like hockey-stick growth curve, Snap growth is flattening, making the firm seem like it's following Twitter's growth pattern, but with less social relevance.[47] With Stories on their way to being "bigger" than feeds, Facebook's category land-grab may be even more critical to the firm.[48]

The dynamics of Facebook's Story victory are important for the tech strategist. Sure Snap moved first, but Instagram, Facebook, and WhatsApp all had user-base scale and network effects (Snap initially also had a reputation for being less intuitive than its rivals).[49] So it's not as if Snap saw a rock solid competitive advantage eroded–instead the larger firms leveraged their competitive advantage to match and surpass an innovator, putting the bulwark of scale and network effects behind its fast-follower feature match.

FIGURE 11.2 Facebook's Stories Totals on Other Platforms

Snapchat last reported DAU (daily active users) for Snapchat Stories in 2017 at less than 150 million. By the 2018 f8 conference, Facebook had announced Stories on WhatsApp (Status), Instagram, and Facebook were all larger than this. Instagram's latest quarter had reported only 191 total users. Facebook is also turning Stories into a platform, allowing vetted apps to post directly to a Story on Facebook or Instagram.



Source: Data from F. Richter, "Attack of the Clones." Statista, May 18, 2018, https://www.statista.com/chart/10558/daus-instagram-stories-whatsapp-status-snapchat/.

Big Bets: Bringing Potential Rivals and Platform Powerhouses into the Facebook Family

While mobile is different, and Facebook hasn't always been a cross-category leader in mobile innovation, Facebook's profitability and IPO provide the firm with cash to try to ensure that it's *Facebook that's going to be the next Facebook*.[50] Three of the firm's acquisitions, each valued at $1 billion or more, demonstrate this.

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Instagram

Facebook's dominance in photo sharing came largely from success over the Web, but photo sharing and many other activities went mobile, fast. At the time of Facebook's IPO, Instagram, an eighteen-month-old firm with thirteen employees, had fifty million users and was adding new ones at a rate of roughly five million a week.[51] Users loved the beautiful, artistic images Instagram's filters created, and photos were being shared not only on Instagram but also on Facebook's rival Twitter and other services. Analysts suggest mobile could have been Facebook's Achilles heel—allowing Instagram to open up and become a Facebook-rivaling platform (Insta-music? Insta-links? Insta-status updates?). Facebook even acknowledged its mobile vulnerabilities in pre-IPO regulatory filings.[52] But when Facebook acquired Instagram for a cool $1 billion, Facebook turned the potential rival into an asset for growth and another vehicle for the firm to remain central to users' lives.[53] Since the acquisition, Instagram has continued to operate a a separate brand, tripling its user base the year following acquisition. (and topping 800 million by mid 2018),[54] usage numbers that dwarf Twitter and Snapchat.[55] New features such as video were introduced, and with the introduction of ads, the app has also began to earn money.

FIGURE 11.3 Facebook Acquires Instagram
Instagram was acquired on the eve of Facebook's IPO for $1 billion. Facebook maintains the app as a separate brand, and it now sports a user base far larger than Twitter or Snapchat.



Source: Image taken from Instagram's photos published on Apple's iTunes Store.

WhatsApp

Mobile messaging posed a bigger threat than smartphone photo sharing, so Facebook ended up writing an even bigger check. A potential acquisition of Snapchat was reported to have ended when that firm's twenty-three-year-old founder refused a Facebook offer of $3 billion,[56] but there was an even bigger prize out there. While less popular in the United States, WhatsApp had emerged as the global leader in mobile messaging, sending more total messages than the entire worldwide

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SMS text messaging standard![57] WhatsApp had 450 million monthly users, and a million more were signing up each day. A billion users for WhatsApp looked like a very real possibility. In the high-growth markets of India, Brazil, and Mexico, WhatsApp usage numbers were *twelve* to *sixty-four times* ahead of Facebook for mobile messaging![58] Seventy-two percent of WhatsApp account holders used the service each day, and collectively they shared over half a billion photos daily. While app switching costs may seem low, users were refining messaging with groups (e.g., "Family," "Project Team," "Running Club"), making it less likely they'd try something with fewer people that required re-creating messaging groups (network effects and switching costs strike again). Facebook began to realize that the only path to avoid being a messaging also-ran was to pony up and acquire WhatsApp, and to do it before it got any bigger.[59] The asking price for the fifty-five person firm with zero revenue:[60] $19 billion—$16 billion in cash, $3 billion in stock. The acquisition instantly turned co-founder Jan Koum into a billionaire, and in a rags-to-riches story, the self-taught programmer signed the deal papers on the door of the welfare office where he once collected food stamps.[61] Nineteen billion dollars seems like an incredible amount to pay for a firm that, at least in the short term, will add nothing to Facebook's bottom line. But this acquisition wasn't about increasing Facebook's total revenue; as *TechCrunch* stated, it was about surviving the global shift to mobile.[62] Yes, WhatsApp lost $138 million in 2014, but by 2018 the firm was at a billion and a half MAUs (monthly active users) and growing, with Facebook only beginning to leverage the platform's ad potential.[63] From the perspective of securing a large user base and taking out a potentially threatening competitor, *Wired* labeled the Instagram and WhatsApp acquisitions as "two of the greatest bargains in recent tech history."[64]

FIGURE 11.4 WhatsApp
WhatsApp has grown to over 1.5 billion monthly active users, with fans creating chat lists and sharing video, audio, photos, and location.



Source: Images from WhatsApp's public archive for news stories at: http://media.whatsapp.com/screenshots/iPhone/screens.

Oculus VR

After the WhatsApp purchase, Mark Zuckerberg publicly stated: "After buying a company for $16 billion, you're probably done for a while,"[65] but within weeks he forked over the equivalent of two Instagrams to acquire a firm started by an eighteen-year-old that had no customers, no revenue, and no complete product. Facebook's $2 billion purchase of Oculus VR is a long-term bet at keeping the firm at the vanguard of computing's evolution. To the uninitiated, the first Oculus product, the Oculus Rift, looks weird. Still in prototype form at the time of acquisition, it's essentially a computing screen that you strap to your face. Two very high-resolution displays fill ski-goggle-like gear with a wraparound image covering your field of vision. Lenses and distortion algorithms tweak computer imagery at vision periphery to hack your visual cortex and send it the kind of images it would expect to encounter in the real world. Turn your head and the image moves in real time. The Rift's big breakthrough was that it doesn't make you puke. Previous VR efforts had so much latency

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(delay) in image rendering that users would become disoriented to the point of nausea. The first versions of Oculus VR products required integration with a PC, phone, or game console, but Oculus now offers stand-alone, fully contained solutions at under $200.

Oculus was founded by Palmer Luckey, a home-schooler who hacked together prototypes in his parents' garage in Long Beach, California. After experiencing an Oculus prototype, video game pioneer John Carmack (of Doom and Quake fame) was so impressed that he quit the firm he'd cofounded to join Oculus as CTO. Luckey launched a Kickstarter campaign to generate interest. Within hours the firm blew past its initial $250,000 goal and eventually hit $2.4 million in commitments. VCs lined up to invest. Gaming firms began working on prototypes. HBO showed an Oculus-enabled *Game of Thrones* experience at the South by Southwest festival. And Zuckerberg strapped on a Rift and saw the future. In a Facebook post announcing the acquisition, Zuckerberg wrote, "Imagine enjoying a courtside seat at a game, studying in a classroom of students and teachers all over the world, or consulting with a doctor face-to-face—just by putting on goggles in your home."[66] Justifying the acquisition, Zuckerberg has also said, "Strategically we want to start building the next major computing platform that will come after mobile."[67] Adds Luckey, "This isn't about sharing pictures. This is about being able to share experiences."[68] While Luckey and crew might have been able to build a multibillion dollar firm on their own, many firms are circling VR, including deep-pocketed rivals with consumer experience (Samsung, Google, Sony, among them). Why sell out? Says Oculus CEO Brendan Iribe, Facebook's resources are allowing Oculus to build product faster and better weather the onslaught of rivals. In the year since the acquisition, the firm grew its employee base fivefold, from 50 engineers to roughly 250. Facebook provides the deep pockets for developing custom, high-resolution optics hardware, VR audio (that makes it seem like sound is above or below you), and offers deep in-house technical expertise as well as the ability to leverage hundreds of thousands of Facebook servers.[69]

FIGURE 11.5 Oculus Rift
Oculus Rift headset with Touch controllers.



Source: Image from Oculus PR Site Press Kit public image library: https://www.oculus.com/en-us/press-kit-hardware/.

Time will tell if these acquisitions prove as strategically significant as Zuckerberg hoped. Luckey is no longer with the firm, having left after being publicly exposed for online troll-like behavior.[70] Facebook has launched several initiatives that failed completely or did not live up to initial promise. The shuttered Poke app; yet another photo-sharing app (Moments); the underperforming Paper (news reader), Slingshot (Snapchat competitor) and Rooms (anonymous chat rooms) apps[71]; the mostly unwanted Facebook Home smartphone platform;[72] and the firm's scuttled Gifts

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and Deals services are just a few examples. Buying promising innovations may be a savvy way for the now cash-rich firm to remain at the forefront of tech industry shifts.

So What's It Take to Run This Thing?

It takes some serious hardware to serve billions. Each day, Facebook's eleven data centers (and growing) are scattered around the planet,[73] serving more than 2.7 billion 'Likes,' 350 million photo uploads, 2.5 billion status updates and check-ins, about three times the messaging volume of the SMS network (through Messenger and WhatsApp),[74] and countless other bits of data, plus the firm crunches much of what it has collected to customize feeds, estimate which ads to serve up, and refine and improve the Facebook experience.[75] Facebook has extraordinary data storage needs that are growing at breakneck speeds. Facebook's storage needs have grown by a factor of *4,000* in just four years,[76] and amount to a total storage well north of three hundred petabytes and growing at more than six hundred terabytes a day.[77]

The Facebook **cloud** (the big group of connected servers that power the site) is scattered across multiple facilities, including server farms in San Francisco, Santa Clara, northern Virginia, Oregon, North Carolina, Iowa, Nebraska, New Mexico, Ireland, Singapore, and Sweden.[78] The innards that make up the bulk of Facebook's massive multisite cloud aren't that different from what you'd find on a high-end commodity workstation: standard hard drives and multicore Intel or AMD processors—just a whole lot of them lashed together through networking and software. Like Google and Amazon, Facebook's servers are custom built, stripping out nonessential parts but adding in components when needed (such as massive and super-fast flash memory–based storage for some of its custom database servers).[79]

Facebook's "cloud brain" for artificial intelligence is also custom built. As a category-creating pioneer, Facebook can't wait for the market to catch up with its needs, so it builds its own servers. The firm's AI-focused servers, known internally as "Big Sur" devices, use clustered Nvidia GPUs to create a massive network for machine learning, powering all sorts of Facebook artificial intelligence tasks, including object and facial recognition, real-time text translation, and the ability to recognize and describe what's in photos or videos. Development goals of AI include being able to accurately describe photos to blind users, and to recognize if a user is troubled and in need of mental health outreach.[80]

Much of what powers the site is **open source software (OSS)**. The service runs on the Linux operating system and Apache Web server software. A good portion of Facebook is written in PHP (a scripting language particularly well suited for website development), while some of the databases are in MySQL (a popular open source database). The firm is a major contributor to open source software efforts and was the force behind Hive, a product used to provide query support for big data projects, and Presto, another open source effort that's even speedier than Hive.[81] While a good portion of Facebook is written in the popular but slower-executing PHP language, the firm has written (and open sourced) a system it calls *HipHop Virtual Machine*, which takes PHP code and compiles (translates) it on the fly from something that a programmer can read to the machine language that a computer can more quickly execute.[82] The object cache that holds Facebook's frequently accessed objects is in chip-based RAM instead of on slower hard drives and is managed via an open source product called Memcache.

Other code components are written in a variety of languages, including C++, Java, Python, and Ruby, with access between these components managed by a code layer the firm calls Thrift (developed at Facebook, which was also turned over to the Apache Software Foundation). Facebook also developed its own media-serving solution, called Haystack. Haystack coughs up photos 50 percent faster than more expensive, proprietary solutions, and since it's done in house, it saves Facebook costs that other online outlets spend on third-party **content delivery networks (CDN)** like Akamai. Facebook receives some 50 million requests per second,[83] yet 95 percent of data queries can be served from a huge, distributed server cache that lives in well over fifteen terabytes of RAM.[84]

All this technology is expensive. Facebook's annual spend on networking equipment and infrastructure is estimated to be between $14 billion and $15 billion in 2018, up about 50 percent from the prior year and on par with Google and Apple spend.[85] Off-the-shelf parts are cheap, but the custom AI stuff can be pricy. Nvidia high-end GPUs can go for $10,000 a piece.[86] With users continuing to shovel data-heavy photos and video on the site (as well as through Facebook properties Instagram and WhatsApp), Facebook will likely be buying servers for years to come. And

cloud

A collection of resources available for access over the Internet.

open source software (OSS)

Software that is free and whose code can be accessed and potentially modified by anyone.

content delivery networks (CDN)

Systems distributed throughout the Internet (or other network) that help to improve the delivery (and hence loading) speeds of Web pages and other media, typically by spreading access across multiple sites located closer to users. Akamai is the largest CDN, helping firms like CNN and MTV quickly deliver photos, video, and other media worldwide.

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it'll pay a pretty penny just to keep things humming. Estimates suggest the firm spends over $1 million a month on electricity and another half million a month on telecommunications bandwidth to keep your feed full and your status updated.[87]

Want to build your own server farm like Facebook? The firm will tell you how to do it. In an unprecedented move, Facebook made public the detailed specifications of its homegrown servers (including custom power supplies, chassis, and battery backup) as well as plans used in building design and electrical and cooling systems. You can find details, photos, and video at http://www.opencompute.org. Facebook claims its redesigned servers are 38 percent more efficient and 24 percent cheaper than those sold by major manufacturers, and that these designs have resulted in yearly energy savings estimated at roughly $52 million, and infrastructure savings of more than $1 billion.[88] These kinds of savings will continue to be important with Facebook, WhatsApp, and Instagram users uploading roughly one billion photos each day.[89] Why give away the low-cost secrets? Says the firm's director of hardware, "Facebook is successful because of the great social product, not [because] we can build low-cost infrastructure. There's no reason we shouldn't help others out with this."[90] Facebook believes sharing will improve products overall and may even attract talent to their innovation-forward shop. Does this dangerously expose a competitive advantage? Not really–Facebook's dominance comes from the size of its user base, network effects, switching costs, and the uniqueness and applicability of its data. You could give everything but data and users to an upstart and they'd still never match the firm.

Swedish Facebook Data Center

Visit a Swedish Facebook Data Center with Bloomberg TV.



View the video online at: //www.youtube.com/embed/X9ELENWZqLE?rel=0

Key Takeaways

- Facebook's primary competitive advantages are grounded in network effects and switching costs.
- The social graph expresses the connections between individuals and organizations.
- Trust created through user verification and friend approval requiring both parties to consent encouraged Facebook users to share more and helped the firm establish a stronger social graph than other social networking rivals.
- Feeds catalyze virality and promote information sharing. Facebook's position as the digital center of its members' online social lives has allowed the firm to envelop related businesses such as photo and video sharing, messaging, bookmarking, and link sharing. Facebook has opportunities to expand into other areas as well.

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- Facebook's dominance on the desktop has allowed the firm to encroach in new markets by essentially turning on features that, in many cases, allowed the firm to dominate categories pioneered by other firms.
- The mobile market differs from the desktop in many key ways that alter competition. Access to address books, media libraries, the cloud, push notifications, home screen icons, and limited screen real estate are enforcing a new competitive reality on Facebook and rivals.
- Many of the dynamics above caused Facebook to lose the lead in mobile photo sharing and messaging, but the firm's deep pockets have allowed it to acquire leading firms, removing threatening rivals and strengthening the firm's competitive assets.
- Facebook has also invested in Oculus VR, an unproven but promising startup that may transform computing by making high-quality virtual reality accessible at a reasonable cost.
- Much of the site's content is in the deep Web, unable to be indexed by Google or other search engines. Some suggest this may create an opportunity for Facebook to challenge Google in search. Partnerships with Bing and Facebook's own Graph Search attempt to harness the firm's deep Web asset to answer questions.
- Facebook's growth requires a continued and massive infrastructure investment. The site is powered largely on commodity hardware, open source software, and proprietary code tailored to the specific needs of the service.

Questions and Exercises

1. What is the social graph? Why is Facebook's social graph considered to be stronger than the social graph created by the sites of its early competitors?
2. Does Facebook have to worry about copycat firms from the United States? In overseas markets? Why or why not? If Facebook has a source (or sources) of competitive advantage, explain these. If it has no advantage, discuss why.
3. Which firms have seen Facebook enter their markets as a potential disruptor? What factors have allowed the firm to gain share in these markets at the expense of established firms? In what ways does it enjoy advantages that a traditional new entrant in such markets would not?
4. Research the Facebook dating app. If you are (or imagine you were) unattached, would you use this feature? Why or why not? What steps has Facebook rolled out to try to protect privacy and make this seem more attractive to users?
5. How does competition in services delivered in the browser on desktop computers differ from those delivered via smartphone app?
6. Consider Facebook's acquisitions of Instagram, WhatsApp, and Oculus VR. Was the firm smart to make these acquisitions, and did it pay a reasonable price? What were the risks in not acting?
7. Large firms in the tech industry are constantly making new acquisitions. Conduct some additional research online: Have Facebook or its rivals recently acquired firms that have the potential to alter the competitive landscape Zuckerberg's firm will compete in? If so, how?
8. What is the "deep Web," and why is it potentially an asset to Facebook? Why is Google threatened by Facebook's deep Web? How is Facebook harnessing the deep Web to provide potentially valuable search products? Do you think the deep Web is enough to draw users to a Facebook search product over Google? Why or why not?
9. Try Graph Search. Do you find it useful? When would you use it, or why wouldn't you use it? Can Facebook turn Graph Search into a money maker? How could it do this, or why won't it accomplish this goal?
10. What privacy concerns are raised with Graph Search and other Facebook features? Do you think these concerns will hinder Facebook's ability to build new businesses using user data?
11. As Facebook grows, what kinds of investments continue to be necessary? What are the trends in these costs over time? Do you think Facebook should wait in making these investments? Why or why not?

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12. How have media attitudes toward their copyrighted content changed over the past decade? Why is Facebook a potentially significant partner for firms like the *New York Times*? What does the *New York Times* stand to gain by encouraging "sharing" of its content? What do newspapers and others sites really mean when they encourage sites to "share"? What actually is being passed back and forth? Do you think this ultimately helps or undermines the *New York Times* and other newspaper and magazine sites? Why?
13. Research Facebook's smartphone apps. Which ones are successful and which have struggled or been shut down? Try those that are available on your own smartphone (or ask a friend to work with you to download the apps and given them a try). What factors are behind the success or failure of these products? Is it just user experience that drives success or failure, or are there other factors at work here, as well?

11.3 Lessons from Platform Facebook: Big Growth, Bad Partners, APIs and a Mobile Melee

Learning Objectives

1. Understand the potential strategic value of evolving from a service to a platform. Learn from Facebook's platform successes as well as its missteps and lost opportunities.
2. Describe Facebook's efforts to integrate its service with other Web sites and the potential strategic benefit for Facebook and its partners.
3. Study the Cambridge Analytica crisis as an example of platform failure, PR nightmare, and ongoing response, and recognize how both the platform and the firm's monetization of user data set the stage for this crisis.
4. Understand how Facebook's web-centric culture allowed for a degree of A/B testing, rapid refinement, and error correction that isn't as easy to obtain in an app-centric smartphone world, and see how this may have led to several of the firm's struggles in developing and deploying mobile offerings.
5. Recognize how Facebook is evolving Messenger in ways far beyond an SMS replacement, so that it is now a platform for many additional services (and revenue-generating and strategic asset creating opportunities for the firm).
6. Examine WeChat and other global platforms, and how their approach differs from Facebook's.

APIs

Programming hooks, or guidelines, published by firms that tell other programs how to get a service to perform a task such as send or receive data. For example, Amazon.com provides APIs to let developers write their own applications and websites that can send the firm orders.

At the firm's first f8 developers conference, Facebook published a set of **APIs** (application programming interfaces) that specified how programs could be written to run within and interact with Facebook. Essentially Zuck was opening up Facebook screen real estate, user base, and features like Feed to the world's developers. Now, any programmer could write an application that would live inside a user's profile. Developers could charge for their wares, offer them for free, or even run ads. Facebook lets developers keep earnings through their apps (Facebook does revenue share with app vendors for some services—for example, taking 30 percent of virtual goods sales transacted through the site). Apps could be cobbled together quickly; news feeds made them spread like wildfire and the early movers saw adoption rates never before seen by small groups of software developers. And for Facebook, becoming a platform meant that each new third-party app potentially added more value and features to the site without Facebook lifting a finger (which, in a prior chapter, we learned about as value-adding complementary benefits from network effects).

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There were some missteps along the way. Some applications were accused of spamming friends with invites to install them (Facebook eventually put limits on viral communication from apps). There were also security concerns, privacy leaks, and apps that violated the intellectual property of other firms (see the "Errant Apps and the Challenges of Running a Platform" sidebar), but Facebook worked to quickly remove misbehaving apps, correct errors, improve the system, and encourage developers. Just one year in, Facebook had marshaled the efforts of some 400,000 developers and entrepreneurs, 24,000 applications had been built for the platform, 140 new apps were being added each day, and 95 percent of Facebook members had installed at least one Facebook application.

The wild early success was a wild ride. Facebook eventually curtailed the vitality offered by the platform, and while many firms can credit Facebook with their success (see Spotify as a prime example), others that were continually reliant on the Facebook sharing model were hurt when app usage began to disappear from the news feed. Many developers would complain of being "Zucked over,"[91] claiming that Facebook became a poor partner making surreptitious platform changes, altering policies without consulting them, and taking away much of the virality that helped fuel the firm's initial app explosion. Perhaps the biggest amount of hurt accrued to once Facebook-reliant casual game firm Zynga. The firm had scrapped an earlier agreement that gave it preferred status in the Facebook news feed, and a revamp to Facebook's feed-ranking algorithm subsequently caused a significant portion of Zynga traffic to be screened out. Zynga had once been within striking distance of becoming the world's most valuable game company, but saw its share price plummet as its Facebook bullhorn fell silent.[92] The shift to mobile, the inability to run Facebook apps within a Facebook mobile app, and changing expectations within the developer community have all conspired to stagnate the once-promising Facebook browser-based apps platform, but Facebook is by no means done with its platform plays.

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Learning from the Cambridge Analytica Scandal: Errant Apps, Privacy Protection and the Challenges of Running a Platform

By opening its platform to third parties, Facebook exposed itself to risk, as well as value. The firm has had to deal with apps that infringe on copyright, that annoy, purvey pornography, step over the boundaries of good taste, and raise privacy and security concerns. Firms from Facebook to Apple (through its iTunes Store) have struggled to find the right mix of monitoring, protection, and approval of platform use while avoiding cries of censorship and draconian control. Platform owners beware: developers can help you grow quickly and can deliver gobs of value, but misbehaving partners can create financial loss, damage the brand, and sow mistrust. But the firm had faced nothing like the firestorm unleashed in the wake of the Cambridge Analytica scandal.

The Cambridge Analytica Scandal Explained

This video explains Facebook's Cambridge Analytica scandal.



View the video online at: http://www.youtube.com/embed/VDR8qGmyEQg?rel=0

In the first half of 2018 Facebook was left reeling with the largest crisis in its history. Already suffering from public distrust from revelations that its news feed was used as a "fake news" machine, a whistleblower at a UK-based research firm, Cambridge Analytica, detailed a surreptitious campaign to harvest user data on a wide scale, develop psychographic profiles, and sell services that, as the Cambridge Analytica website claimed, will "find your voters and move them to action."[93]

Data was accessed, in part, from an online quiz named "ThisIsYourDigitalLife." Sounds innocuous, right? If you haven't taken a quiz with a goofy premise like "*Which Harry Potter Character Are You?*" and shared the result in your feed, then almost certainly someone else that you know has done this. In the case of "ThisIsYourDigitalLife," only 270,000 people authorized the app to collect data, but all were told the focus was academic research and no commercial ties were disclosed. A Facebook policy (since halted) that allowed app developers to access not only information on a user, but also information on their friend network, accelerated data access that created working profiles on (as of this writing) some 87 million users, mostly US citizens.[94] To underscore the issue: users were told the quiz was for academic use (data was eventually used commercially for political profiling and targeted campaign advertising), psychographic profiles were built without consent, and friends of the users—who had never even been asked if their data could be collected and shared—had all sorts of personality-identifying data vacuumed up ("likes", demographics, and other identifying data).[95]

To be fair, using data analytics for political means has been in wide use for some time. The Obama campaigns ran a much-envied machine credited with helping the one-term senator with a distinctly non-European name vault into the White House as America's first black president.[96] However, the Obama campaign made it very clear that all of their apps were associated with the campaign. In addition to the secret harvesting and profiling, controversy was further fueled when it was revealed that Cambridge Analytica was funded by GOP mega-donor and hedge fund billionaire Robert Mercer, and counted Trump advisor and former Breitbart head Steve Bannon as a board member. Other details alleged outreach to the firm by a Russian oil

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company run by a Kremlin-friendly oligarch—at this point nothing has come from this outreach, but at a time of constant headlines of a concerted Russian election influence campaign, this only fueled anger and distrust.[97]

In the wake of of the event, the oft-repeated axiom "if you're not paying [for an Internet service] then you are the product" became a staple of news coverage.[98] A #DeleteFacebook campaign trended. At this point there's little evidence that it curtailed Facebook use, and many who have left Facebook are thought to have shifted to Facebook-owned Instagram. But far more damaging is what events have done to morale at the firm—with the most notable distraught employee being Jan Koum, the billionaire co-founder of WhatsApp who resigned in protest citing Facebook's behavior.[99] Zuckerberg was also called before lawmakers on both sides of the Atlantic and endured several days of public grilling. Advertisers became skittish about visible partnerships with a tainted firm, Facebook has allegedly canceled plans to introduce an Alexa-rivaling smart speaker, and the investigation and resulting auditing of other partners will undoubtedly exact a financial toll.

Zuckerberg has apologized directly and repeatedly. Facebook has shut down app access to friend data, shut down 200 apps, has begun auditing "thousands" of apps that may have had access to data harvesting capabilities, notified users who have had their data compromised either directly or via friends, and introduced a host of new tools to give users greater transparency and control regarding their online privacy and data exposure.[100] Facebook has endured previous scandals and had already been subject to government-mandated audit. But another question resulting from the incident is, Who audits the auditors? Federally mandated audits were performed by well-known "Big Four" accounting firm PwC, and the firm found Facebook's data controls were effective at protecting user privacy—all while Cambridge Analytica was snarfing data and building profiles.[101] Cambridge Analytica has since disbanded, but it's unclear if additional data has escaped into the wild and if it poses continued concern to individuals and society. Keep following this case—the firm's response to the scandal, as well as government demands and public behavior, will provide insights on preventing and dealing with crisis in the age of "Big Data."

Zuckerberg's Congressional Hearing on April 10, 2018

Watch Mark Zuckerberg squirm before Congress. This is an important managerial lesson highlighting what can go wrong from sloppiness, partner betrayal, and unforeseen negative consequences.



View the video online at: http://www.youtube.com/embed/rFkbDYDflHs?rel=0

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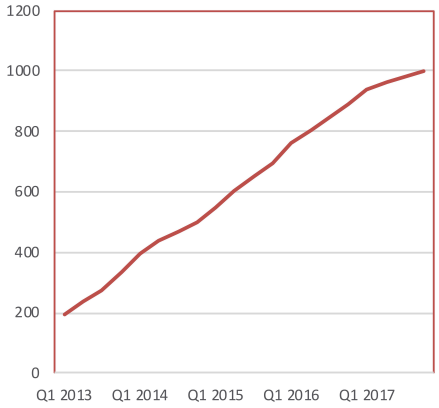
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Mobile Is Tougher, But Global Players Have Big Mobile Platforms

Certain technical aspects of the smartphone ecosystem put the brakes on Facebook's fast-paced "done is better than perfect" culture. On the Web, Facebook can test an innovation by rolling it out to a subset of users and gauging their reaction. But this so-called A/B testing is harder with mobile. Google and Apple release apps and updates to all of their users at once, so experimental feature testing with a subset of users is far more difficult to accomplish on a mobile phone. The app updating process is also usually slower than the instant "it's here" that occurs when visiting a Web page that automatically loads the latest version on a server, making fixes for app development mistakes more challenging to distribute.[102]

FIGURE 11.6 WeChat Growth, MAUs in Millions

China's fast-growing WeChat passed the 1 billion milestone in Q4 2017. Known as Weixin in China, it is not only the world's third largest mobile-messaging service behind WhatsApp and Facebook Messenger, it is also a platform offering digital payments, e-commerce, taxi services, and access to third-party developers.



Source: Data from "Number of monthly active WeChat users from 2nd quarter 2010 to 2nd quarter 2017 (in millions),"Statista, 2018, https://www.statista.com/statistics/255778/number-of-active-wechat-messenger-accounts/.

While Facebook suffered to bring its platform to mobile, it should be noted that several global messaging apps are directly accessing user address books and building their own app platforms from within iOS and Android. These include South Korea's KakaoTalk, Japan's Line, and most notably, China's massive WeChat. At roughly 700 million users by Spring 2016, WeChat (owned by Shenzhen-based Tencent) is behind only WhatsApp and Facebook Messenger in messaging,[103] but the firm's open platform supports digital payments, shopping, gaming, banking, Uber-style taxi service,[104] and open access to third-party developers.[105] These aren't just experiments: WeChat's 2016 payment processing volume is expected to be over half a trillion dollars. That's roughly *two times* greater than *all* of PayPal's 2015 volume.[106] WeChat payments may process $1.2 trillion in 2017. That's in $USD and it's not a typo—the entire US mobile payment market at that time was only $112 billion.[107] One analyst says "Weixin [what WeChat is called in China] is basically the mobile Internet for China." Food delivery startup Call-A-Chicken raised $1.6 million without a website; it doesn't need one because it does all of its business through Weixin.[108] It's worth noting that profitable Tencent had 2017 revenues of $36 billion and profits of $10.9 billion with a market cap approaching half a trillion US dollars, numbers roughly comparable to Facebook.[109]

Messenger: A Pillar Business Building Facebook's Future

Zuckerberg claims messaging is "one of the few things that people actually do more than social networking," making it a must-win for his firm.[110] While Facebook ponied up some serious dinero for WhatsApp and Instagram, its home-grown Messenger is on a tear. Many questioned the firm's unbundling of Messenger, splitting it as a separate stand-alone from the Facebook app,[111] but today Messenger boasts 900 million users.[112] In messaging, only WhatsApp is bigger.

To help Messenger realize its potential, Zuckerberg turned on the sales charm and did what many thought impossible: he poached the CEO of another thriving, high-growth, industry leading firm, PayPal. David Marcus left the helm of PayPal, where he led 15,000 employees to run Messenger's group of fewer than 100 employees. Marcus ran Messenger like a separate business (not unlike Instagram, WhatsApp, or Oculus), but pulled in Facebook's scaled-for-a-billion-users resources when needed[113] (although he has since taken the lead of Facebook's so-far-secret blockchain group).[114]

The once-scrawny Messenger has bulked up, and now includes key features of other leading messaging apps: group messaging, stickers, location sharing, notifications if your message has been

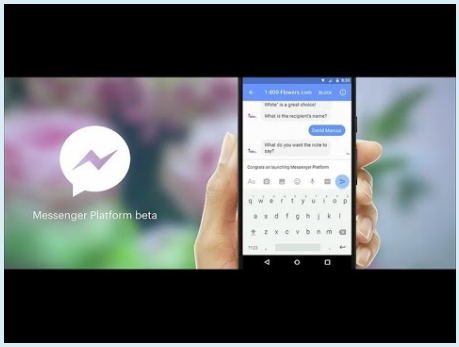
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seen, recording and sending audio messages. It's also a Skype competitor, offering free VoIP (Voice over IP) Internet calls. Under Marcus, Messenger has also expanded to become a tool for corporations to communicate with customers. Firms can now use Facebook to send customer updates (receipts, shipping information), and can use Messenger for customer support chat. And the Facebook Messenger platform allows firms to build AI (artificial intelligence), powered chatbots that interact with customers using natural language and can learn from interactions and preferences over time. Early uses included gift ordering from 1-800-Flowers, ride hailing from Uber or Lyft, and requesting a news digest from CNN. Firms are finding Messenger especially attractive in the wake of Gmail segregating "Promotions and Offers" to a separate tab, a function that often hides time-sensitive communication.[115] Such reasons may have motivated flash-sales site Zulily to sign up as one of the first firms working through Messenger.[116] Minor League Baseball offers a chatbot for fan interaction that works in both English and Spanish.[117] If Messenger can find that delicate balance of service but not spam, it may evolve as a critical business-to-consumer communication channel.

Zuckerberg Announces Facebook Messenger Platform to Create Chatbots

Facebook's CEO demonstrates Messenger chatbot capabilities.



View the video online at: http://www.youtube.com/embed/EOYnFUJyOIQ?rel=0

While the PayPal guy was at the helm, Messenger also become a payments platform. The payments feature allows users to send and receive money with their contacts. To many this will sound a lot like Venmo, an effort that used to be under Marcus's supervision when he ran PayPal. Getting customer debit cards linked to Facebook accounts may also prime the pump for other fee-based services, such as in-ad purchases via a "Buy" button.[118]

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FIGURE 11.7 Facebook Messenger Payments Feature
The Payments feature in Facebook Messenger lets customers use their debit cards to exchange money with the simplicity of sending a text.



Source: https://newsroom.fb.com/news/2015/03/send-money-to-friends-in-messenger/.

And taking a page from Asia's top messaging apps, such as WeChat and Line, Facebook has introduced a platform that allows developers to build their products that integrate directly via Messenger. The first implementation isn't great and adoption was sluggish.[119] Apps were initially tough to find, requiring users to click on the ellipses ("...") button during a chat session to uncover the Messenger app store. And offerings were skimpy (stickers, photo editors, sound-clips).[120] But games followed (first up was a Pictionary/DrawSomething-clone called Doodle Draw). The App store is overcrowded, so Messenger could help developers stand out, but only if they apply the lessons of limiting game spam learned from Facebook's maturity as a platform for browser games.[121] If Facebook can turn Messenger into a sort of must-use notification service for app and firm outreach it can also co-opt a key role of the OS and further cement the firm into all sorts of user experiences. If you can get shopping updates and info for your game-in-progress, why not travel, bank, breaking news, or anything else?

Many of the lessons learned from Facebook's browser platform, and its mobile efforts, will help shed light on how to best build new platforms, like Oculus. It's pretty clear that Zuck is thinking beyond products to platforms as the bulwark of Facebook's value-add and future competitive strength.

APIs, Playing Well with Others, and Value Added: The Success and Impact of Open Graph

While Facebook's in-browser apps platform has stalled, and Facebook is looking to mobile and Messenger for further growth and innovation, another aspect of the Facebook platform, Facebook's Open Graph, continues to project Facebook's influence beyond the site itself. The initiative allows developers to link Web pages and app usage into the social graph, placing Facebook directly at the center of identity, sharing, and personalization—not only on Facebook but also across the Web. Consider some examples of what Open Graph can do.

With just a few lines of HTML code specified by Open Graph, any developer can add a Facebook "Like" button to his or her site and take advantage of the social network's power of viral distribution. When a user clicks that page's "Like" button, it would automatically send a link of that page to his or her news feed, where it has the potential to be seen by all of his or her friends. No additional

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sign-in is necessary as long as you logged into Facebook first (reinforcing Facebook's importance as the first stop in your Internet surfing itinerary). The effort was adopted with stunning speed. Facebook's "Like" button was served up more than one billion times across the Web in the first twenty-four hours, and over 50,000 websites signed up to add the "Like" button to their content within the first week. (Facebook now includes several new options beyond "Like" and "Message Us" buttons to launch Messenger chatbots.)[122]

Facebook also offered a system where website operators can choose to accept a user's Facebook credentials for logging in. Users like this because they can access content without the hurdle of creating a new account. Websites like it because with the burden of signing up out of the way, Facebook becomes an experimentation lubricant: "Oh, I can use my Facebook ID to sign in? Then let me try this out."

Other efforts allow firms to leverage Facebook data to make their sites more personalized. Firms around the Web can now show if a visitor's friends have "Liked" items on the site, posted comments, or performed other actions. Using this feature, Facebook users logging into Yelp can see a list of restaurants recommended by trusted friends instead of just the reviews posted by a bunch of strangers. Users of the music-streaming site Pandora can have the service customized based on music tastes pulled from their Facebook profile page. They can share stations with friends and have data flow back to update the music preferences listed in their Facebook profile pages. When you visit CNN.com, the site can pull together a list of stories recommended by friends.[123] Think about how this strengthens the social graph. While items in the news feed might quickly scroll away and disappear, that data can now be pulled up within a website, providing insight from friends when and where you're likely to want it most. Facebook's opening of the "Stories" feature to third parties, effectively creating a platform from a product well ahead of one-time now laggard Stories leader Snapchat (see prior section) is another example of Facebook's relentless drive to build and strengthen its platforms.

When taken together, these features enlist websites to serve as vassal states in the Facebook empire. Each of these ties makes Facebook membership more valuable by enhancing network effects, strengthening switching costs, and creating larger sets of highly personalized data to leverage.

Strategic Concerns for Platform Builders: Asset Strength, Free Riders, and Security

Facebook also allows third-party developers to create all sorts of apps to access Facebook data. Facebook feeds are now streaming through these devices: Samsung, Vizio, and Sony smart televisions; Xbox and Nintendo game consoles; Verizon's FiOS pay-television service; the Ford Sync auto platform, and the Amazon Kindle. While Facebook might never have the time or resources to create apps that put its service on every gadget on the market, they don't need to. Developers using Facebook's access tools will gladly pick up the slack.

But there are major challenges with a more open approach—most notably, a weakening of strategic assets, revenue sharing, and security. First, let's discuss the potential for weakened assets. Mark Zuckerberg's geeks have worked hard to make their site the top choice for most of the world's social networkers and social network application developers. Right now, everyone goes to Facebook because everyone else is on Facebook. But Facebook, or any firm that opens up access to users and content, risks supporting efforts that undermine the critical assets of network effects and switching costs. If you can get Facebook content on other sites, why go to Facebook?

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free rider problem

When others take advantage of a user or service without providing any sort of reciprocal benefit.

Related to asset weakening is the issue of revenue sharing. Hosting content (especially photos and rich media) is a very expensive proposition. What incentive does a site have to store data if it will just be sent to a third-party site that will run ads around this content and not share the take? Too much data portability presents a **free rider problem** in which firms mooch off of Facebook's infrastructure without offering much in return. As an example of this tension, Facebook and Twitter, firms once known for their openness, have erected walls to make it more difficult for users to integrate their services. Twitter users used to be able to click on an Instagram photo and have it displayed directly in the Twitter app or in a pop-up window in Twitter-owned TweetDeck, but doing so prevents Facebook from wrapping Instagram content in messages, collecting "Likes," and—although it doesn't currently do so—running ads. Instagram also blocked user ability to find friends on Twitter.[124]

Finally, consider security. Allowing data streams that contain potentially private posts and photographs to flow through the Internet and have them land where you want them raises all sorts of concerns. What's to say an errant line of code doesn't provide a back door to your address book or friends list, to your messaging account, or to photos you'd hoped to only share with family? Security breaches can occur on any site, but once the data is allowed to flow freely, every site with access is, for hackers, the equivalent of a potential door to open or window to crawl through.

colossal walled garden

A closed network or single set of services controlled by one dominant firm.

Facebook's increasing dominance, long reach, and widening ambition have a lot of people worried, including the creator of the World Wide Web. Sir Tim Berners-Lee has warned that the Web may be endangered by Facebook's **colossal walled garden**.[125] The fear is that if increasingly large parts of the Web reside inside a single (and, for the most part, closed) service, innovation, competition, and exchange may suffer. In the wake of the Cambridge Analytica scandal, some have even called for Facebook to be broken up.[126]

Key Takeaways

- Facebook has created a set of services and a platform for hosting and integrating with other services, helping the firm foster its stated mission to "make the world more open and connected."
- Facebook's platform allows the firm to further leverage the network effect. Developers creating applications create complementary benefits that have the potential to add value to Facebook beyond what the firm itself provides to its users.
- Most Facebook applications are focused on entertainment, and although Zynga's initial success has waned, several have built million-dollar-plus businesses.
- Running a platform can be challenging. Copyright, security, appropriateness, free speech tensions, efforts that tarnish platform operator brands, privacy, and the potential for competition with partners can all make platform management more complex than simply creating a set of standards and releasing this to the public.
- The Cambridge Analytica scandal shows what can happen when a firm builds a business from access to user data, violates user expectations, and fails to recognize and deal with unscrupulous partners. The fallout from users leaving Facebook is likely less severe than the impact on employee morale, potential hires, partners growing leery of associating with a firm with a tarnished reputation, and potentially increasing government regulation.
- Several major global messaging apps, including WeChat and Line, have evolved into platforms that host other apps and services, creating substantial revenue opportunities along the way.
- Facebook Messenger is evolving into a platform. Messenger now supports payments, while developers can create apps linked to Messenger and offered via the Messenger app store.
- Corporate communications via Messenger are especially attractive when e-mail may be segregated from a main inbox and quarantined in a "Promotions and Offers" folder.
- Facebook has extended its reach by allowing other websites to leverage the site. Using the firm's Open Graph tools, Facebook partners can add the "Like" button to encourage viral sharing of content, leverage Facebook user IDs for log-in, and tap a user's friend and feed

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data to personalize and customize a user's experience. Stories, now open to third parties, has the potential to involve into a similarly strong platform.

- These efforts come with risks, including enabling free riders that might exploit the firm's content without compensation and the potential for privacy and security risks.
- While Facebook's website is easy to update and push out to all users, or to test on a subset of users on a smaller scale, the firm does not have this kind of control over mobile apps.
- Some fear that Facebook may be an all-too-powerful walled garden that may stifle innovation, limit competition, and restrict the free flow of information.

Questions and Exercises

1. Why is mobile app development more challenging from a testing, experimentation, quality control, and maintenance perspective than browser-based services?
2. Were you contacted by Facebook stating that your data was compromised by Cambridge Analytica or another data breach? If so, how did this make you feel? What have you done as a result? Has your use of Facebook changed? Have you changed your usage of Facebook's other platforms (especially Instagram)?
3. Examine Facebook's current user privacy tools. Do you feel this is adequate? Search online to identify the Facebook tool that can be used to download the information that Facebook has collected about you. Does this surprise you? After seeing this information, have you changed any settings or other online behavior? Why or why not?
4. What competitive asset does the application platform initiative help Facebook strengthen? For example, how do apps make Facebook stronger when compared with rivals?
5. Have you used Facebook apps for the browser? For Messenger? Which are your favorites, or why don't you use them? What makes some Facebook apps successful?
6. Leverage your experience or conduct additional research. Are there developers who you feel have abused the Facebook app network? Why? What is Facebook's responsibility (if any) to control such abuse?
7. Why might some e-commerce firms be inclined to use Facebook Messenger to overcome limitations in e-mail? Explain.
8. How are global messaging apps like WeChat and Line behaving like platforms? Do additional research (online, with your own experience if you've used these services, or by interviewing a colleague who is a user), find examples, and share them with your class.
9. How is Facebook Messenger evolving into a platform? Do you think they are doing a good job at this? Why or why not?
10. Cite effective examples you've seen of Facebook features being incorporated into other websites (or if you haven't seen any, do some background research to uncover such efforts). Why do the efforts you've highlighted "work" or why are they ineffective? Do they benefit users, and if so, how? Does everyone benefit? Is anyone at risk? If so, explain the risks.
11. What risks does running a platform open up to a platform owner like Facebook? What challenges has it encountered, and how did it deal with these challenges?
12. Why have Facebook and Twitter been erecting walls that block users from integrating these services? What is the free rider problem? Give real examples of this phenomenon in social networks and digital media.
13. What is a walled garden? Facebook has been called a walled garden. Name other firms that might also be described in this term. In your opinion, is Facebook a walled garden? Why or why not? What might be the consequences if the firm is widely viewed as being more powerful and less open?
14. Some are skeptical on the future of bots (watch the YouTube video at: https://www.youtube.com/watch?v=G8z--x5tFOI from *The Verge*, mentioning the failure of Microsoft's "Tay" and questioning the appeal of chat bots in Messenger). Try Messenger bots. What is your opinion? Are there scenarios where bots make sense? Why or why not?

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11.4 Advertising and Social Networks: A Challenging Landscape but a Big Payoff

Learning Objectives

1. Describe the differences between the Facebook and Google ad models.
2. Understand how content adjacency and user attention create challenges for social network operators and firms seeking to advertise on social networks.
3. Explain the hunt versus hike metaphor, contrast the relative success of ad performance on search compared to social networks, and understand the factors behind the latter's struggles.
4. Recognize how firms are leveraging social networks for brand building, product engagement, and driving purchase traffic.
5. Understand Facebook's considerable advantages and efforts with respect to ad targeting.
6. Compare Facebook's conventional advertising metrics with those of Google, as well as Facebook's mobile app install program. Understand the unique opportunity and potential challenges Facebook faces as it expands its app install program.
7. Recognize the challenges that mobile advertising presents for Facebook and understand why mobile is also a potential opportunity.

If Facebook is going to continue to grow and give away its services for free, it needs to make money somehow. Right now the bulk of revenue comes from advertising. Fortunately for the firm, online advertising is hot. For years, online advertising has been the only major media category that has seen an increase in spending (see Chapter 18). Firms spend more advertising online than they do on radio, magazine, cable television, or newspaper ads.[127] But not all Internet advertising is created equal. For Facebook, the size of the firm's market has created a money-gushing bonanza, but one that is very different than Google's offering. Social has its challenges and we'll dive deeper into what's different, what's tougher, what's being tried, and what's working.

First a look at what's different about search advertising and social ads.

content adjacency
Concern that an advertisement will run near offensive material, embarrassing an advertiser and/or degrading their products or brands.

Firms face two key challenges when advertising on social media: **content adjacency** and user attention.

Content Adjacency Challenges: Do You Really Want Your Brand Next to *That*?

The *content adjacency* problem refers to concern over where a firm's advertisements will run. Consider all of the questionable titles in social networking groups. Do advertisers really want their ads running alongside conversations that are racy, offensive, illegal, or that may even mock their products? This potential juxtaposition is a major problem with any site offering ads adjacent to free-form social media. Summing up industry wariness, one Procter & Gamble manager said, "What in heaven's name made you think you could monetize the [screen] real estate in which somebody is breaking up with their girlfriend?" [128]

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The issue of content adjacency came to a head when Facebook saw several blue-chip advertisers, including the UK media giant BSkyB and retail behemoth Marks & Spencer, pull their ads after they ran on a sexually themed Facebook page that may also have contained photos of minors.[129] Another campaign, led by several groups raising awareness of online hate speech and misogynistic content, resulted in tens of thousands of tweets and thousands of e-mails sent to firms whose advertisements were showing up next to "particularly vile content."[130] These crises caused Facebook to update its guidelines on hate speech; improve training for complaint reviewers; work more closely with groups concerned about hateful, graphic content on the social network; and restrict ads from appearing next to pages and groups that contain violent, graphic, or sexual content.[131] An IDC report suggests that it's because of content adjacency that "brand advertisers largely consider user-generated content as low-quality, brand-unsafe inventory" for running ads.[132] Dispelling concerns hinges on a combination of evolving public attitudes toward content adjacency issues in social media, as well as better technology and policing of the context in which ads appear.

Attention Challenges: *The Hunt* versus *the Hike*

Google and other search sites are on a hunt—a task-oriented expedition to collect information that will drive a specific action. Search users are expressing intent in search. They want to learn something, buy something, research a problem, or get a question answered. To the extent that the hunt overlaps with ads, it works. Just searched on a medical term? Google will show you an ad from a drug company. Looking for a toy? You'll see Google ads from eBay sellers and other online shops. Even better, Google only charges text advertisers when a user clicks through. No clicks? The ad runs at no cost to the advertiser. From a return on investment perspective, this is extraordinarily efficient. How often do users click on Google ads? Enough for this to be the single most profitable activity among any Internet firm. In 2017, Alphabet revenue topped $110 billion. Profits were $12.6 billion (but it would have been nearly $10 billion higher had it not taken a one-time tax hit for repatriating profits). Over $95 billion of this coin came from pay-per-click ads[133] (see Chapter 18 for more details). Facebook brought in $40.6 billion, garnering nearly $16 billion in profit. That was the first year Facebook was more profitable than Google, but it was a bit of a quirk, as Google endured a one-time tax charge of nearly $10 billion due to a change in tax laws.[134]

While users go to Google to hunt, they go to Facebook as if they were going on a hike—they have a rough idea of what they'll encounter, but this often lacks the easy-to-monetize, directed intent of search. They're there to explore and look around and enjoy the sights (or site). They've usually allocated time for fun, and they don't want to leave the terrain when they're having conversations, looking at photos or videos, and checking out updates from friends.

For years, Facebook's usage patterns were reflected in much lower click-through rates than Google. Google users click on ads around one to two percent of the time (and at a much higher rate when searching for product information). At Facebook, click-throughs can register as low as 0.02 percent (although these can also go higher with targeting).[135] Such rates vary widely over time and by context, but most reports show a dramatic performance (one or two orders of magnitude) on CTR metrics when comparing Google and Facebook.[136]

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Facebook Ads: Despite Post-IPO Concerns, a Massive Potential Upside is Realized

Worries over Facebook's ad model were underscored when growth slowed in the two quarters prior to the firm's IPO and many questioned the firm's ability to successfully monetize mobile, temporarily driving the stock below issue price.[137] Despite these concerns, Facebook's performance has silenced skeptics.[138] 2017 revenue grew more than 47 percent. Facebook's ability to better manage supply and demand to improve pricing, leverage data for targeting, and create lucrative new ad products and formats have kept growth engines oiled and fueled for expansion. And no one doubts Facebook's mobile ad muscle now that mobile brings in more than 90 percent of the firm's ad revenue.[139] While at IPO Facebook made no money from mobile, today Facebook's money is nearly all from mobile.

Precise Targeting

First is the advertising appeal of precise targeting. Large advertising networks have tried to meticulously track users to develop a profile of their demographics, likes, and interests. Facebook knows all about you because you've told it the details—your age, the things you're enthusiastic about, where you live, your relationship status. This opens up all sorts of targeting opportunities to even the smallest of advertisers. In one example, a wedding photography studio targeted ads at women aged twenty-four to thirty whose relationship status was engaged—that's like sticking a flyer in front of precisely everyone you want to reach and not wasting a dime on anyone else. The firm, CM Photographics, reports that just $600 in Facebook ads resulted in nearly $40,000 in revenue.[140]

In a significant "big data" play for more accurate consumer targeting, Facebook now allows advertisers to combine externally collected data with Facebook's insights. Partnerships with third-party data providers Acxiom, Datalogix, and Epsilon (see Chapter 15 for more on such third-party data providers) allow data from offline purchases and loyalty programs to be used in targeting a vendors' ad campaigns that run on Facebook. As *AdAge* points out, "Use a loyalty card for discounts at the drug store? The ads you see on Facebook could start looking familiar."[141] Other Facebook initiatives will allow brands to upload e-mails, phone numbers, and addresses from their proprietary CRM (customer relationship management) databases to show ads to existing customers who are on Facebook. And while a big, combined database of offline and online activity may raise privacy concerns, Facebook claims it uses a technique called "hashing" that can find a match without allowing Facebook data to be intelligible to data vendors, or vice versa.[142]

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Facebook, Help Get Me a Job!

The news is filled with stories about employers scouring Facebook to screen potential hires. But one creative job seeker turned the tables and used Facebook to make it easier for firms to find him. Recent MBA graduate Eric Barker, a talented former screenwriter with experience in the film and gaming industries, bought ads promoting himself on Facebook, setting them up to run only on the screens of users identified as coming from firms he'd like to work for. In this way, someone Facebook identified as being from Microsoft would see an ad from Eric declaring "I want to be at Microsoft" along with an offer to click and learn more. The cost to run the ads was usually less than $5 a day. Said Barker, "I could control my bid price and set a cap on my daily spend. Starbucks put a bigger dent in my wallet than promoting myself online." The ads got tens of thousands of impressions and hundreds of clicks, and dozens of people called offering assistance. Today, Eric Barker is gainfully employed at a "dream job" in the video game industry.[143]

FIGURE 11.8 Self-Advertising on Facebook
Eric Barker used Facebook to advertise himself to prospective employers.



Mobile Revenue on the Upswing

Also despite concerns about mobile advertising, the story seems to be getting better. As of the first quarter of 2016, over 90 percent of Facebook's monthly active users (MAUs) visited using mobile devices, and over half only access using mobile.[144] By cracking the mobile ad code, Facebook has also been able to earn more from its global audience, with 51 percent of ad dollars now coming from outside the US.[145] Mobile users provide Facebook with a steadier flow of customer interaction throughout the day. One survey found that the average smartphone user checks Facebook fourteen times a day and that most check their phones immediately after waking up in the morning.[146] As for upside, also consider that Instagram only began running ads in November 2013,[147] and as of this writing, WhatsApp only recently began running a modest number of ads. That leaves a lot of room

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for new ad growth, with the possibility of even more as Stories becomes a platform for serving third-party content on Facebook.[148] Results in Facebook mobile suggest the firm understands how to run mobile ads without excessively annoying users.

Ads in Feeds: Better Performance Even as Fewer Ads are Shown

CPM

Cost per thousand impressions—the amount charged every time an ad appears 1,000 times (M is the roman numeral for 1,000).

Facebook was initially reluctant to place ads in the news feed, but such ads have proven to be hugely successful for the firm and pretty much dispelled earlier concerns over "the hike" at Facebook being a poor ad platform. Unlike search ads, ads in the news feed move beyond the easy-to-ignore real estate on the right side of the desktop and instead put a message right in the middle of the exact screen real estate that a user is paying attention to. News feed ads have been shown to deliver a twenty-six times higher return on investment than sidebar ads.[149] And news feed ads are evolving with new video ad offerings. One survey found that more people age eighteen to twenty-four access Facebook during evening primetime hours than watch ABC, CBS, NBC, and Fox combined.[150] Advertisers that are losing audience reach in declining primetime numbers are likely to shift more ad dollars to channels where desirable demographics are spending more time. Video ads on Facebook carry a **CPM** of $4, a value that has been steadily growing.[151] Note: CPM stands for cost per thousand impressions—a common way to express advertising rates which refers to the amount charged every time an ad appears 1,000 times (M is the roman numeral for 1,000). And in a further bid to go after YouTube, Facebook has begun sharing 55 percent of ad revenue with digital content creators. While the rate is similar to YouTube's, Facebook has the added advantage of putting content in front of users (via the feed) who might not normally get exposed to it.[152]

Facebook has also leveraged a bit of Econ 101 to juice profits. Instead of annoying users by saturating their feeds with ads, Facebook has actually cut back on the percentage of ads that appear in feeds. This has created an inventory scarcity that allowed the firm to jack up prices as firms compete for a slot (i.e., more demand for limited supply). The net result: a better user experience and higher profits.[153] Layer on some data for targeting and firms will pay even more for what (hopefully) users find to be more appealing promotions. While the number of ads dropped, platform use and user growth continued to grow to the point that the firm now serves more ads than ever.[154]

Beyond "Right Margin" Display Ads: Big, New Winners Emerge

Facebook allows advertisers to enhance ads with "social context," showing the names of friends who have "liked" the firm or checked-in to advertiser locations.[155] These ads attempt to take advantage of the concept of social proof—adding legitimacy for a product through its association with your friends. Ads with social context have been shown to perform better (e.g., a 50 percent greater likelihood of higher recall and 35 percent sales lift[156]), so Facebook has baked opportunities for social ads into its ad products.[157] Various ad types focus further on a desired outcome (like a page, sign up for an event, request more information, shop, engage with a post, etc.[158]). Such ads play to Facebook's social and data strength, and offer additional targeting that should improve ad quality for its users (a significant problem in Facebook's earlier ad products).

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An Ad Network for Facebook. Can it Best Google?

Ad revenue is also likely to increase now that tweaks in Facebook's news feed post-selection algorithm are limiting the reach of organic posts from firm fan pages.

Posts from fan pages used to be a free promotion source for any organization hoping to reach the news feeds of those who "liked" their product. While posts have long been curated by Facebook algorithms, such posts used to reach about 16 percent of a page's fans. Sources report that organic reach from fan posts has dropped to a range from 6.15 percent to as low as 2 percent.[159] While disappointing to marketers who have worked hard to cultivate a fan base on Facebook, it can't come as a surprise that Facebook would one day limit the free ride on its service and attempt to commercialize fan pages by promoting post reach. Among the many ad products Facebook offers are "Promoted Posts," which increase the reach of an item that a firm shares. Expect firms with a substantial Facebook following, especially those that have seen solid results from past campaigns, to boost their advertising as a result.

More upside potential comes from Facebook's advertising network. Google earns about 20 percent of its revenue from ads it runs on third-party sites (referred to as the Google's ad network). Next time you search the Web, look for advertisements labeled "Ads by Google." Google serves up these ads and splits the take with website operators. Up until mid-2014, Facebook only ran ads within Facebook properties, but with the launch of the Facebook Audience Network, the firm can make money off its billion-plus users, even when they're not on Facebook's own sites and apps.[160] Mobile app developers can, too. All developers need to do is put a snippet of Facebook code into their apps. Zuckerberg's firm will line up advertisers, select and run targeted ads based on its massive knowledge of individual users and user preferences, measure ad performance, and collect payments to forward on to its partners (after taking a cut, of course). While your Facebook data will be used to target ads outside the service, the firm's ad network doesn't give advertisers or publishers any personal data, it simply performs matching on its own servers, then delivers the appropriately targeted ad to the app. And users can opt-out of any ad tracking, as well.[161] Some think that a Facebook ad network might be able to offer ad targeting that performs *better* than Google's AdSense product. Google targets ads on other websites based largely on keywords found on those sites, also using details it can glean from tracking a person's Web browsing history (see Chapter 18 for details). Facebook can do all this, but it could also add in all sorts of data from the dark Web that Google can't see: data from a user's social activity, their highly accurate personal profile, and more. As an added bonus, Facebook can use its ad network to boost revenue without increasing the density of ads in its own products—another win for usability.

Content Providers, Step Deeper Inside My Walled Garden

Facebook has also offered to host and serve content on its own servers. The "Instant Articles" service helps vendors overcome the problem of slow page loads and content that's poorly formatted for mobile. Articles usually take an average of eight seconds to load, often enough to prompt users to quit, and causing content providers to miss out on the ad revenue from a page view. Caching articles on Facebook's servers allows pages to load ten times faster,[162] and articles are precisely formatted for display on a user's mobile device, even offering special formats like maps, zoomable photos, and video. Publishers have the option to fill their ad inventory themselves and keep all of the ad revenue (Facebook does have some guidelines on the format of ads that can be displayed), but the Facebook Audience Network will gladly line up advertisers for any unsold inventory the firm wants to make available, for a 30 percent cut for Zuck. Clicks will be recorded by comScore, reflecting traffic as if users visited a firm's site, and shared links will also refer back to a website rather than to the article cached on Facebook.[163] Initial big media partners included *The New York Times*, BuzzFeed, *The Atlantic, The Guardian,* NBC News, and *National Geographic*, but Facebook has since opened the platform up to all publishers. Facebook says it doesn't play favorites with "Instant Article" partners, but as *TechCrunch* speculates: "The animated Instant Article covers are

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certainly more eye-catching than traditional static blurbs, and those clicks tell the feed to show a story to more people."[164] Video on Facebook is booming and presents yet another content serving (and ad sales) opportunity that Facebook can develop and exploit. Facebook serves as many clips as YouTube in part because it's handled so well. Sound-off clips cut the annoyance while piquing interest, making the feed look "like a Harry Potter newspaper come to life."[165]

Some worry "Instant Articles" reinforce Facebook's walled garden and give the firm even more power over how journalism is distributed and seen, but if Facebook can placate concerns and deliver value to partners, it may be able to convince more to allow its ad network to serve ads on their content, as well.

Better Advertisement Everywhere. What's Up Next?

As for more speculative opportunities for ad market growth, consider the longer-term possibilities for social television. Facebook almost certainly wants to play a starring role in your living room, making the TV a platform for social activity: video chat, serving targeted ads, social entertainment recommendations, games, and all sorts of commerce. It will be tough to navigate the tensions of bandwidth-capping cable guys, channel owners, and hardware firms keen to build their own platform, but Zuckerberg has Reed Hastings on his board. No one has built a further-reaching platform with consumer electronics firms than the Netflix CEO, and he should provide keen insight as Facebook spreads further. And don't count out Oculus. Those court-side immersive experiences Zuckerberg imagined would go great with deeply engaging ads, as well.

Facebook continues to refine its ad offerings, targeting, and reach potential, and the recent and continued surge in ad growth suggests that the firm's advertising customers are mostly satisfied and coming back for more. It's also worth noting that big advertisers aren't the only ones Facebook (and rivals) are after. Zuckerberg's firm has been used by over one million different advertisers, and many of these are small businesses using the firm's self-service ad platform.[166] Results-focused offerings for these clients, many of whom increasingly view a Facebook presence as being as important or more important than a standard Web page, bode well for future revenue growth.[167] With more than half of Facebook's revenue coming from outside the United States[168] rising worldwide mobile engagement and a growing middle class in many emerging markets where Facebook operates point to revenue forecasts that suggest the continued trajectory of up and to the right.

The Hidden Ways Facebook Ads Target You

This video from Vice shows various tools in user targeting, and also uncovers workarounds and algorithmic abuse. The video also briefly mentions fake news, which is covered in the next section.



View the video online at: http://www.youtube.com/embed/EM1IM2QUYjk?rel=0

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Key Takeaways

- Issues of content adjacency and user attention can make social networking ads less attractive than ads running alongside search and professionally produced content sites.
- Google benefits from much of its advertising being associated with intent-to-purchase. Users are on a "hunt" to find information when they enter Google, and ads can be seen as quite helpful. Facebook users are not necessarily seeking anything related to purchase.
- Display ads and video ads are often charged based on impression.
- Facebook ads can be precisely targeted since the firm has a large amount of actual data on users' self-expressed likes, interests, and demographics. Facebook has also taken steps to allow third-party databases to be incorporated into targeting ads on site while preventing the possibility that databases can be combined to reveal online information to offline partners or vice versa.
- Mobile traffic is growing, and despite initial concerns over Facebook's ability to find growth in this space, the firm's mobile ads in particular have grown at a tremendous rate and are solidly profitable.
- Ads in the news feed have the advantage of falling directly within the screen real estate that a consumer is focused on. As such, they are considered superior to ads that may occupy easy-to-ignore spaces on the right-hand side of a content window.
- Facebook has cut the number of ads it shows its users, and the scarcity this builds, along with better targeting, has allowed the firm to charge more. This has improved the user experience while improving profits.
- "Social Context" ads, which include the names of friends who have liked a firm's page, perform better on recall and sales lift than conventional ads, enhancing Facebook's advertising appeal. These ads also use a type of "social proof," leveraging friend interest to improve the likelihood of customer engagement.
- Facebook has also found success in mobile install ads. Some gaming firms are willing to spend as much as $10 per install for these ads.
- The Facebook Audience Network provides a way for firms to allow Facebook to gather advertisers, target and serve ads on third-party sites and apps, and collect revenue for them.
- "Instant Articles" allow Facebook to host, cache, and serve content from media firms. Faster article loads should increase article engagement and allow partners to make more money. Facebook hopes partners may be more inclined to use its ad network, as well. Video ads cached and served on Facebook are also booming, with Facebook serving as many videos a day as YouTube.
- Some are concerned that allowing Facebook to host and serve content reinforces Facebook's walled garden, where users rarely venture out, and where Facebook grows even more powerful as a vital partner in content distribution.

Questions and Exercises

1. What is the content adjacency problem? Search for examples of firms that have experienced embarrassment due to content adjacency. Describe them, why they occurred, and if site operators could have done something to reduce the likelihood of these issues occurring.
2. What kinds of websites are most susceptible to content adjacency? Are news sites? Why or why not? What sorts of technical features might act as breeding grounds for content adjacency problems?
3. How are most display ads billed? What acronym is used to describe the pricing of most display ads?
4. How are most text ads on Google billed? What's the appeal for advertisers?

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5. If a firm removed user social media content because it was offensive to an advertiser, what kinds of problems might this create? When (if ever) should a firm remove or take down user content?
6. Has Facebook been improving the organic reach of brands online or reducing this reach? What are the implications for brands with fan pages and for Facebook?
7. Describe an innovative marketing campaign that has leveraged Facebook or other social networking sites. What factors made this campaign work? Are all firms likely to have this sort of success? Why or why not?
8. Have advertisers ever targeted you when displaying ads on Facebook? How were you targeted? What did you think of the effort?
9. How do you feel about Facebook allowing third-party databases to be used for ad targeting on the firm's site? Does this concern you? Why or why not? What is the upside and potential downside for Facebook, advertisers, and users for this sort of targeting?
10. What were the concerns with Facebook and mobile advertising, and how have Facebook mobile ads been performing for the firm?
11. Why do ads in feeds perform better than conventional display ads?
12. How has Facebook leveraged "Econ 101" to improve the user experience while improving ad profitability?
13. What are the benefits of Facebook hosting and serving content via "Instant Articles" and video caching? What are the concerns?
14. Why do some speculate that the Facebook Audience Network advertising network is potentially better at targeting users than Google's ad network?

11.5 Move Fast and Breaks Things: Fumbles, Fake News, and Global Growth Challenges

Learning Objectives

1. Recognize how user issues and procedural implementation can derail even well-intentioned information systems efforts.
2. Recognize the risks in being a pioneer associated with new media efforts and understand how missteps led to Facebook and its partners being embarrassed (and in some cases sued) as a result of system design and deployment issues.
3. Examine the challenges that leveraging potentially sensitive consumer data, altering privacy settings, and changing terms of service may present to innovative firms. Understand the difference between opt-in and opt-out efforts, the breadth of possible consumer reaction, and impact of such policies on a business.
4. Learn about the fake news crisis, the motivations of bad actors, the challenges the firm faces in dealing with the issue, the limitations of technical and human-based solutions, and the potential longer-term damage to the firm.
5. Highlight areas of opportunity and concern regarding Facebook's designs on emerging market growth.

The road around Facebook's campus is named "Hacker Way," and concrete letters in the firm's central courtyard spell the word "HACK" (the term used by software engineers to refer to a clever solution, rather than the negative connotation used in security circles). Graffiti-laden walls under-

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score that Facebook is a creative and edgy place, and slogans like "Done is Better than Perfect" and "Move Fast, Break Things" are cultural signposts that direct staff to keep an eye on what has helped make the firm successful. This is, after all, a business built on network effects, and in Facebook's world, it's either be quick or be dead. And yes, sometimes things break. A mistake by one engineer once accidentally released all of Facebook's top-secret projects.[169] Oops! While the firm does strive to reduce errors, and Zuck has shifted slightly (crowing the less catchy "move fast with stable infrastructure"[170]), Facebook's "no-beta" culture tolerates mistakes on the road to progress. Even new hires in the firm's engineering boot camp work hands-on with the actual site. Code changes are rolled out to progressively larger groups so that user reaction and major bugs can be dealt with, but well-received updates can make it out to over a billion users within hours. The willingness to take bold risks on new initiatives has allowed the firm to push forward with innovations that many users initially resisted but eventually embraced (e.g., the news feed, the messenger app). But moving fast with less forethought has also led to alienating gaffes that have damaged the firm's reputation. By examining some of Facebook's mistakes, managers can raise their internal awareness of pitfalls associated with implementing technology initiatives, and by watching Facebook's responses to missteps, managers can gain insight into effective course correction if initial efforts run into trouble.

FIGURE 11.9 Inspirational Signs at Facebook Headquarters Campus
Facebook's campus is full of signs and slogans to reinforce the firm's risk-taking, move-fast, hacker-centric culture.



Source: John Gallaugher

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Got a Great Team? Break 'Em Up and Spread 'Em Around!

Building such a great infrastructure requires a super-smart and super-creative talent base. In order to keep the ideas humming, Facebook regularly rotates technical staff. Every eighteen months employees are required to leave their teams and work on something different for at least a month. Getting people into new groups helps the firm's geniuses more broadly share their knowledge, generates idea flow, and prevents managers from developing fiefdoms. The firm also runs legendary hackathons, all-night sessions with one key rule: no one is allowed to work on what they normally do. Engineers blue-sky innovate on something new and show it to Zuckerberg and a senior staff brain trust, who then decide which projects go forward.[171]

Beacon Busted—Management Lessons on Tech Planning and Deployment

The launch, public outcry, resulting PR disaster, and eventual repeal of Facebook's highly touted "Beacon" platform provide a lesson for managers regarding the peril in introducing system modifications without considering their full implications. For all of Facebook's high-speed, innovation-fueled growth, moving fast does have a downside when things break.

The Beacon effort started from a simple question: Could the energy and virulent nature of social networks be harnessed to offer truly useful consumer information to its users? Word of mouth is considered the most persuasive (and valuable) form of marketing,[172] and Facebook was a giant word-of-mouth machine. What if the firm worked with vendors and grabbed consumer activity at the point of purchase to put it into the news feed and post it to a user's profile? If you watched a video, bought a cool product, or dropped something in your wish list, your buddies could get a heads-up, and they might ask you about it. The person being asked feels like an expert, the person with the question gets a frank opinion, and the vendor providing the data just might get another sale. The effort, named Facebook Beacon, looked like a home run. Some forty e-commerce sites signed up, including Fandango, eBay, Blockbuster, Travelocity, Zappos, and the *New York Times*. Zuckerberg was so confident of the effort that he stood before a group of Madison Avenue ad executives and declared that Beacon would represent a "once-in-a-hundred-years" fundamental change in the way media works.

User reaction to Beacon was swift and brutal. The commercial activity of Facebook users began showing up without their consent. The biggest problem with Beacon was that it was "opt-out" instead of "opt-in." Facebook (and its partners) assumed users would agree to sharing data in their feeds. A pop-up box did appear briefly on most sites supporting Beacon, but it disappeared after a few seconds.[173] Many users, blind to these sorts of alerts, either clicked through or ignored the warnings. And, well, there are some purchases you might not want to broadcast to the world.

"Facebook Ruins Christmas for Everyone!" screamed one headline from MSNBC.com. Another, from *U.S. News and World Report*, read "How Facebook Stole Christmas." The *Washington Post* ran the story of Sean Lane, a twenty-eight-year-old tech support worker from Waltham, Massachusetts, who got a message from his wife just two hours after he bought a ring on Overstock.com. "Who is this ring for?" she wanted to know. Facebook had posted a feed not only that her husband had bought the ring but also that he got it for a 51 percent discount—making him look cheap!

Overstock.com quickly announced that it was halting participation in Beacon until Facebook changed its practice to opt in.[174] MoveOn.org started a Facebook group and online petition protesting Beacon. The Center for Digital Democracy and the US Public Interest Research Group asked the Federal Trade Commission to investigate Facebook's advertising programs. And a Dallas woman sued Blockbuster for violating the Video Privacy Protection Act (a 1998 US law prohibiting unauthorized access to video store rental records).

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Zuckerberg would later say regarding Beacon, "We've made a lot of mistakes building this feature, but we've made even more with how we've handled them. We simply did a bad job with this release, and I apologize for it."[175] Beacon was eventually shut down, and $9.5 million was donated to various privacy groups as part of its legal settlement.[176] There's not much evidence that Beacon's failure had any notable impact on Facebook's growth. But perhaps a bigger problem was that many of those forty A-list e-commerce sites that took a gamble with Facebook now had their names associated with a privacy screw-up that made headlines worldwide. Not a good thing for one's career. A manager so burned isn't likely to sign up first for the next round of experimentation.

From the Prada example in Chapter 3 we learned that savvy managers look beyond technology and consider complete information systems—not just the hardware and software of technology but also the interactions among the data, people, and procedures that make up (and are impacted by) information systems. Beacon's failure is a cautionary tale of what can go wrong if users fail to broadly consider the impact and implications of an information system on all those it can touch. Technology's reach is often farther, wider, and more significantly impactful than we originally expect.

Faked Out by Fake News

There are countless stories of the Facebook platform being used for good: happy reunions, life-saving connections, organizing for positive change, and of course, as a vehicle that helps entrepreneurs worldwide to uncover customers and thrive.[177] But technology has no built-in morality, and tools to connect can become tools for abuse. The extent to which so-called "fake news" on Facebook has been used to fan the flames of political discord has been astonishing, troubling, and has caused a deep, existential crisis within the firm, its user base, management, and society. There can also be an immediate physical danger from the spread of Fake News—for example, the widely shared #PizzaGate story claimed a Washington, DC, restaurant was a front for a Hillary Clinton-associated child sex trafficking ring involving children kept in a basement. One man, intent on exposing this alleged crime, traveled to and opened fire at the storefront, which didn't even have a basement.[178]

Facebook's fake news exploiters have different motivations. For example, there are the hard-partying Macedonian teens who couldn't care less won the US presidential election, but bought ads as well as hacked Facebook profiles, and used these to share sensationalist stories. The idea—get people fired up to spread this content virally. Anyone who clicks through to view the fake news site is lining the teens pockets, since these sites make money by running ads served by ad networks, such as Google's. The small Macedonian town of Veles (25 percent unemployment, once known as "the second most polluted city in Yugoslavia[179]) has been identified as hosting 150 fake news sites that garnered 40 million page views in six months, netting tens of thousands of dollars in profit from peddling outrage to duped Americans. One teen made so much money that he quit high school to work full time on the effort.[180] Ad targeting—good for finding a Christmas gift or vacation spot, and also good for inciting the angry to follow your click-bait.

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Fake News

How a Hard-Partying Macedonian Teen Earns Thousands Publishing Lies



View the video online at: http://www.youtube.com/embed/gOiHIsYA03I?rel=0

Even more troubling is the highly sophisticated campaign allegedly undertaken by agents acting on behalf of the Russian government. Much of this was led by the innocuously named "Internet Research Agency," a fake-news farm in St. Petersburg, Russia. Facebook has stated that as many as 150 million Americans may have been exposed to these messages over Facebook and Instagram in the time leading up to the 2016 US presidential election. An analysis by BuzzFeed showed that the top 20 fake news stories had more shares, reactions, and comments on Facebook than the top twenty news stories from reputable sites.[181] In 2018, the US Justice Department indicted 13 Russians and three companies for using social media to subvert the 2016 election and push voters toward Donald Trump. While other social media sites were mentioned, Facebook and its properties were singled out far more than any other tech firms.[182]

Facebook didn't help its credibility in the months leading up to the indictment. Zuckerberg originally dismissed the notion that Facebook played a role in tipping the election as a "crazy idea",[183] he later declared he regretted his original statements and attitude.[184] Facebook's initial estimate of the number of fake news accounts (only 18 million) was far less than the over half a billion fake accounts it would eventually disable and remove.[185] As more details were revealed and Zuck was dragged before lawmakers on both sides of the Atlantic, many questioned why Facebook wasn't able to identify, catch, and disrupt this activity while it was happening. The firm had an active mechanism in place to stop ad fraud and curtail posts with pornography and violence. Wouldn't the patterns of fake news be easy to recognize and stop? *Recode* asked, why the people who "build their own Internet beaming drones…aren't smart enough to figure out the difference between the *New York Times* and the *Denver Guardian*, which doesn't actually exist."[186] And the media buys were not what most would call a small campaign. The Russians were spending upwards of $1.25 million a month on these ads.[187] Some wondered if Facebook turned a blind eye because it was making money from the Russian ads.[188] And apparently it wasn't limited to the US election, either. Election-tampering accusations have been leveled against Russians sowing discord in the Brexit vote, the Scottish Independence referendum, and elections in France and the Netherlands, and additional fears given forthcoming elections in Mexico, Columbia, Brazil, Sweden, and other nations.[189]

Facebook had announced or undertaken a multipronged approach to battling fake news, but this is an admittedly difficult task. How do you police a platform that can be accessed by a quarter of the planet at any given time? And how do you bless one media outlet over another while balancing expectations of free speech and unbiased presentation? An early Facebook solution randomly surveyed users on the reputability of a news source and put red flags next to questionable content. What happened? Users who found the fake news reinforced their own political views actually shared red flagged stories even more than the real stuff.[190] Facebook has also partnered

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with independent fact-checking organizations (Snopes, Politifact, ABC News, and FactCheck.org, with Facebook committing to expanding partners over time), but has since expanded to more than twenty, worldwide.[191] All are members of the Poynter International Fact Checking Network, and have agreed to a common set of principles. If at least two of the fact-checkers identify the post as a fake, Facebook will shrink the size of the article, follow the post with links debunking the claim, and downrank posts so that they are buried deep within in a user's news feed. If a user still clicks on the disputed article, a popup box warning "Disputed by 3rd Parties" displays first, allowing the user to continue or cancel their click-through. Any articles identified as fake will also be banned from using Facebook's advertising and promotional products, and Facebook will drop any ads from websites that run such ads or that appear to trick the user into thinking they are real (e.g., abcnews.com.co or buzzfeedfeed.com—catch the differences?). An icon accompanying some posts will allow the user to get additional information about that news source. Facebook has also increased screening for bogus accounts, and it screens ads for similarities with already banned content. For postings that aren't clearly from a news or fake news site, Facebook will ask employees to screen whether or not the content is a personal post, with personal content not being subject to the "fake news" flags and penalties. Users can also flag a post as fake news for possible fact-checker screening.[192] Facebook uses technology to identify behavior associated with a possible fake article (e.g., articles that are frequently deleted after posting, articles that have consistent comments declaring they are "fake"). The firm is also using reverse image search to see if an image has been doctored. Many images also carry "meta data" added by the phone or camera that took the photo (e.g., time, date, geolocation), and comparing images with the same meta data but alterations in a portion of their content can also surface Photoshopped fakes. Machine learning will be used to focus the fake-finding over time, but AI has its limits. Figures released by Facebook showed its AI had a 100 percent success rate at detecting spam, it could detect both terrorist propaganda and fake accounts 99.5 percent of the time, and adult nudity and sexual activity at a 95.8 percent rate. But AI found hate speech only 38 percent of the time.[193] Efforts such as the firm's Fighting Abuse @Scale conference bring together some of the best minds concerned about this issue and who are tackling similar problems, but this isn't something with a single, long-term solution.

Facebook's Fight Against Misinformation

Hear Facebook employees discussing the challenges of fake news, respecting free speech, and battling bad actors. Technology used in the fight is also demonstrated.



View the video online at: http://www.youtube.com/embed/zgkF23nFIBw?rel=0

Facebook's initial reaction to the fake news controversy, its initial stumbles, and its enduring efforts to curtail the problem highlight challenges faced by firms offering services that can be used for good or ill. While Facebook has endured past privacy gaffes and has continued to grow through controversies, the attention and criticism the firm has faced over fake news has been relentless and the most severe it has faced to date. Managers will learn quite a bit by watching how Face-

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book continues to follow up, which efforts work or fail, and how governments, users, employees, and business partners react to these developments.

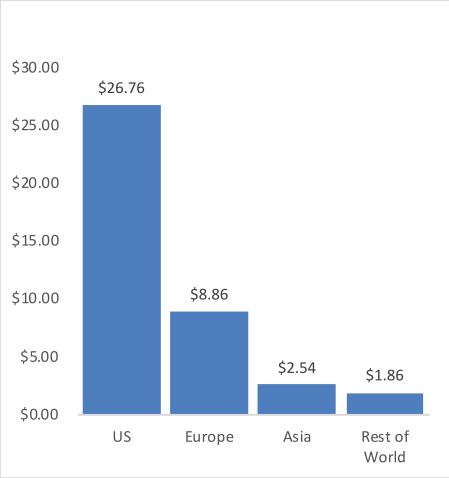
Challenges of Going Global: Low ARPUs, Legitimate Rivals, and Unreachable Users

crowdsourcing
The act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call.

localization
Adapting products and services for different languages and regional differences.

With most of its revenue coming from outside the United States, Facebook is already massively global. Facebook's **crowdsourcing localization** effort, where users were asked to look at Facebook phrases and offer translation suggestions for their local language, helped the firm rapidly deploy versions in dozens of markets, blasting the firm past one-time rivals in global reach. But network effects are both quick and powerful, and late market entry can doom a business reliant on the positive feedback loop of a growing user base. And global competition is out there. Facebook wannabes worldwide include VKontakte ("in contact"), Russia's most popular social networking site; Line, the app and platform which is tops in Japan and has a large following in many other countries; and Qzone and WeChat (both owned by Tencent), which are wildly popular in China. And don't be surprised to see some of these well-capitalized overseas innovators making a move on US markets too. China's Tencent and Japan's Rakuten are among non-US firms that have acquired US-based Internet firms.

FIGURE 11.10 Facebook's Average Revenue per User
Facebook Average Revenue per User by Region



Source: Data from Facebook Year End 2017 Financial Results; https://investor.fb.com/investor-news/press-release-details/2018/Facebook-Reports-Fourth-Quarter-and-Full-Year-2017-Results/default.aspx.

While global growth can seem like a good thing, acquiring global users isn't the same as making money from them. Free sites with large amounts of users from developing nations face real cost or revenue challenges. As the *New York Times* points out, fewer than half of global Internet users have disposable incomes high enough to interest major advertisers, meaning that in terms of average revenue per user (ARPU), these new social networking recruits are likely to be far less lucrative in the near future than the firm's current users.[194] In the last quarter of 2015, the average user in the United States and Canada was worth $26.76, but in Europe that figure was only $8.86, Asia-Pacific ARPU was $2.54, and in Latin America and Africa ARPU was $1.86.[195]

Making money in the face of this so-called international paradox requires an awareness of fast-and-cheap tech trends highlighted in Chapter 5 and an ability to make accurate predictions regarding regional macroeconomic trends. If you ignore a market that's unprofitable today, a rival could swoop in and establish network effects and other assets that are unbeatable tomorrow. But if you move too early, losses could drag you down. To make Facebook more appealing to low-end users, Facebook has built an app that requires just 1 percent of the computing resources used by its main smartphone app. Facebook Lite won't support video, and images will be compressed,[196] but users can post status updates and pictures, scroll through a news feed and get notifications.[197] The firm will sell ads through Facebook Lite, even though high-appeal video and hi-res images aren't on the platform.

Concerns aren't just financial and technical; they're also political and ethical. Facebook is officially banned in China (although many Chinese have used technical work-arounds to access the site), and Zuckerberg is clearly interested in the Chinese market. He reportedly spends an hour each day learning Chinese and has made several trips to China, addressing crowds in "halting, but passable" Mandarin.[198] Some say even a censored Facebook would be a catalyst for Chinese democratic reform, while others see this as a compromise of the firm's belief in the power of exchange and promoting the free flow of information. The firm's COO Sheryl Sandberg said, "There are compromises on not being in China, and there are compromises on being in China. It's not clear to me which one is bigger."[199]

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The Admirable Goals and Unintended Consequences of Internet.org

Zuckerberg has also been thinking beyond short, to mid-term profits, and has declared Internet access to be a "human right."[200] As announced in a cover story in *Time* magazine, his explicit goal is "to make sure that actually, literally every single human being on Earth has an Internet connection." To achieve the goal, Facebook has been actively working on schemes for providing Internet access to areas with no signal. For example, by purchasing a designer of solar-powered drone aircraft, Facebook hopes that one day these systems will circle underserved areas at altitudes above clouds and troubling weather, returning to earth only when they need maintenance.[201] While these efforts get lots of press, the reality is that about 85 percent of the world's population already lives within range of a cell tower with at least a 2G data network. So why are so many offline? Three reasons: 1) data is too expensive for many of the world's poorest citizens; 2) services aren't designed for emerging market use by populations who need ultra-low bandwidth services that run reliably on very low-end or old, recycled hardware; and 3) content is not compelling enough to draw in non-users. If done right, however, the impact of Internet could be life-changing. That device in a pocket is a tool to lubricate markets, educate, and connect citizens with government services and health care. A Deloitte study (albeit one commissioned by Facebook) posited that moving the population of India with Internet access from 15 percent to 75 percent would create 65 million jobs, cut extreme poverty by 28 percent, and reduce infant mortality by 85,000 deaths a year. [202]

To get to Zuckerberg's goal of everyone online, Facebook has partnered in the creation of Internet.org, a nonprofit organization crafting nonexclusive partnerships with local carriers to offer a free tier of services, a sort of "Internet dial tone" that includes social networking (of course), as well as vital information such as weather, health care information, education, and food prices, all through a lightweight app that runs on very low- end phones (often called "feature phones" as opposed to app-installing smartphones).[203] The admirable goal of bringing the Internet to the masses has stumbled quite a bit. There were technical snafus—a SpaceX rocket carrying a Facebook satellite slated to bring Internet service to parts of sub-Saharan Africa blew up.[204] The first test of the firm's solar-powered drone crashed.[205] And there were political problems—interests in India thwarted Facebook's efforts, citing this was a walled-garden initiative that violated principles of net neutrality by creating a two-tiered Internet, one for the rich and one for the poor. Although Facebook vehemently protested, mentioning that the service was open to all firms (Google had joined), criticism continued. A rebranded effort "Free Basics" was meant to seem less like an ominous Internet takeover, but even this effort has had problems.[206] The lofty intentions of connectivity have met the harsh reality of humanity's dark side. Free Facebook in Myanmar has been blamed for fanning the flames of the Rohingya population genocide, with reports claiming Facebook had been pulled from the nation, as a result. Other Facebook-fueled hate outbreaks have been reported in Cambodia, the Philippines, and Sri Lanka.[207] In many of these nations, Facebook has been seen as a way to get news without the bias of government affiliation, so the problem of fake news and hate speech may even be more influential in such populations.[208] Facebook has claimed that it's Internet.org efforts have connected over 100 million people to the Internet,[209] but what were likely well-intentioned efforts also exposed unseen and unintended consequences that can often accompany technology use.

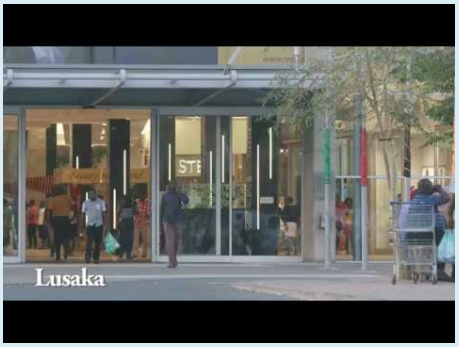
Stay tuned, as Zuckerberg enters his thirties, it looks like he's just getting started.

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Internet.org Users in Zambia

Hear from a diverse group of Internet.org users in Zambia on how the service has impacted their lives.



View the video online at: http://www.youtube.com/embed/zS6xBV4ZwZY?rel=0

Key Takeaways

- Facebook empowers its engineering staff to move quickly, at times releasing innovations before they are perfect. The hope is that this will foster innovation and allow the firm to gain advantages from moving early, such as network effects, switching costs, scale, and learning.
- While moving early has its advantages, Facebook has also repeatedly executed new initiatives and policy changes in ways that have raised public, partner, and governmental concern.
- Word of mouth is the most powerful method for promoting products and services, and Beacon was conceived as a giant word-of-mouth machine with win-win benefits for firms, recommenders, recommendation recipients, and Facebook.
- Beacon failed because it was an opt-out system that was not thoroughly tested beforehand and because user behavior, expectations, and system procedures were not completely taken into account. Partners associated with the rapidly rolled out, poorly conceived, and untested effort were embarrassed. Several faced legal action.
- Facebook also reinforced negative perceptions regarding the firm's attitudes toward users, notifications, and their privacy. This attitude served only to focus a continued spotlight on the firm's efforts, and users became even less forgiving.
- The fake news crisis is motivated by various bad actors, including those seeking to make money by attracting users to fake news sites that make money by running advertising, to the consorted effort identified in the US indictment of Russian interference in the US election. Similar efforts to interfere with politics have been uncovered in other regions of the world.
- Facebook was slow to acknowledge the extent and impact of fake news and its possible influence on the 2016 US election. The firm has subsequently experimented with several efforts. Flagging content as fake actually increased the intensity of sharing. The firm also enlists third-party fact-checking organizations and artificial intelligence, and demotes news deemed deliberately deceptive. The firm has also increased steps to close and prevent fraud accounts, stop advertising linked with fake news sites and accounts, and prevent organizations with a track record of misinformation from using Facebook's advertising and targeting tools.
- Global growth is highly appealing to firms, but expensive bandwidth costs and low prospects for ad revenue create challenges akin to the free rider problem.
- Despite concern, Facebook is investing in new technologies and access services that promise to dramatically lower Internet access barriers, with a goal to bring billions of customers online. Consumers not only represent potential ad revenue growth as markets

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develop and incomes increase but also entirely new product lines, such as mobile banking, may emerge from within emerging markets.

- Most of the world's population live within cell tower range or near other means to access the Internet. Cost, compelling content, and technical issues to make services available on low-end hardware are the three main factors that conspire to limit Internet use.
- Many have criticized Facebook, Internet.org, and the set of services branded as Free Basics, as violating principles of net neutrality and extending Facebook's walled garden as a de facto proxy for the Internet; however, Internet.org has opened their services to any provider that can meet a basic set of criteria, and claims that its efforts have provided free access to over 100 million people worldwide.
- Providing technology can sometimes lead to tragic unintended consequences. Facebook has been identified as a tool used to spread hatred and violence against the Rohingya people in Myanmar, as well as in Cambodia, the Philippines, and Sri Lanka.

Questions and Exercises

1. At Facebook, why is "done better than perfect," and why is it considered important to "move fast and break things"?
2. What was Beacon? Why was it initially thought to be a good idea? What were the benefits to firm partners, recommenders, recommendation recipients, and Facebook? Who were Beacon's partners, and what did they seek to gain through the effort?
3. Describe the biggest problem with Beacon. Would you use Beacon? Why or why not?
4. How might Facebook and its partners have avoided the problems with Beacon? Could the effort be restructured while still delivering on its initial promise? Why or why not?
5. Beacon shows the risk in being a pioneer—are there risks in being too cautious and not pioneering with innovative, ground-floor marketing efforts? What kinds of benefits might a firm miss out on? Is there a disadvantage in being late to the party with these efforts as well? Why or why not?
6. What is the motivation behind the spread of fake news? Where does it come from and why has it been shared?
7. Have you seen fake news on Facebook? Were you able to tell it was fake news at the time? Have you seen others share fake news?
8. What problems has Facebook experienced when trying to address the problem of fake news? How is it using human beings and technology to address the problem? Investigate the firm's current attempts to curtail negative content online, and share the results with your class.
9. How did Facebook localize its site so quickly in various different regions of the world?
10. What factors encourage firms to grow an international user base as quickly as possible? Why is this a risk, and what is the so-called international paradox? What sorts of firms are at more risk than others?
11. List the pros, cons, and unknowns if Facebook were to seek a way for the Chinese government to allow its expansion into China. What are the risks if the firm remains out of the country? What do you think the firm should do?
12. How is Facebook seeking to reach the next billion Internet users? What technologies and service offerings is the firm hoping to leverage? How might the firm make money off of such users?
13. Do you agree with Mark Zuckerberg that "connectivity is a human right"? Why or why not? What goal do governments and the private sector aim for in helping empower disenfranchised populations?
14. What are the benefits of offering Internet.org to low-income users worldwide? What are the concerns? Do you think Internet.org should be welcomed, halted, or limited with constraints? Be prepared to discuss with your class.
15. What problems have accompanied Zuckerberg's initially promising goals for Internet.org? Investigate the current state of what Facebook is doing to curtail its use as a platform to

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spread violence. Is it working? What lessons can you learn, as a manager, when rolling out products in a way that may avoid Facebook's missteps and problems?

16. So you've had a chance to learn about Facebook, its model, growth, outlook, strategic assets, and competitive environment. Do you think the firm will dominate in the future or be swept aside by technology's relentless advance? Why?

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CHAPTER 12

Rent the Runway: Entrepreneurs Expanding an Industry by Blending Tech with Fashion

12.1 Introduction

Learning Objective

1. Understand the Rent the Runway model and how the founders thought they could build a tech-fueled business model to expand the market for high-end fashion.

There were serious problems in the fashion industry and Jenn Hyman and Jenny Fleiss knew it. Younger fashion fans were rabid for well-known designers but rarely could afford them. Designers wanted to reach the elusive younger demographic, too. They may be cash-strapped now but they also represent potentially lucrative lifelong customers. On top of this, social media was putting even more pressure on women to "wear something new" that hadn't already appeared in their Facebook and Instagram photos, making the problem of a full closet with nothing to wear even more acute.

Their solution is the fashion rental powerhouse, Rent the Runway—a firm that is recasting the relationship many women have to high-end fashion by delivering value to everyone who sees this hurt. The *New York Times* calls the firm "Netflix for Fashion."[1] Forbes calls it "Catch and Release Couture,"[2] and many of the firm's 9 million customers[3] call it a fairy godmother that makes "Cinderella moments" happen. Rent the Runway delivers selection, convenience, value, and quality in a way that millions of women see as the best option for dressing to dazzle, but the firm has expanded far beyond the initial target of young consumers, and a sole focus on event rentals. An additional fast-growing subscription business offers a "closet in the cloud," with an emphasis on fashion for work. The firm has opened showrooms coast to coast, and its leadership in logistics is providing smarts to brands eager to leverage learning from the leader.[4]

FIGURE 12.1 Rent the Runway
Jennifer Hyman and Jenny Fleiss, founders of Rent the Runway.



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Rental and Subscription: Here's How it Works

Consider the firm's two major business lines as rental and subscription. Event rental is now branded as Rent the Runway Reserve, and customers browse the Rent the Runway site, select a dress (or other clothing item or accessory), and schedule a delivery date for a four-day loan (eight-day rentals are available for an added fee). Rentals are often only 10 percent of a dress's retail price.[5] That's like getting high-end designer garments at a fast-fashion price. Need help narrowing options or selecting a style? Stylists are available for phone calls, e-mails and online chat. Rent the Runway will send two sizes to make sure you receive a dress that fits. Customers who are on the fence about a choice can choose a second style as a backup for an additional fee. Items arrive in a branded garment bag that the customer can keep. The company uses reusable garment bags for shipping both ways.

The Rent the Runway subscription brands come in Unlimited and Update flavors and are targeted at work and weekend wear. Unlimited, at $159 a month, allows customers to continually rotate four fashion items from a massive selection of tops, skirts, dresses, and accessories, and over 450 brands. The Update model starts at $89 a month, has fewer brands, and limits shipments to four a month (vs. Unlimited's constantly available rotation). Build a queue of favorites and send back an item when you want something else, or purchase an item you want to keep.[6] In an age where Uber, Airbnb, and Spotify change how we think about owning automobiles, homes, and music, Rent the Runway is going right after your closet.

Rental and Subscription: Here's How it Works

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A Fashion Company with a Technology Soul

The model sounds straightforward, but execution is astonishingly complex. This is a massive e-commerce company where 100 percent of the inventory is returned, needs to be inspected, cleaned, pressed, possibly mended, then packaged up for good-as-new send-out to the next precisely sched-

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uled customer order.[9] The stakes are especially high in the events-focused rental business. Get this wrong and you've likely ruined an event that was weeks in the planning. Get it right and the client experiences the holy grail of business: full-blown customer delight. A woman is often wearing Rent the Runway at a time when she looks her best, her hair and makeup are done, she's with friends, and she's at a fantastic party where she's showered with compliments. Says co-founder Fleiss (who now runs Code Eight, a startup operating in Walmart's Store No. 8 incubator),[10] Rent the Runway "empowers women to feel confident and beautiful for the most memorable moments of their lives."[11]

The only way to pull this off is to build, as CEO Jenn Hyman puts it, a "fashion company with a technology soul."[12] Look beyond the exquisite, high-end fashion lovingly delivered to delighted customers and you'll see a massive, ultra-complex, precision-scheduled reverse logistics business, with deep industry partnerships, world-class analytics, a growing mobile- and social-enabled model that encourages return engagement, and more.[13] The complexity of the business helps keep away the competition; and competitive assets that include brand, scale, partnerships, and data are all strengthened the longer the firm operates. The firm's expertise is opening new opportunities to provide smarts and services to brands anxious to evolve their businesses to keep pace with customer expectations and habit changes. Says Juliet de Baubigny, a partner at venture firm Kleiner Perkins, a company that has invested in scores of tech firms, including Google, Twitter, Snapchat, Spotify, and Uber: "We didn't back [Rent the Runway] as a fashion startup. It's the sharing economy meets the Facebook–Instagram generation."[14]

Rent the Runway Co-Founder and CEO Jennifer Hyman at the Code Commerce Conference

Interview with Rent the Runway co-founder and CEO Jennifer Hyman at the Code Commerce Conference, March 2017.



View the video online at: http://www.youtube.com/embed/ar5I1hDZrrQ?rel=0

Key Takeaways

- Rent the Runway is a highlight of the sharing economy, enabling consumers to rent designer clothes and accessories at a fraction of the retail price. The firm also offers a subscription service where consumers can choose fashion items to keep indefinitely or swap out for new items whenever they want.
- The firm's CEO and co-founder, Jenn Hyman, describes the firm as a "fashion company with a technology soul." The firm leverages mobile, social, big data, and advanced tech-enabled logistics to deliver on the promise of "Cinderella Moments."

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Questions and Exercises

1. What sorts of customers was Rent the Runway designed to appeal to? Do you think these are the only customers who would find the model appealing? Why or why not?
2. What challenges do you think the entrepreneurs faced in going from idea to implementation? What challenges are customer-focused? Which are supplier-focused?
3. Have you or has anyone you know used Rent the Runway? If so, describe your experiences or interview a friend who has experience and share this with your class. If you can't find anyone who has used the firm, interview women you know and ask them if they've heard of the firm and what they think of the firm's offerings, and report back on their thoughts as well as why they would or wouldn't use the effort. What do these responses tell you about growing a new venture?

12.2 Founding the Business: Are We On To Something?

Learning Objectives

1. Recognize key entrepreneurship and product development concepts of product/market fit, minimum viable product, and customer lifetime value.
2. Understand how the entrepreneurs behind Rent the Runway went about testing and refining their business thesis to gain confidence in their idea and approach.
3. Identify potential issues with customer and supplier perception, and how Rent the Runway counteracts these concerns.

Time magazine has called Rent the Runway one of the country's 50 Best Websites,[15] and Jenn Hyman and Jenny Fleiss have been named to Fast Company's list of Most Influential Women in Technology,[16] *Inc.* magazine's 30 Under 30,[17] and *Fortune's* list of Most Promising Women Entrepreneurs,[18] yet all this started when both women were still in their twenties, hadn't yet finished their MBAs (both were students at Harvard), and had little fashion industry or technology expertise.

The "light bulb moment" that sparked the idea for the firm happened when Jenn Hyman's younger sister showed off a $2,000 Marchesa dress she'd bought for a wedding she'd be attending. For a young woman fresh out of college, price tags like that represent a big chunk of one's salary, spent on an item that has a limited shelf life. And yes, she had a full closet, but complained of nothing to wear. Blame Facebook, the outfit killer.[19]

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Hyman teamed up with classmate Fleiss to immediately explore **product-market fit**—the idea that they were crafting a solution the market wants, one that customers are willing to pay for, and one that'll scale into a large, profitable business. The first step wasn't about building a website or a logistics system, it involved running low-tech tests to prove that they were really on to something. These tests amounted to quickly developing what entrepreneurs often call the **minimum viable product (MVP)**, a bare-bones offering that allows the team to collect customer feedback and to validate concepts and assumptions that underlie the business idea.[20] If concepts don't work out, the founders want to know early so they can **pivot**, or alter their product offering, business model, or target market in hopes of crafting a more viable business. There were lots of unknowns: Would women want to rent dresses? Would they return dresses in decent shape so they could be rented again? Would they rent from a website and trust delivery and product quality?

One test involved purchasing 100 dresses and setting up a popup rental shop for college students.[21] Hyman watched one undergrad slide into a silver-sequined Tory Burch minidress, twirl in front of the mirror and cry out to friends, "Oh my God, I look so hot!"[22] Initial evidence of customer interest and delight? Check! Later tests investigated how much customers were willing to pay, and verified that women were willing to rent from a photo even if they couldn't try the product on first (in true MVP style, tests were conducted with PDF photos rather than building a full-blown website).[23] All this helped provide confidence in their concept and armed the founders for making a persuading pitch to investors.[24]

product-market fit

A key concept in entrepreneurship and new product development that conveys the degree to which a product satisfies market demand. Successful efforts should be desired by customers, and scale into large, profitable businesses.

minimum viable product (MVP)

A bare-bones offering that allows entrepreneurs and product developers to collect customer feedback and to validate concepts and assumptions that underlie a business idea.

pivot

Altering a product offering, business model, or target market in hopes that the change will lead to a viable business.

Customers Like It—But What About Suppliers? Growing the Customer Base and Creating a Win-Win

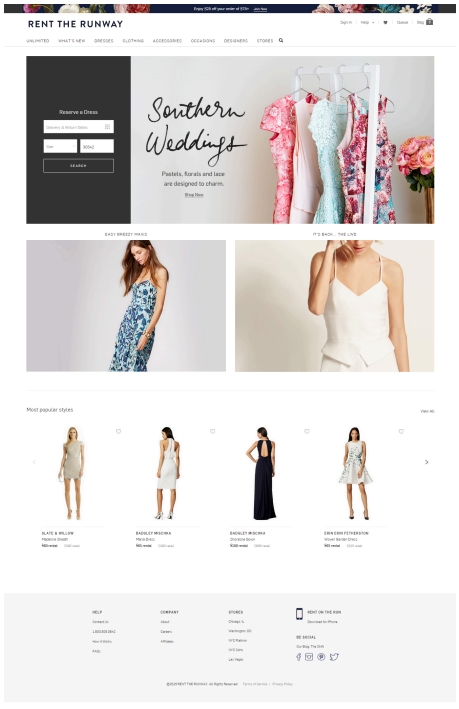
Rent the Runway needed to buy from designers in bulk, and at a discount, in order for the model to work. But designers needed to be convinced it was worth taking a risk on two women with an unprofitable fledgling business and little direct domain experience. Some designers were initially concerned that rental would dilute their brand. Many also feared that rental would cannibalize retail sales.[25]

Being effective stewards of designer brands has always been important at Rent the Runway, and the care with which the firm showcases designer products extends from website to packaging. "We try to be brand ambassadors for the designers," says Hyman.[26] One way the firm does this is through landing pages dedicated to each designer. These include photos and bios, which educate women about individual brands and convey product quality, especially important for the new customer who may be migrating from fast-fashion retailers like Zara to high quality couture.[27] Stylists are also highly trained at effectively communicating garment quality and artistry. Shipped dresses arrive in customer homes nestled in a quality garment bag, not unlike if it were purchased in a store.

Rather than cannibalizing sales, Rent the Runway is now seen by many designers as a vital partner: an experiential marketing channel that introduces high-end designer brands to new customers. Rent the Runway clients are about a decade younger, on average, than the typical department store patron.[28] And while most e-commerce shoppers buy brands they are already familiar with, 98 percent of Rent the Runway customers rent brands they've never bought before.[29] With rental, women are more likely to experiment more heavily with different styles and colors. For example, yellow was recently the most popular color across a year's worth of rentals.[30] The halo effect from a positive experience

FIGURE 12.2 Rent the Runway Website

The Rent the Runway website helps deliver high value and high fashion to millions of women.



Source: © Rent the Runway.

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renting a designer's more daring dresses may prompt a woman to purchase more frequently worn staples like a little black cocktail dress or accessories.[31] Some designers are now even testing new looks on Rent the Runway, while others are developing exclusive lines for the site.[32]

Technology also helps Rent the Runway improve customer service over time. A customer will browse and visit a website much more frequently than she'll visit a store, and this helps develop keen insights on her preferences. What is she paying attention to? What does she return to but hasn't yet rented? How are her tastes evolving, and are these reflected in market, demographic, and regional trends? The firm also meets with each designer several times a year to learn concerns and share ideas.[33] Today, Rent the Runway carries apparel and accessories from over 550 brands, attracting customers and further delivering the scale and reach that designers wouldn't get solely through conventional sales channels.[34]

Customer Evolution

While the model was proven on cash-strapped college students, the firm's understanding of its target customer has evolved. The average Rent the Runway customer is actually someone who can afford to buy the dress. Average customer income is around $100,000.[35] For these savvy, affluent consumers who value experiences ahead of ownership, Rent the Runway is the smartest, most convenient way to shop.

customer lifetime value

Sometimes abbreviated as CLV, CLTV, or LTV. Refers to the current value of future profits that will accrue from acquired customers. CLV = NPV (future customer profits).

While customers skew affluent, the young customer who gets hooked on the fashion rental experience may very well become a Rent the Runway lifer, delivering up what marketers refer to as high **customer lifetime value**. Someone who has a good first experience at prom rental will move on to college events, graduate to weddings and engagement parties, use the firm for holiday parties or society events, rent a bridal dress, and use the site for high-end maternity fashions when baby is on the way.

And many of the customers who start with rental are moving on to subscription. Ninety-eight percent of women who use the subscription are working women who would otherwise spend thousands of dollars getting dressed for work each day. Once a woman has signed up for and is satisfied by the subscription service, she's likely to remain a customer for a long time, sliding into an even more lucrative tier of customer lifetime value. Hyman points out how satisfied Amazon customers remain loyal Amazon Prime members and sees similar behavior in her subscription business.[36]

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Customer Lifetime Value

The concept of customer lifetime value (sometimes abbreviated as CLV, CLTV, or LTV) is vital when planning a profitable business. The idea is to predict the value of future profits that will accrue from acquired customers, so CLV is often stated as the **net present value** (NPV) of future profits from the customer relationship. It's an easy concept to state, but a much trickier one to predict, especially in a new industry that redefines customer relationship and engagement. Firms (especially new ones) don't really know how long a customer will remain with the firm (i.e., **churn rate**), how much it costs to maintain a customer, what is a reasonable rate for discounting the value of future profits into today's dollars, and how customer purchases will change over time, especially as tastes and product offerings evolve.

One key consideration is **customer acquisition costs**. The cost to acquire a customer must be less than reasonably estimated customer lifetime value (i.e., it should cost you less to bring in a customer than the value that customer will eventually return to your business). The greater this gap, the more profitable the customer.

Customer Acquisition Costs < CLV = NPV (future customer profits)

For all firms, but especially early-stage startups, low customer acquisition costs can be critical. Customer word-of-mouth and social media all help keep acquisition costs low. And firms more likely to generate repeat customers will see a CLV boost—key, since that regular cash flow is what's going to keep you in business!

net present value

The value of future cash flows discounted into today's dollars (it is discounted because a dollar today should be worth more in the future assuming inflation or the potential to earn money on the dollar if it is invested).

churn rate

The rate at which consumers leave a product or service.

customer acquisition costs

The amount of money a firm spends to convince a customer to buy (or in the case of free products, try or use) a product or service.

Key Takeaways

- The idea from Rent the Runway came from observing how an existing market was underserving a family member and other young women.
- Many uncertainties existed, and co-founders Hyman and Fleiss addressed these by launching a series of experiments to test product/market fit. They did many of these experiments with minimum viable products: running popup rental shops on college campuses, and sharing PDFs with potential customers to see how women would respond to the prospect of renting without seeing and trying on a garment.
- Many supplier uncertainties existed, as well, but the firm worked closely with suppliers and demonstrated that they could actually grow the market and create a channel for reaching customers with a potential for high customer lifetime value.
- The co-founders have discovered that the model appeals not just to young, cash-strapped women, but to all women who seek convenience and value and who are interested in more broadly sampling high-end fashion.
- The firm has expanded into subscription fashion, as well, providing clothing and accessories for a monthly fee. Subscription is a continuous, predictable, reliable revenue stream yielding even stronger customer lifetime value, and the firm's rental business provides an acquisition channel for the subscription business.

Questions and Exercises

1. How did the founders of Rent the Runway go about testing their original idea? Why was their approach especially efficient and useful when compared to building and deploying a website ready for a full launch?
2. What unknowns and concerns existed with respect to customer engagement with the concept? How did Rent the Runway's founders dispel these concerns?

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3. What concerns did suppliers and designers have? How did Rent the Runway's founders dispel these concerns? Describe how the firm seeks to build deep and mutually beneficial industry partnerships.
4. How does the subscription business complement the rental business? Does a customer for one increase or decrease the likelihood of using the other? How might CLV differ among these two business lines?

12.3 Customer Engagement (Mobile, Social, and Physical Storefronts)

Learning Objectives

1. Understand how mobile and social are exceptionally useful for a firm like Rent the Runway.
2. Recognize why, although Rent the Runway is an e-commerce firm, it also benefits from having storefronts.

Mobile

As with many new efforts, the biggest challenge to adoption comes not from a given competitor, but rather from inertia. Firms need to develop ways of getting customers to try their experience, reengage, and experiment with new offerings. While Rent the Runway began on the Web, customer engagement via mobile is vital for the firm's future. Mobile represents even more customer convenience. Booked a calendar item on your phone? The same device can be used to select a dress and reserve it for the big event. A woman who has downtime and a smartphone can browse whenever she'd like; the phone is an always-open store with fresh looks constantly being added. The firm's emphasis on mobile is clearly showing success. Shortly after Rent the Runway launched its first mobile app, mobile spiked to over 40 percent of firm traffic, and continues to rise.[37]

Despite the success of mobile, as mentioned in the Facebook chapter, many experimental features and A/B tests are more easily conducted on the Web. Changes on a firm's website are immediately available to all users the next time they visit the site, and it can be easier to run experiments by showing new features and design changes to a subset of users who access the site via a browser. For mobile apps, users may have to download a new version of the app, problems take longer to fix, and updates take longer to distribute for wide use.

Social

The mobile device isn't just the store—it's a world-connected camera to capture and share looks and fuel up a hyper-viral word -of-mouth machine leveraging the firm's biggest fans as its most persuasive marketers. As we've seen in other chapters, mobile is the key gateway to social.

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Referrals matter. Rent the Runway sees a 75 percent higher conversion rate from friend referrals than from other marketing methods.[38] Experience from other retailers suggests that friend referrals result in better customers, as well. Online home goods retailer One Kings Lane reports that customers brought in through friend referrals have a customer lifetime value two times greater than those arriving from other channels.[39] Among friends, dress commentary is often the first icebreaker: "You look so good! What are you wearing?" "Oh, I Rented the Runway—have you heard of them?" Venture capitalist Aileen Lee of Kleiner Perkins refers to the value of referrals in encouraging trial and purchase as **social proof**—positive influence created when someone finds out that others are doing something. And of course, social media magnifies the potential reach and impact of social proof.

social proof

The positive influence created when someone finds out that others are doing something.

Executives noted that Rent the Runway's Facebook page was a traffic magnet on Mondays. Women would post glowing, positive experiences with the firm, and they were changing their profile pictures to recently taken photos of them decked out in Rent the Runway dresses.[40] When it became clear that customers loved sharing their experiences online, the firm launched photo reviews on the Rent the Runway website. At first this seemed a bit risky. Would customers consider it icky to see other women in their dresses? Would there be inappropriate comments? It turns out the community was much more altruistic and supportive—pretty much the opposite of what one finds in YouTube comments. Any woman can submit a photo, the firm only screens for nudity and offensive images. These images are linked to the "Find Women Like Me" tool, which allows women to enter key parameters: height, bust size, dress size, and age, then comb through thousands of images to show social proof in the form of what real women are wearing. Members can also post questions to the women in the photos. Examples: "What heel height did you wear with that? Did you wear Spanx? Will that work as a maternity dress?"[41] Women who have viewed a user-generated photo are 200 percent more likely to rent than those who have viewed a product photographed on a model.[42] Rent the Runway has an ever-tuned ear to the customer, and has leveraged social in other ways, including Twitter chats and style councils held on Facebook, seeking input on straight-from-the-catwalk couture.[43] Blogs are another way that user-generated content helps spread the word with lower costs and higher effectiveness. Customers arriving at the site via the earned media of a fashion blog have a 200 percent higher conversion rate than customers arriving via the **paid media** of search engine ads.[44] As a result, most of the firm's online growth is organic, with over 90 percent of new customers acquired via word-of-mouth (or the digital equivalent).[45] Rent the Runway does very little paid advertising.

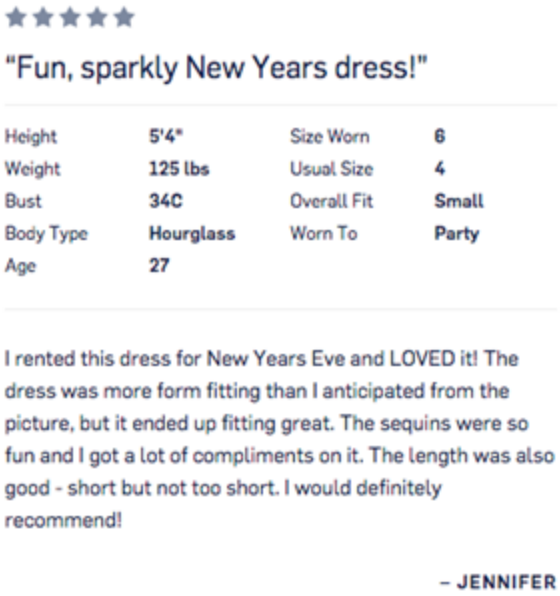
paid media

Refers to efforts where an organization pays to leverage a channel or promote a message. Paid media efforts include things such as advertisement and sponsorships.

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FIGURE 12.3 Rent the Runway Review
This sample customer comment on Rent the Runway shares that the dress reviewed is suitable for New Year's Eve, offers details on fit and length, and includes additional information about the sequin detailing.



Source: © Rent the Runway.

Social not only helps spread the good word about Rent the Runway; as mentioned earlier, it also helps fuel business demand. The firm's CEO has stated that today's Internet "creates pressure for women. Now you can't repeat outfits because your friends have seen that outfit on social media. As ridiculous as that sounds, that is what drives our business."[46]

Physical Retail—When Brick and Mortar Has a Role in an Online Business

At Amazon, being an Internet pure-play without physical storefronts brings clear advantages. Eliminating stores creates labor, real estate, energy, security, inventory, and other cost efficiencies that flow right to the bottom line. Pure play works for Amazon because, for the most part, the firm sells commodity products that users are already familiar with and don't need to experience before feeling comfortable making a purchase.

Providers of experience goods, however, may need to spend more effort convincing customers to try their offerings. Any highly differentiated products that may be unfamiliar to consumers might be able to benefit from in-person customer engagement. This was the idea behind the Apple store. Apple products offered at the Apple store give firm-trained employees an opportunity to present features and advantages of the company's unique products, demonstrate how they work together, and offer free on-site customer support. For Apple this formula has resulted in the single most successful retail chain in the United States on a sales-per-square-foot basis, dwarfing not just consumer electronics categories, but also clothing retailers, high-end jewelers, and everyone else.[47]

Rent the Runway's move into physical retail locations allows the firm to continue to offer online efficiencies for most of its customers, but it also creates an opportunity for some customers to have a high-touch in-person experience. According to Hyman, this can be especially important for "serving up a new customer behavior like renting clothes."[48] The physical retail experience can attract new customers, while underscoring the merits of the model and laying the groundwork for an enduring customer relationship that can shift online over time. A similar expansion into

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physical stores is also happening at clothier Bonobos and eyewear firm Warby Parker, both fashion-centric retailers that started online.[49]

Rent the Runway's stores are focused on customized, high-value customer engagement. Customers go online to book an appointment with an in-store stylist, and technology is leveraged to enhance the store visit. Customers give information in advance on the type of event they're planning to attend and they can share additional information that might allow stylists to pull product for their appointment and be best prepared for their arrival. The firm charges for booked appointments ($25 for single-event styling, $40 for longer, multiple-event appointments), but also allows walk-ins, as available. If a customer tries on ten dresses and likes several, this is data that can be used for later targeting and customer-focused follow-up, personalizing online shopping and e-mail marketing with styles she's most likely interested in. Stores also act as a way to offer a fit guarantee, and can function as mini-distribution centers with same-day rental of certain styles, plus dress pickup and dropoff. The high level of service offered by the firm prompts Hyman to quip, "We're more like a hotel company than a fashion company."[50] And for customers that are local, Rent the Runway retail can replace a last-minute department store run. Since an estimated 30 percent of purchases at retailers like Zara and H&M are for a last-minute need, the retail footprint means Rent the Runway can compete to capture sales from fast fashion, too.[51]

Retail was rolled out cautiously, with a limited MVP experience offered at the firm's South Village, Manhattan headquarters. A second physical retail trial was conducted in carve-out space inside the Fifth Avenue store of accessory retailer Henri Bendel (Bendel's was a good initial partner. The store didn't sell dresses, so it didn't fear sales cannibalization, and Bendel's could benefit from increased traffic).

With the concept proven, Rent the Runway moved out of Bendel's, and now has several standalone stores in locations that include New York, Washington, DC, Chicago, and at the Cosmopolitan Hotel in Las Vegas (Rent the Runway has also experimented with popup shops and a mobile road tour).[52] The firm also has a 30,000 square foot shop inside a San Francisco Neiman Marcus. While renting dresses inside a firm that sells them may seem risky, the average RTR client age is 29 compared to 51 at Neiman. It's hoped the move will bring in an entirely new customer base to Neiman, and perhaps have them stick around and shop for everything from makeup to accessories.[53] Customer rental patterns differ by location. A DC client will come with her calendar app open, planning for formal events throughout the year, while the Vegas customer is more likely to walk out with a dress to wear that evening (one goal: allow clients to go on vacation without packing a suitcase[54]). Even with these differences, each in-store engagement is an opportunity to delight the customer and gather data to strengthen the relationship so that she can be turned into a loyal, regularly renting client.

Retail-accessible inventory is also helping the firm with greater turnaround efficiencies. New York customers were the first to benefit from same-day service. Order product by noon and you're guaranteed to get it by 5 pm.[55] And retail is becoming a location where subscription customers can drop by, drop off selections they're done using, and walk out with new items. iPad kiosks integrated with inventory allow subscribers to pick up an item, scan it themselves, and head home with pieces for a new look[56]—fashion that's so fast it's nearly frictionless. While retail has been successful for all of the reasons outlined above, Hyman envisions there being fifteen to twenty destination-style Rent the Runway retail locations in major metropolitan areas, not hundreds that a major retail brand would have.[57]

Key Takeaways

- Mobile is an always-on store that encourages users to browse and engage with the site.
- Mobile also allows the firm to collect additional, valuable data on each user so that it can better understand her preferences and interests.

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- The mobile camera and calendar also integrate with Rent the Runway—allowing for scheduling and social sharing.
- Social media "kills" outfits, heightening interest in the kind of efficient, high-quality wardrobe rotation that Rent the Runway offers.
- Rent the Runway has leveraged the concept of social proof to spread the word about the firm, encourage others to sign up, and help customers gain additional information so that they can overcome inertia and rent a dress.
- Storefronts make sense when products are novel and customers may need additional education to help them get over inertia and actually try the new firm's offerings. Rent the Runway storefronts also act as mini-warehouses and additional points to gather experience-enhancing customer data.

Questions and Exercises

1. Why is mobile especially important to Rent the Runway? How are customers using mobile devices to engage with the firm?
2. How has the rise of social media helped Rent the Runway?
3. What concerns do firms have when encouraging customers to socially share and publicly engage a brand online? Describe Rent the Runway's experience. Do you think this is typical or unique? Why?
4. In what ways do retail storefronts help the firm? In what ways are Rent the Runway stores like Apple stores?
5. It's been suggested that younger consumers spend less on fashion and prioritize experiences like food and travel. Do you think this is the case? What do these trends mean for retailers? Is Rent the Runway in a position to capitalize on or be hurt by these trends?
6. Research examples of firms that have created new store-based retail experiences like Bonobos and Warby Parker, where customers shop in a smaller footprint store, but get items shipped to their home address. Have you visited a firm like this? How was your experience? How have these firms fared regarding recent growth and expansion? How do these experiences mesh with a firm's online offerings?

12.4 Data

Learning Objectives

1. Recognize the many ways that data can be collected and leveraged to enhance the Rent the Runway business model.
2. Understand the concept of agile software development and why it is important to Rent the Runway and the many other firms that practice this approach.

It was clear from the start that data would be the lifeblood of the business. The firm's chief analytics officer was one of the firm's first hires,[58] and the team now includes top talent who honed their skill at Oracle, Netflix, and other data-crunching champs.[59] Consider the potential of data to drive efficiencies throughout the firm's unique value chain. When sourcing product, data helps uncover demand patterns—how popular are long dresses, short dresses, colors, designers, and styles? The firm can also gain a sense of how trends change over time by season, geography, and demographics.

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For operations, data exposes bottom-line impacting variations such as, how long do certain materials last, how prone are they to needing repair, and how does this impact cost and any prep delay before certain types of dresses can be sent out again?[60] Analytics have helped inform the length of a rental period, expectations on turnaround time, slack inventory needed to cover for any dresses not returned on time, methods that can encourage on-time returns, selection of optimal shipping partners, the locations of the firm's warehouse and stores, and much, much more.[61]

The website and mobile app can then track online engagement and deliver a host of customer metrics—where a customer clicks, what she's searching on and which products she's returning to. Hyman quipped during one interview that customers queueing up maternity fashions tell the firm they're pregnant before friends and family.[62] Outside the website and mobile app, analytics inform which e-mail campaigns are working; how Facebook, Pinterest, Twitter, Instagram, and other social media drive traffic; and what sorts of other marketing campaigns are most effective. The firm's recommendation engine is continually refined, not just for dress suggestions, but also as feedback is gathered on the conversion rate for accessories and other products offered for purchase.[63] Customers provide additional feedback on dress fit, comfort, and other satisfaction indicators. A/B testing is used to continually refine the firm's approach through constant experimentation.[64] More data will also provide even more insights on fit for a given body type—nudging customer satisfaction even higher.[65] All of this underpins an evolving personalization engine that presents products you're most likely to be interested in.

Like Uber, the airline industry, hotels, and other service providers with limited inventory and varying demand, Rent the Runway also leverages analytics for **demand pricing**.[66] A hot summer dress available in limited quantities may be priced higher from May to August, but data will also help expose value in underutilized inventory a customer is most likely to be interested in, maximizing return from the firm's vast dress library.[67]

demand pricing

Pricing that shifts over time (also known as dynamic pricing), usually based on conditions that change demand (e.g., charging more for high-demand items with limited availability).

agile software development

A systems development method in which requirements and solutions rapidly and iteratively evolve through collaboration between self-organizing, cross-functional teams, rather than a top-down, centrally managed, schedule-driven approach.

continuous deployment

A software development approach where an organization's developers release products, features, and updates in shorter cycles, when ready, rather than wait for centrally managed delivery schedules.

Geek Up, Get Agile, and Innovate Faster

As nontechnical founders, Fleiss and Hyman have nonetheless gained insight into ways to build key firm skills. Software development was initially outsourced, but it was quickly shifted in house as the firm was able to expand its technical team—vital, since Rent the Runway's custom-built systems underpin the firm's competitive advantage. To help inform technology decision-making, the firm's founders went to tech meet-ups, searched out engineers to chat up and recruit, and read widely—everything from software development books to coder blogs.[68]

Rent the Runway is one of the many practitioners of **agile software development**, a systems development technique that leverages cross-functional, self-organizing teams designed to rapidly leverage business knowledge and software development skills.[69] The new reality of software development has business people working in tandem with coders and system architects on continued innovation, iteration, and refinement, further underscoring the importance of tech in all careers.[70] Rent the Runway also practices **continuous deployment**, allowing the firm to have shorter release cycles on software updates.[71] This helps Rent the Runway rapidly push out bug fixes and new features when they're ready for release, rather than waiting for a slower-moving, centrally managed schedule.[72] One finds these techniques, which foster more autonomy and collaboration in software development, in use by many tech leaders, including Etsy, Facebook, Google, and Netflix.[73] At Rent the Runway, this is the kind of practice that's vital for a fast-paced startup that's inventing the future of commerce. Find out more about agile and related topics in the "Software Development Methodologies" section of the chapter "Understanding Software: A Primer for Managers."

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Key Takeaways

- Rent the Runway can collect data from mobile and Web use, from interaction on its own websites and mobile offerings, and from social media.
- Operations also offer a wealth of insight that can help Rent the Runway cut costs and better serve its customers.
- Data informs all sorts of aspects of the business, including dress, designer, and material durability; designer and style popularity; shipment priorities; shipping pricing decisions; warehouse worker scheduling; product and service refinement; pricing; and more.
- At Rent the Runway, technologists work closely on iterative product development with members of other business teams to iteratively develop, test, and refine new concepts. This helps the firm produce more products more quickly that more fully take into account the needs of the business and its customers.
- Agile also helps the firm with continuous deployment, a method that lets Rent the Runway (and other practitioners of this approach) introduce software updates as needed and when they are done, as opposed to waiting for centrally managed schedules.

Questions and Exercises

1. In what ways is data collected at Rent the Runway?
2. How does data enhance the customer experience?
3. How does data enhance firm operations? How does it help cut costs and improve efficiency?
4. How does Rent the Runway price product? What other firms use this approach and why?
5. Describe the concepts of agile software development and continuous deployment. Why do they make sense in an entrepreneurial environment like Rent the Runway? What do these techniques imply about the skills set of technologists and managers?

12.5 Operations and Logistics

Learning Objectives

1. Understand and appreciate the scale and breadth of the operations and logistics business that Rent the Runway needs to run its business.
2. Recognize the critical role that technology plays in implementing this model.

A significant part of the firm's technology use and data analytics ends up focused on an operations and logistics model that is, at its core, people moving product—a one-of-a-kind orchestration of luxury good selection, cleaning, repair, packaging, shipping, return, and inspection that's executed over and over again. No one has done anything like this at the scale of Rent the Runway. Consider that the firm's Secaucus, New Jersey, distribution center, about the size of two football fields, isn't just the firm's primary warehouse; it's the largest single dry cleaning operation in the United States.[74] The firm's expertise in building one center makes expansion that much easier. It's new 300,000 foot, 600-employee center north of Dallas will offer speedier service to West Coast fashionistas.[75]

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Inside a Rent the Runway "Dream Fulfillment Center"

This video allows you to look inside a Rent the Runway "Dream Fulfillment Center."



View the video online at: http://www.youtube.com/embed/Lze7kDXAqEQ?rel=0

Extremes also apply to the Rent the Runway distribution center workweek. Most of the events that prompt client rentals occur on the weekend, so return envelopes flood in on Monday and Tuesday. Products need to be prepped, packaged, and out the door by an ultra-busy Wednesday to ensure that they'll arrive on time for the next set of weekend parties.[76] Tech points the way to prioritization. Receiving staff scan the outside of returned envelopes and a message pops up on-screen with each scan, immediately determining if an item needs to go out right away. Garments are placed into bins color coded for urgency: black can eventually be prepped for restocking, but red is for those high-priority items that need to be immediately turned around for send out to another customer.[77] The system will also identify mid-term priority items, as in "get to this if you have time after taking care of priority items—if we ship it today, we'll save money." It'll even prioritize return shipping based on inventory demands, printing a higher-priced but faster-shipping return label for a customer if product turn around is especially acute.[78]

Next up for urgent items is a cleaning, but tech alone can't yet match the human touch that's sometimes needed. This isn't a simple rack 'em and steam 'em facility. Garments are expensive, materials are diverse, and stains potentially too varied for conveyor belt cleaning alone to meet Rent the Runway quality standards. Instead, highly skilled "spotters," some with decades of experience in the industry and earning over $100,000 a year, inspect garments, assess stains, and choose the right method for any problem issues needing an especially pristine clean.[79] Spotters are more like potion master chemists, each working alongside an assembly of bottles, vials, sprays, and air hoses that can be used to restore a good-as-new sparkle.[80]

After cleaning, a team of over four dozen seamstresses stand ready as the Navy Seals of dress repair. These so-called "Dream Fulfillment Centers" also have a massive operation for jewelry mending and leather dyeing.[81] Any individual item might be matched with additional products such as a second dress size, or additional accessories, so technology dispatches warehouse workers to pick any other products needed for a complete order. Items are scanned for a pre-packaging double check, shipping labels are automatically printed, and items are boxed and ready to be sent out. Delivery firms drop by around 8 pm to get garments on their way.[82] The firm's operations are so efficient that many items arriving by 8 am can be turned around in twelve hours for same-day send-out.[83]

The more times a dress is rented, the more revenue the firm generates, and despite the firm's exacting standards for maintaining product quality, dresses can be turned about thirty times during their rental life.[84] Even after a lifetime of partying, most dresses are still in pretty good shape. Much of the post-rental inventory is eventually sold via semi-annual inventory-clearing sales.[85]

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Rent the Runway's leadership elected to expand its infrastructure and systems rather than harvest early profits.[86] These investments help deliver the scale, data, and operational advantage likely to be essential to keeping challengers at bay. Overbuilding can make a lot of business sense. A large distribution facility doesn't just provide expansion capacity for growth, it also acts as a staging area for experimenting with new ideas and product lines. Apparently this investment is paying off. Although the firm is privately held (so public financials aren't available), it has been reported that the firm is profitable on an EBITDA basis[87] (an accounting term referring to Earnings Before Interest, Taxes, Depreciation, and Amortization). The milestone points to the eventual full profitability of the business, may make raising additional capital easier, and, since Rent the Runway will seem like less of a financial risk, will also allow the firm access to cheaper debt to fund inventory purchases.[88]

Fulfillment as a Service

Rent the Runway has proven the ROI (return on investment) for fashion rental, and changing consumer habits has attracted retailers and brands to their offices, eager to learn more. Amazon has leveraged its fulfillment expertise as a service that it provides others, and Rent the Runway will do the same with its unique and proprietary fulfillment platform. The firm's new logistics arm will be yet another revenue channel for the firm, and could provide partners not only insights, but also data that they can't get from anywhere else. Hyman claims "We are the only retailer that knows: "Did she wear it or not. How many times. Did you like it love it or was it just ok?"[89]

Key Takeaways

- Rent the Runway leverages technology to run a reverse logistics business in which every product that is sent out to a customer must also come back. Technology is used to schedule and prioritize inventory flow.
- Product must also be washed, perhaps repaired, and prepped for send-out in what is often a very small window of time for completion.
- Despite relying so heavily on technology, many aspects of Rent the Runway's business still need human participation.

Questions and Exercises

1. How does technology help Rent the Runway prioritize items to be sent out?
2. How does technology help the firm optimize shipping rates?
3. In what ways are human beings still necessary to the process? How does technology help here, and how might new technology help more? Do you think the firm will need this many workers in another ten years? Why or why not?

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12.6 Subscription: Bigger than Rental

Learning Objective

1. Recognize new business opportunities for Rent the Runway, why they are attractive, and what challenges the firm faces when exploring these initiatives.

Rent the Runway's founders are ambitious. Jenn Hyman has declared the ultimate opportunity for Rent the Runway "is to build the Amazon of rental."[90] In addition to wedding dresses, maternity dresses, and plus-size fashions, the company's offerings now include jewelry, handbags, scarves, and even rentals of "ugly sweaters" for holiday parties. And Rent the Runway will suggest undergarments, makeup, and hair accessories to further enhance your look (all available for purchase).[91]

Jenn Hyman has described the subscription business this way: "We have a vision to create your closet on rotation."[92] Rent the Runway's offerings: Update and Unlimited are really is the fashion equivalent of the old Netflix DVD-by-mail service. It's a flexible, subscription-based ownership model for accessories and clothing. For the $89 a month *Update* offering, subscribers can swap out four items a month. The $159 monthly *Unlimited* option also tops out at four items, but subscribers have an unlimited ability to replace items each month, and a larger selection of luxury items. Subscribers create a queue of requested items. Customers choose the items they want first and can keep them as long as they'd like. Send an item back and choose the next item you want. Subscription offerings include maternity, denim, sizes from zero to 22, handbags, shoes, jewelry, and more. As Hyman describes it, subscription is your "closet in the cloud."

The subscription business began as a startup inside a startup, expanding beyond the firm's special events rentals with a new service offering an every-day Rent the Runway use case. Prior to launching subscriptions, Rent the Runway execs made field visits with scores of women to discuss fashion and their closets. Managing a work wardrobe emerged as a key concern.[93] Three iterations of the service were offered on the way to rollout. First, an accessories-only program was tested for $49 a month. Handbags and jewelry were less complex categories for the first experiment since there weren't any sizing issues. A $99 beta program (which had a wait list topping 40,000 customers) followed, expanding available items to include everyday fashions: daytime dresses, skirts, tops, and outerwear.[94] The eventual rollout offered to all customers included a much broader catalog of still four-at-a-time items for $159 a month, and this expanded to include the Update model—a lighter pocketbook commitment for those women interested in sampling the style smorgasbord. Love an item you've been sent? You can also buy it from Rent the Runway.

For many women, Update and Unlimited make solid financial sense. The average American woman buys 68 pieces of clothing a year,[95] and half of those items will be worn only once.[96] Even frequently worn items, like a winter coat, might be better chosen as a six-month rental. And the ability to browse and manage a fashion queue on your phone is a potential time-saver for professional women, mothers, and anyone else with dwindling hours to dedicate to store shopping. Women are also more likely to take risks with subscription fashion. Get the fit wrong or the style doesn't work? Just send it back and try the next item on your wish list. Subscribers report shopping 80 percent less, but when they do shop, they're buying higher quality.[97] Rent the Runway also benefits from a deeper relationship with the customer—generating more interactions, more opportunity for delight, and a greater trove of data. Subscription customers are using the service 150 days a year, rather than just a few one-off special event dress rentals.[98] Hyman's grand vision: "Every woman should have a subscription to fashion just like you have a subscription to music or entertainment and through that subscription you'll be able to have fun with this amazing industry."[99]

Many investors advised management to stick to the core rental business, but targeted experiments verified the wisdom of doubling down on subscribers. Revenue from subscriptions is grow-

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ing over 150 percent a year and is thought to surpass the original rental business by late 2018,[100] with gross margins estimated as topping 50 percent.[101] The effort seems to be once again redefining how women think about fashion purchases, and the appeal is clear: Your smartphone can mimic a magic trapdoor at the back of your closet where thousands of beautiful items can be summoned forth at the press of a button.

Key Takeaways

- Rent the Runway has an opportunity to move to a subscription business, further enhancing the concept of the "closet in the cloud."
- Customers can buy items they like at a discount.
- Customers are currently not used to subscribing to fashion, so convincing them to try this model may be a challenge.

Questions and Exercises

1. What is Rent the Runway Unlimited? Would you use this? Why or why not?
2. What other areas could Rent the Runway expand into? Would you recommend these? What about men's fashion? Casual fashion?
3. Why did Rent the Runway choose the initial product categories to focus on when testing the Unlimited service?

12.7 Conclusion

Learning Objectives

1. Recognize potential sources of competitive advantage created by Rent the Runway that make it difficult for customers to challenge the firm.
2. Identify successful firms founded or led by women, and why having a female-led business can be an advantage for Rent the Runway.

unicorn

term for startups valued at $1 billion or more

Rent the Runway's founders represent a new generation of entrepreneurs leveraging a collection of enabling technologies to fundamentally recast the consumer relationship in a multibillion dollar industry. Mobile, social, big data, tech-orchestrated operations, and collaborative consumption all come together in a market-growing set of services that create value for both customers and designers. Success is never a sure thing, and imitators exist in the United States and abroad, but the castle that makes Rent the Runway's Cinderella moments possible is protected by some pretty deep moats that potential competitors will find difficult to cross. This is a firm that has raised over $210 million in capital, not only from some of the strongest venture firms in the US, but also from Jack Ma and Joe Tsai—the brains behind Alibaba, the China-based company that is one of the largest Internet firms on the planet.[102] Already valued at $800 million,[103] many speculate that Rent the Runway is on their way to so-called **unicorn** status, the tech industry's name for those extraordinary startups valued at $1 billion or more.[104]

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The rise of successful tech firms founded by women continues. Newcomers to the list include Adi Tatarko's $2 billion Houzz (matching designers with customers),[105] Katrina Lake's Stitch Fix (went public at a valuation of over $1.6 billion),[106] Lea Brusque's TaskRabbit (errands in the sharing economy, which sold to Ikea[107]), Minnie Ingersoll's Shift (reimagining car buying), and Payal Kadakia's ClassPass (membership covering classes at multiple fitness studios), among many others. Women have also been co-founders of multibillion-dollar giants like Cisco and HTC, as well as more recent startups including Eventbrite, Poshmark, SlideShare, and Birchbox. And women execs have run some of tech's biggest firms, including HP, IBM, Oracle, and Yahoo!. Still, women remain underrepresented among venture-backed entrepreneurs and in the tech industry as a whole. Rent the Runway's leaders are committed to changing this. The firm's Chicago storefront also serves as a platform to promote local women entrepreneurs. The store will host talks with Chicago businesswomen, and selected entrepreneurs will have their stories posted on the Rent the Runway website. The firm has also partnered with investment bank UBS to run Project Entrepreneur, a venture competition that aims to help female entrepreneurs build high-growth, high-impact businesses. All managers, technologists, and would-be startup captains can learn from the Rent the Runway story, but helping to mentor and inspire broader participation in innovation is a legacy from the firm's founders that boldly stands alongside crafting the new colossus of couture.

Creating a Magnet for Talent and Capital

Rent the Runway has also become a much-sought-after employer for talented women executives and technologists. While firms like Facebook and Twitter are about 70 percent male, the equation is flipped at Jenn's shop. Many of the firm's top executives are women, and the company has so much female talent that one of the men's rooms at headquarters had to be converted to a ladies' room.[108] Among those cautious and weary of "gamer gate"[109] headlines and concern over a lack of gender diversity in the tech industry,[110] the female friendly and mentor-rich environment of Rent the Runway gives the firm a recruiting edge. The industry-impacting opportunity from Rent the Runway has also attracted an eclectic set of backers, from top-tier venture capital firms that include Bain, Highland Capital Partners, and Kleiner Perkins, to an investment from Condé Nast Publications, the parent of the fashion bible *Vogue.*

Jenn Hyman has also been a leader in offering benefits to hourly workers, including expanded parental, paternity, and sick leave. With the job market likely to tighten as more workers hit retirement age, it's also good business to offer benefits to hourly workers as well as salaried workers. Hyman wrote in the *New York Times*, "*When I announced our new paid family sick leave plan at our warehouse, for instance, a woman stood up to see whether she could use this policy to care for her daughter, who was scheduled to have a C-section soon. Before that, she had been planning to simply quit her job, without ever telling us why*." Hyman hopes the effort will strengthen the firm's shared culture and will also help reduce turnover, creating a business case alongside the compassion case for worker benefits.[111] Hyman's leadership has extended beyond Rent the Runway, as well, including her 2018 appointment to the Board of Directors of the $50 billion global cosmetics giant, Esteé Lauder.[112]

Key Takeaways

- Rent the Runway has the potential to grow a series of assets that will repel rivals, among them: brand, scale, deep industry partnerships, data, and more.
- There have been many tech firms founded by and led by women. These firms are often talent magnets for high-performing women who seek a supportive environment rich in mentors and led by leaders they find easier to identify with.

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Questions and Exercises

1. Why do you suppose so few women are involved in entrepreneurship and technology? What can industries, firms, universities, and other entities do to improve this situation?
2. Conduct research online. Which firms are considered as doing an exceptional job in attracting underrepresented talent to the workplace? Why are these efforts working?
3. How can firms increase the pipeline so that more people from underrepresented groups bring their minds to tech and entrepreneurship?
4. Research and find additional women-led or -founded tech firms, and share these with your class.
5. Describe the resources Rent the Runway is building for sustainable competitive advantage. Which of these do you think is exceptionally strong and will keep the firm at the top of the industry? Why? Is the firm vulnerable? If so, how so, and if not, why not?

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CHAPTER 13

Understanding Software: A Primer for Managers

13.1 Introduction

Learning Objectives

1. Recognize the importance of software and its implications for the firm and strategic decision making.
2. Understand that software is everywhere; not just in computers, but also cell phones, cars, cameras, and many other technologies.
3. Know what software is and be able to differentiate it from hardware.
4. List the major classifications of software and give examples of each.

We know **computing hardware** is getting faster and cheaper, creating all sorts of exciting and disruptive opportunities for the savvy manager. But what's really going on inside the box? It's **software** that makes the magic of computing happen. Without software, your PC would be a heap of silicon wrapped in wires encased in plastic and metal. But it's the instructions—the software code—that enable a computer to do something wonderful, driving the limitless possibilities of information technology.

computer hardware

The physical components of information technology, which can include the computer itself plus peripherals such as storage devices, input devices like the mouse and keyboard, output devices like monitors and printers, networking equipment, and so on.

software

A computer program or a collection of programs. It is a precise set of instructions that tells hardware what to do.

Software is everywhere. An inexpensive "dumb" cell phone has about 1 million lines of code.[1] Ford automobiles actually have more lines of code than Twitter and Facebook combined.[2] Software might even be in grandpa. The average pacemaker has between 80,000 and 100,000 lines of code.[3] In this chapter we'll take a peek inside the chips to understand what software is. A lot of terms are associated with software: operating systems, applications, enterprise software, distributed systems, and more. We'll define these terms up front, and put them in a managerial context. A follow-up chapter, Chapter 14, will focus on changes impacting the software business, including open source software, software as a service (SaaS), cloud computing, virtualization, and the rise of apps. These changes are creating an environment radically different from the software industry that existed in previous decades—confronting managers with a whole new set of opportunities and challenges.

Managers who understand software can better understand the possibilities and impact of technology. They can make better decisions regarding the strategic value of IT and the potential for technology-driven savings. They can appreciate the challenges, costs, security vulnerabilities, legal and compliance issues, and limitations involved in developing and deploying technology solutions. And since firms that cannot communicate will struggle to work in tandem, managers who understand software can appreciate the key role that technology plays in partnerships, merger and acquisitions, and firm valuation. Given the pervasiveness of tech in all managerial disciplines, a firm without technologists in the boardroom is setting itself up for failure. In the next two chapters we will closely examine the software industry and discuss trends, developments and eco-

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nomics—all of which influence decisions managers make about products to select, firms to partner with, and firms to invest in.

What Is Software?

When we refer to computer hardware (sometimes just hardware), we're talking about the physical components of information technology—the equipment that you can physically touch, including computers, storage devices, networking equipment, and other peripherals.

Software refers to a computer program or collection of programs—sets of instructions that tell the hardware what to do. Software gets your computer to behave like a Web browser or word processor, lets your smartphone play music and video, and enables your bank's ATM to spit out cash.

It's when we start to talk about the categories of software that most people's eyes glaze over. To most folks, software is a big, incomprehensible alphabet soup of acronyms and geeky phrases: API, ERP, OS, SQL, to name just a few.

operating system

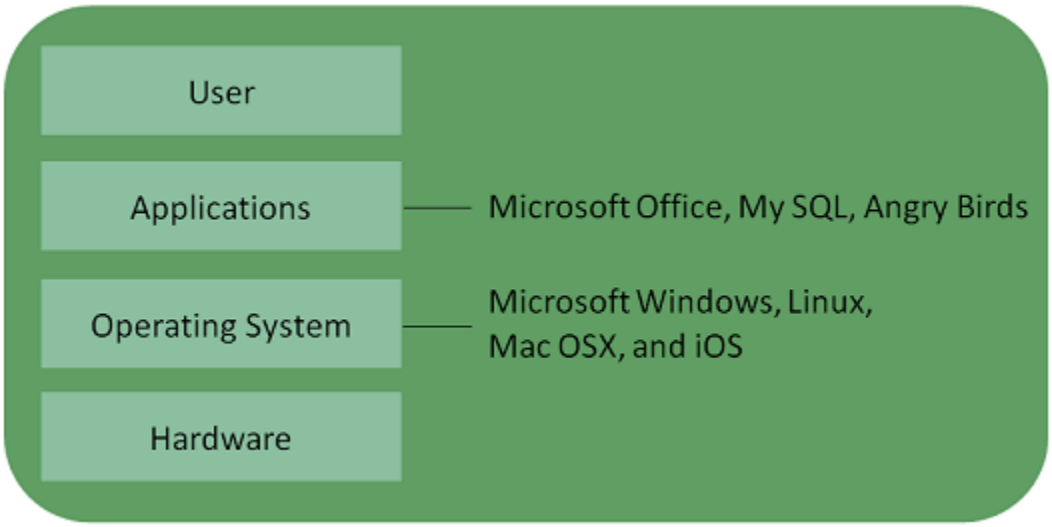
The software that controls the computer hardware and establishes standards for developing and executing applications.

applications

Includes desktop applications, enterprise software, utilities, and other programs that perform specific tasks for users and organizations.

Don't be intimidated. The basics are actually pretty easy to understand. But it's not soup; it's more of a layer cake. Think about computer hardware as being at the bottom of the layer cake. The next layer is the **operating system**, the collection of programs that control the hardware. Windows, Mac OS X, iOS, and Linux are operating systems. On top of that layer are **applications**—a range of which include end-user programs like those in Office, apps that run on smartphones, and the complex set of programs that manage a business's inventory, payroll, and accounting. At the top of the cake are users.

FIGURE 13.1 The Hardware/Software Layer Cake



The flexibility of these layers gives computers the customization options that managers and businesses demand. Understanding how the layers relate to each other helps you make better decisions on what options are important to your unique business needs, can influence what you buy, and may have implications for everything from competitiveness to cost overruns to security breaches. What follows is a manager's guide to the main software categories with an emphasis on why each is important.

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Key Takeaways

- Software refers to a computer program or collection of programs. It enables computing devices to perform tasks.
- You can think of software as being part of a layer cake, with hardware at the bottom; the operating system controlling the hardware and establishing standards; the applications executing one layer up, and the users at the top.
- How these layers relate to one another has managerial implications in many areas, including the flexibility in meeting business demand, costs, legal issues, and security.
- Software is everywhere—not just in computers, but also in cell phones, cars, cameras, and many other technologies.

Questions and Exercises

1. Explain the difference between hardware and software.
2. Why should a manager care about software and how software works? What critical organizational and competitive factors can software influence?
3. What role has software played in your decision to select certain products? Has this influenced why you favored one product or service over another?
4. Find the *Fortune* 500 list online. Which firm is the highest ranked software firm? While the *Fortune* 500 ranks firms according to revenue, what's this firm's profitability rank? What does this discrepancy tell you about the economics of software development? Why is the software business so attractive to entrepreneurs?
5. Refer to earlier chapters (and particularly to Chapter 2): Which resources for competitive advantage might top software firms be able to leverage to ensure their continued dominance? Give examples of firms that have leveraged these assets, and why they are so strong.

13.2 Operating Systems

Learning Objectives

1. Understand what an operating system is and why computing devices require operating systems.
2. Appreciate how embedded systems extend Moore's Law, allowing firms to create "smarter" products and services.

Computing hardware needs to be controlled, and that's the role of the operating system. The operating system (sometimes called the "OS") provides a common set of controls for managing computer hardware, making it easier for users to interact with computers and for programmers to write application software. Just about every computing device has an operating system—desktops and laptops, enterprise-class server computers, your mobile phone. Even specialty devices like video game consoles, television set-top boxes, Kindles, and smart applicances run some form of OS.

Some firms, like Apple and Nintendo, develop their own proprietary OS for their own hardware. Microsoft sells operating systems to everyone from Dell to the ATM manufacturer Diebold (listen for the familiar Windows error beep on some cash machines). And there are a host of spe-

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cialty firms, such as Wind River (purchased by Intel), that help firms develop operating systems for all sorts of devices that don't necessarily look like a PC, including cars, video editing systems, and fighter jet control panels.

Anyone who has used both a PC and a Mac and has noticed differences across these platforms can get a sense of the breadth of what an operating system does. Even for programs that are otherwise identical for these two systems (like the Firefox browser), subtle differences are visible. Screen elements like menus, scroll bars, and window borders look different on the Mac than they do in Windows. So do the dialogue boxes that show up when you print or save.

user interface (UI)

The mechanism through which users interact with a computing device. The UI includes elements of the graphical user interface (or GUI, pronounced "*gooey*"), such as windows, scroll bars, buttons, menus, and dialogue boxes; and can also include other forms of interaction, such as touch screens, motion sensing controllers, or tactile devices used by the visually impaired.

These items look and behave differently because each of these functions touches the hardware, and the team that developed Microsoft Windows created a system distinctly different from their Macintosh counterparts at Apple. Graphical **user interface (UI)** items like scroll bars and menus are displayed on the hardware of the computer display. Files are saved to the hardware of a hard drive or other storage device. Most operating systems also include control panels, desktop file management, and other support programs to work directly with hardware elements like storage devices, displays, printers, and networking equipment. The Macintosh Finder and the Windows Explorer are examples of components of these operating systems. The consistent look, feel, and functionality that operating systems enforce across various programs help make it easier for users to learn new software, which reduces training costs and operator error.

Operating systems are also designed to give programmers a common set of commands to consistently interact with the hardware. These commands make a programmer's job easier by reducing program complexity and making it faster to write software while minimizing the possibility of errors in code. Consider what an OS does for the game developer writing for the Nintendo Switch. Nintendo's Switch OS provides programmers with a set of common standards to use to access the controllers, play sounds, draw graphics, save files, and more. Without this, games would be a lot more difficult to write, they'd likely look different, be less reliable, would cost more, and there would be fewer titles available.

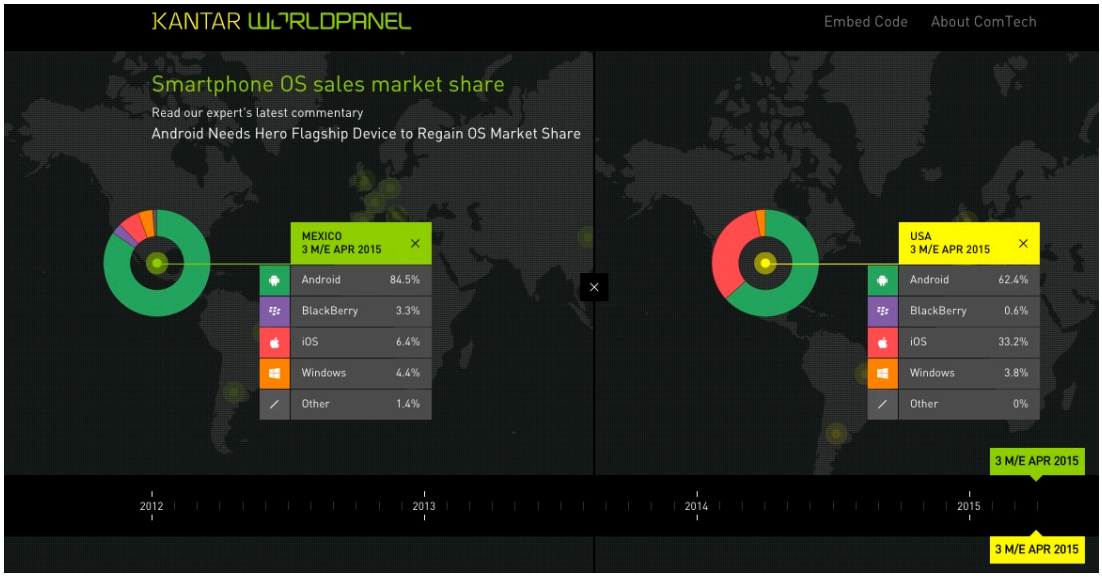
Similarly, when Apple provided developers with a common set of robust, easy-to-use standards for the iPhone and (via the App Store) an easy way for users to install these applications on top of the iPhone/iPod touch/iPad's operating system (iOS), software development boomed, and Apple became hands-down the most versatile mobile computing device available.[4] In Apple's case, some fifty thousand apps became available through the App Store in less than one year, and well over two million apps in total are available today. A good OS and software development platform can catalyze network effects (see Chapter 8). While the OS seems geeky, its effective design has very strategic business implications!

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FIGURE 13.2 Smartphone OS Market Share

Operating system market share is notoriously difficult to calculate, and a search online will reveal widely varying numbers. That said, this interactive graphic will give you a sense of the variance in major mobile operating systems worldwide. A slider will allow you to compare how share has changed.



Source: Kanta World Panel website; http://www.kantarworldpanel.com/global/smartphone-os-market-share/.

Firmware and Embedded Systems

Most personal computers have an operating system installed on their hard drives. This system allows the OS to be replaced or upgraded easily. But many smaller, special-purpose computing devices have their operating systems installed on nonvolatile memory, often on read-only memory (ROM) chips. Control programs stored on chips are sometimes referred to as **firmware**. The OS in an iPad, automobile, your TV's set-top box, and in the hardware that controls Philips Hue lightbulbs is most likely stored as firmware. Your PC also has a tiny bit of firmware that allows it to do very basic functions like start-up (boot) and begin loading its operating system from disc.

Another term you might hear is **embedded systems**. As computing gets cheaper, special-purpose technology is increasingly becoming embedded into all sorts of devices like cars, picture frames, aircraft engines, photocopiers, and heating and air conditioning systems. The software programs that make up embedded systems are often stored as firmware too. Using microprocessors and embedded software to enable commonly encountered devices to communicate with one another (think of the Nest thermostat or app-controlled lighting and door locks) is sometimes referred to as the Internet of Things. Embedded systems are now found in everything from herd-tracking cow collars[5] to pipeline monitoring sensors, eliminating the need for workers to trek out and monitor operations.[6]

Moore's Law (see Chapter 5) enables embedded systems, and these systems can create real strategic value. The Otis Elevator Company, a division of United Technologies, uses embedded systems in its products to warn its service centers when the firm's elevators, escalators, and moving walkways need maintenance or repair. This warning provides Otis with several key benefits:

1. Since products automatically contact Otis when they need attention, these systems generate a lucrative service business for the firm and make it more difficult for third parties to offer a competing business servicing Otis products.
2. Products contact service technicians to perform maintenance based on exact needs (e.g., lubricant is low, or a part has been used enough to be replaced) rather than guessed schedules, which makes service more cost-effective, products less likely to break down, and customers happier.

firmware

Software stored on nonvolatile memory chips (as opposed to being stored on devices such as hard drives or removable discs). Despite the seemingly permanent nature of firmware, many products allow for firmware to be upgraded online or by connecting to another device.

embedded systems

Special-purpose software designed and included inside physical products (often on firmware). Embedded systems help make devices "smarter," sharing usage information, helping diagnose problems, indicating maintenance schedules, providing alerts, or enabling devices to take orders from other systems.

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3. Any product failures are immediately detected, with embedded systems typically dispatching technicians before a client's phone call.
4. The data is fed back to Otis's R&D group, providing information on reliability and failure so that engineers can use this info to design better products.

Collectively, software embedded on tiny chips yields very big benefits, for years helping Otis remain at the top of its industry.

Key Takeaways

- The operating system (OS) controls a computer's hardware and provides a common set of commands for writing programs.
- Most computing devices (enterprise-class server computers, PCs, phones, set-top boxes, video games, cars, the Mars Rover) have an operating system.
- Some products use operating systems provided by commercial firms, while others develop their own operating system. Others may leverage open source alternatives (see Chapter 14 "Software in Flux: Partly Cloudy and Sometimes Free").
- Embedded systems are special-purpose computer systems designed to perform one or a few dedicated functions, and are frequently built into conventional products like thermostats, door locks, cars, air conditioners, industrial equipment, and elevators.
- Embedded systems can make products and services more efficient, more reliable, and more functional, and can enable entire new businesses and create or reinforce resources for competitive advantage.

Questions and Exercises

1. What does an operating system do? Why do you need an operating system? How do operating systems make a programmer's job easier? How do operating systems make life easier for end users?
2. What kinds of operating systems are used in the devices that you own? On your personal computer? Your mobile phone? The set-top box on top of your television? Are there other operating systems that you come into contact with? If you can't tell which operating system is in each of these devices, see if you can search the Internet to find out.
3. For your list in the prior question (and to the extent that you can), diagram the hardware/software "layer cake" for these devices.
4. For this same list, do you think each device's manufacturer wrote all of the software that you use on these devices? Can you add or modify software to all of these devices? Why or why not? What would the implications be for cost, security, complexity, reliability, updates and upgrades, and the appeal of each device?
5. Operating system market share is notoriously difficult to calculate. Do some research on major OS markets (PCs, tablets, smartphones, or other products). Gather data and share with your class. Is your data inconsistent with classmates' data? Why do you suppose there are such discrepancies? Even if data are precisely inaccurate, are there rough trends that you can trust, and if so, what sorts of managerial decisions might these influence?
6. Which mobile OS has a larger global market share: Android or iOS? Which has returned more money to developers through its app store? Is this data what you'd expect? Why or why not?
7. Some ATM machines use Windows. Why would an ATM manufacturer choose to build its systems using Windows? Why might it want to avoid this? Are there other non-PC devices you've encountered that were running some form of Windows?
8. What are embedded systems? When might firms want to install software on chips instead of on a hard drive? Why are embedded systems important for the Internet of Things?

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9. It's important to understand how technology impacts a firm's strategy and competitive environment. Consider the description of Otis elevator's use of embedded systems. Which parts of the value chain does this impact? How? Consider the "five forces": How does the system impact the firm's competitive environment? Are these systems a source of competitive advantage? If not, explain why not. If they are, what kinds of resources for competitive advantage can these kinds of embedded systems create?
10. Can you think of other firms that can or do leverage embedded systems? Provide examples and list the kinds of benefits these might offer firms and consumers.
11. Research the Americans with Disabilities Act of 1990 (or investigate if your nation has a similar law), and the implications of this legislation for software developers and website operators. Have firms been successfully sued when their software or websites could not be accessed by users with physical challenges? What sorts of issues should developers consider when making their products more accessible? What practices might they avoid?

13.3 Application Software: Apps, Desktop Products, and Enterprise Systems

Learning Objectives

1. Appreciate the difference between desktop and enterprise software.
2. List the categories of enterprise software.
3. Understand what an ERP (enterprise resource planning) software package is.
4. Recognize the relationship of the DBMS (database system) to the other enterprise software systems.
5. Recognize both the risks and rewards of installing packaged enterprise systems.

Operating systems are designed to create a **platform** so that programmers can write additional applications, allowing the computer to do even more useful things. While operating systems control the hardware, *application software* (sometimes referred to as *software applications*, *applications*, or even just *apps*) performs the work that users and firms are directly interested in accomplishing. Think of applications as the place where the user's or organization's real work gets done. As we learned in Chapter 8, the more application software that is available for a platform (the more games for a video game console, the more apps for your phone), the more valuable it potentially becomes.

platforms

Products and services that allow for the development and integration of software products and other complementary goods. Windows, iOS, Android, and the standards that allow users to create Facebook apps are all platforms.

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desktop software

Applications installed on a personal computer, typically supporting tasks performed by a single user.

enterprise software

Applications that address the needs of multiple users throughout an organization or work group.

software package

A software product offered commercially by a third party.

enterprise resource planning (ERP)

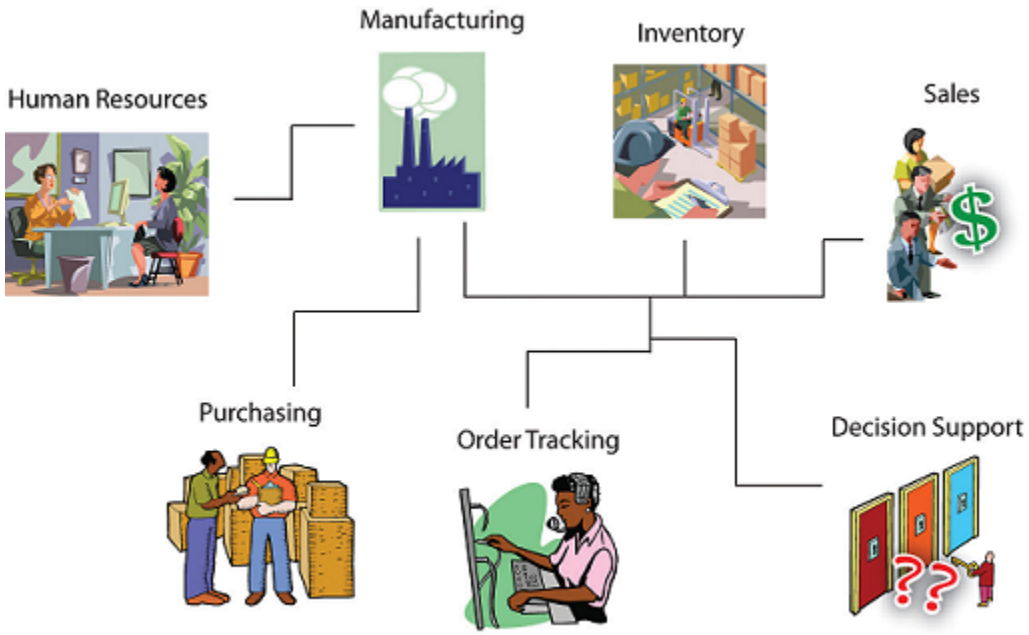
A software package that integrates the many functions (accounting, finance, inventory management, human resources, etc.) of a business.

Desktop software refers to applications installed on a personal computer—your browser, your Office suite (e.g., word processor, spreadsheet, presentation software), photo editors, and computer games are all desktop software. **Enterprise software** refers to applications that address the needs of multiple, simultaneous users in an organization or work group. Most companies run various forms of enterprise software programs to keep track of their inventory, record sales, manage payments to suppliers, cut employee paychecks, and handle other functions. Another term you might hear is *apps*. While the definition of *apps* is somewhat fluid, most folks use the term *app* to refer to smaller pieces of software that are designed for a specific platform, such as the programs that are executed on a smartphone, tablet, television, or specialized platform like the Apple Watch or Oculus Rift.

Some firms write their own enterprise software from scratch, but this can be time consuming and costly. Since many firms have similar procedures for accounting, finance, inventory management, and human resource functions, it often makes sense to buy a **software package** (a software product offered commercially by a third party) to support some of these functions. So-called **enterprise resource planning (ERP)** software packages serve precisely this purpose. In the way that Microsoft can sell you a suite of desktop software programs that work together, many companies sell ERP software that coordinates and integrates many of the functions of a business. The leading ERP vendors include the firms SAP and Oracle, although there are many firms that sell ERP software, and there are ERP and other enterprise products delivered "through the cloud" to browsers or apps, requiring no back-end software to be run on-site.

A company also doesn't have to install all of the modules of an ERP suite, but it might add functions over time—for example, to plug in an accounting program that is able to read data from the firm's previously installed inventory management system. And although a bit more of a challenge to integrate, a firm can also mix and match components, linking software the firm has written with modules purchased from different enterprise software vendors.

FIGURE 13.3 ERP in Action[7]



An ERP system with multiple modules installed can touch many functions of the business:

- *Sales*—A sales rep from Vermont-based SnowboardCo. takes an order for five thousand boards from a French sporting goods chain. The system can verify credit history, apply discounts, calculate price (in euros), and print the order in French.

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- *Inventory*—While the sales rep is on the phone with his French customer, the system immediately checks product availability, signaling that one thousand boards are ready to be shipped from the firm's Burlington warehouse, the other four thousand need to be manufactured and can be delivered in two weeks from the firm's manufacturing facility in Guangzhou.
- *Manufacturing*—When the customer confirms the order, the system notifies the Guangzhou factory to ramp up production for the model ordered.
- *Human Resources*—High demand across this week's orders triggers a notice to the Guangzhou hiring manager, notifying her that the firm's products are a hit and that the flood of orders coming in globally mean her factory will have to hire more workers to keep up.
- *Purchasing*—The system keeps track of raw material inventories, too. New orders trigger an automatic order with SnowboardCo.'s suppliers, so that raw materials are on hand to meet demand.
- *Order Tracking*—The French customer can log in to track her SnowboardCo. order. The system shows her other products that are available, using this as an opportunity to cross-sell additional products.
- *Decision Support*—Management sees the firm's European business is booming and plans a marketing blitz for the continent, targeting board models and styles that seem to sell better for the Alps crowd than in the US market.

Other categories of enterprise software that managers are likely to encounter include the following:

- **customer relationship management (CRM)** systems used to support customer-related sales and marketing activities
- **supply chain management (SCM)** systems that can help a firm manage aspects of its value chain, from the flow of raw materials into the firm through delivery of finished products and services at the point-of-consumption
- **business intelligence (BI) systems**, which use data created by other systems to provide reporting and analysis for organizational decision-making

Major ERP vendors are now providing products that extend into these and other categories of enterprise application software, as well.

Most enterprise software works in conjunction with a **database management system (DBMS)**, sometimes referred to as a "database system." The database system stores and retrieves the data that an application creates and uses. Think of this as an additional layer in our cake analogy. Although the DBMS is itself considered an application, it's often useful to think of a firm's database systems as sitting above the operating system, but under the enterprise applications. Many ERP systems and enterprise software programs are configured to share the same database system so that an organization's different programs can use a common, shared set of data. This system can be hugely valuable for a company's efficiency. For example, this could allow a separate set of programs that manage an inventory and point-of-sale system to update a single set of data that tells how many products a firm has to sell and how many it has already sold—information that would also be used by the firm's accounting and finance systems to create reports showing the firm's sales and profits.

Firms that don't have common database systems with consistent formats across their enterprise often struggle to efficiently manage their value chain. Common procedures and data formats created by packaged ERP systems and other categories of enterprise software also make it easier for firms to use software to coordinate programs between organizations. This coordination can lead to even more value chain efficiencies. Sell a product? Deduct it from your inventory. When inventory levels get too low, have your computer systems send a message to your supplier's systems so that they can automatically build and ship replacement product to your firm. In many cases these messages are sent without any human interaction, reducing time and errors. And common database systems also facilitate the use of BI systems that provide critical operational and competitive

customer relationship management (CRM)

Systems used to support customer-related sales and marketing activities.

supply chain management (SCM)

Systems that can help a firm manage aspects of its value chain, from the flow of raw materials into the firm, through delivery of finished products and services at the point-of-consumption.

business intelligence (BI) systems

Systems that use data created by other systems to provide reporting and analysis for organizational decision making.

database management system (DBMS)

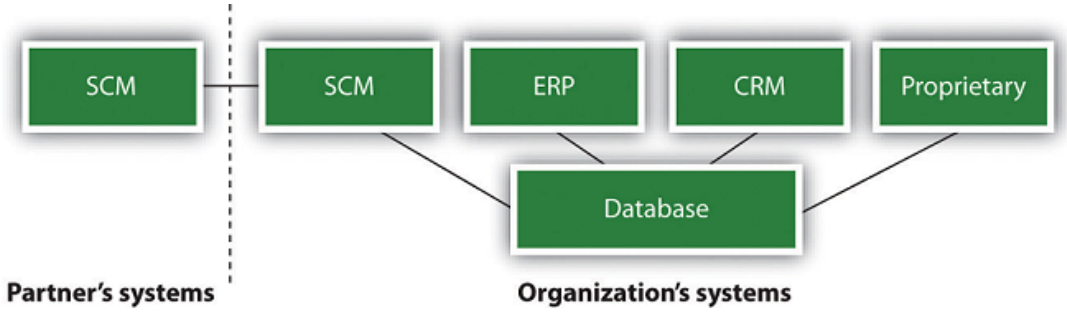
Sometimes referred to as database software; software for creating, maintaining, and manipulating data.

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knowledge and empower decision making. For more on CRM and BI systems, and the empowering role of data, see Chapter 15.

FIGURE 13.4 Database Management System
An organization's database management system can be set up to work with several applications both within and outside the firm.



And That's Just the Start

Be prepared for even more discussions on software categories and the changing nature of software. Future chapters will discuss additional topics, such as cloud computing—where software and other computing functions are delivered as a service through an Internet connection rather than being installed on a user or firm's computer hardware. Many products, from hefty ERP systems (NetSuite is one leader, which Oracle has acquired) to end-user application suites (think Google Docs, Sheets, and Presentation) are being delivered "via the cloud."

You'll also learn about additional classifications of software, including artificial intelligence and machine learning systems. These systems mimic or improve upon functions that would otherwise require human intelligence. As you continue through this book, be sure to see the connections with earlier topics, as well. The spread of software from your tiny doorbell to the massive data crunched to target advertising, is all being powered by the fast/cheap computing trends we learned about in earlier chapters.

The Rewards and Risks of Packaged Enterprise Systems

When set up properly, enterprise systems can save millions of dollars and turbocharge organizations. For example, the CIO of office equipment maker Steelcase credited the firm's ERP with an $80 million reduction in operating expenses saved from eliminating redundant processes and making data more usable. The CIO of Colgate Palmolive also praised their ERP, saying, "The day we turned the switch on, we dropped two days out of our order-to-delivery cycle."[8] Packaged enterprise systems can streamline processes, make data more usable, and ease the linking of systems with software across the firm and with key business partners. Plus, the software that makes up these systems is often debugged, tested, and documented with an industrial rigor that may be difficult to match with proprietary software developed in-house.

But for all the promise of packaged solutions for standard business functions, enterprise software installations have proven difficult. Standardizing business processes in software that others can buy means that those functions are easy for competitors to match, and the vision of a single monolithic system that delivers up wondrous efficiencies has been difficult for many to achieve. The average large company spends roughly $15 million on ERP software, with some installations running into the hundreds of millions of dollars.[9] And many of these efforts have failed disastrously.

FoxMeyer was once a six-billion-dollar drug distributor, but a failed ERP installation led to a series of losses that bankrupted the firm. The collapse was so rapid and so complete that just a year after launching the system, the carcass of what remained of the firm was sold to a rival for less

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than $80 million. Hershey Foods blamed a $466 million revenue shortfall on glitches in the firm's ERP rollout. Among the problems, the botched implementation prevented the candy maker from getting product to stores during the critical period before Halloween. Nike's first SCM and ERP implementation was labeled a "disaster"; their systems were blamed for over $100 million in lost sales.[10] Even tech firms aren't immune to software implementation blunders. HP once blamed a $160 million loss on problems with its ERP systems.[11] Manager beware—there are no silver bullets. For insight on the causes of massive software failures, and methods to improve the likelihood of success, see Section 6 of this chapter.

Companies that have efficient, flexible information systems don't just see value through operations efficiency and cost savings. Technology can also influence a firm's options with respect to inter-firm partnerships, as well as merging with, acquiring, or getting acquired by other firms (M&A, or mergers and acquisitions). Firms that have systems that work smoothly internally may find it easier to partner with others. Consulting firm McKinsey suggests that many mergers don't live up to expectations because firms struggle when trying to combine complex and incompatible information systems. Efficient and integrated enterprise systems may also make firms more attractive acquisition targets or make it easier for a firm to acquire other firms and realize the benefit from acquisition. McKinsey suggests acquired firms may be more valuable and acquirers may be justified in bidding more for acquisition targets since efficient tech may allow firms to capture the 10 to 15 percent cost savings that successful mergers can usually realize by combining IT systems. McKinsey points to Oracle as an example of a firm whose efficiency has helped it win at M&A (mergers and acquisition). Oracle, which sells ERP systems, consolidated seventy of its own information systems into a single ERP for the entire firm, saving an estimated $1 billion annually. Serious coin, but from a strategic perspective, it also created internal systems that were streamlined and simplified, making it easier to integrate acquired firms. Oracle bought over fifty firms in a four-year period and can now integrate most acquisitions in six months or less.[12]

Key Takeaways

- Application software focuses on the work of a user or an organization.
- Desktop applications are typically designed for a single user. Enterprise software supports multiple users in an organization or work group.
- Popular categories of enterprise software include ERP (enterprise resource planning), SCM (supply chain management), CRM (customer relationship management), and BI (business intelligence) software, among many others.
- These systems are used in conjunction with database management systems, programs that help firms organize, store, retrieve, and maintain data.
- ERP and other packaged enterprise systems can be challenging and costly to implement, but can help firms create a standard set of procedures and data that can ultimately lower costs and streamline operations.
- The more application software that is available for a platform, the more valuable that platform becomes.
- The DBMS stores and retrieves the data used by the other enterprise applications. Different enterprise systems can be configured to share the same database system in order to share common data.
- Firms that don't have common database systems with consistent formats across their enterprise often struggle to efficiently manage their value chains, and often lack the flexibility to introduce new ways of doing business. Firms with common database systems and standards often benefit from increased organizational insight and decision-making capabilities.
- Enterprise systems can cost millions of dollars in software, hardware, development, and consulting fees, and many firms have failed when attempting large-scale enterprise system integration. Simply buying a system does not guarantee its effective deployment and use.

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- When set up properly, enterprise systems can save millions of dollars and turbocharge organizations by streamlining processes, making data more usable, and easing the linking of systems with software across the firm and with key business partners.
- Efficient enterprise systems may also make it easier for firms to partner with other organizations, and can give it advantages when considering mergers and acquisitions.

Questions and Exercises

1. What is the difference between desktop and enterprise software?
2. Who are the two leading ERP vendors?
3. List the functions of a business that might be impacted by an ERP.
4. What do the acronyms ERP, CRM, SCM, and BI stand for? Briefly describe what each of these enterprise systems does.
5. Where in the "layer cake" analogy does the DBMS lie?
6. Name two companies that have realized multimillion-dollar benefits as a result of installing enterprise systems.
7. Name two companies that have suffered multimillion-dollar disasters as a result of failed enterprise system installations.
8. How much does the average large company spend annually on ERP software?
9. How do efficient enterprise systems help firms with respect to partnering with other organizations, as well as decisions around M&A?

13.4 Distributed Computing, Web Services, and APIs: The Platform Builders

Learning Objectives

1. Understand the concept of distributed computing and its benefits.
2. Understand the client-server model of distributed computing.
3. Know what Web services and APIs are and the benefits that these technologies bring to firms.
4. Appreciate the importance of messaging standards and understand how sending messages between machines can speed processes, cut costs, reduce errors, and enable new ways of doing business.

distributed computing

A form of computing where systems in different locations communicate and collaborate to complete a task.

When computers in different locations can communicate with one another, this is often referred to as **distributed computing**.[13] Distributed computing can yield enormous efficiencies in speed, error reduction, and cost savings and can create entirely new ways of doing business. Designing systems architecture for distributed systems involves many advanced technical topics. Rather than provide an exhaustive decomposition of distributed computing, the examples that follow are meant to help managers understand the bigger ideas behind some of the terms that they are likely to encounter.

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Let's start with the term **server**. This is a tricky one because it's frequently used in two ways: (1) in a hardware context a server is a computer that has been configured to support requests from other computers (e.g., Dell sells servers), and (2) in a software context a server is a program that fulfills requests (e.g., the Apache open source Web server). Most of the time, server *software* resides on server-class *hardware*, but you can also set up a PC, laptop, or other small computer to run server software, albeit less powerfully. And you can use mainframe or super-computer-class machines as servers, too. And as mentioned in the prior section, many firms choose not to own some of their applications or any of their own server hardware at all. Instead, they pay third-party firms to host their software "in the cloud." This option is particularly attractive for smaller firms that can't or don't want to invest in the expense and expertise associated with owning and operating hardware, for firms looking for extra computing capacity, and for firms that want public servers (e.g., websites) to be in fast, reliable locations outside of a company's own private network.

server

A program that fulfills the requests of a client.

The World Wide Web, like many other distributed computing services, is what geeks call a *client-server* system. Client-server refers to two pieces of software: a **client** that makes a request and a server that receives and attempts to fulfill the request. In our WWW scenario, the client is the browser (e.g., Internet Explorer, Chrome, Firefox, Safari). When you type a website's address into the location field of your browser, you're telling the client to "go find the Web server software at the address provided, and tell the server to return the website requested." Smartphone and tablet apps can also act as clients that make requests of more powerful server programs running elsewhere on the Web. Another example is smartphone voice recognition software, such as Apple's Siri. Voice recognition typically requires computing power far greater than that held on a smartphone, so Apple sends your voice to a more powerful collection of servers for processing and interpretation.

client

A software program that makes requests of a server program.

It is possible to link simple scripting languages to a Web server for performing calculations, accessing databases, or customizing websites. But more advanced distributed environments may use a category of software called an **application server**. The application server (or app server) houses business logic for a distributed system. Individual software components or **web services** served up by the app server are programmed to perform different tasks: returning a calculation ("sales tax for your order will be $11.58"), accessing a database program ("here are the results you searched for"), or even making a request to another server in another organization ("Visa, please verify this customer's credit card number for me").

application server

Software that houses and serves business logic for use (and reuse) by multiple applications.

web services

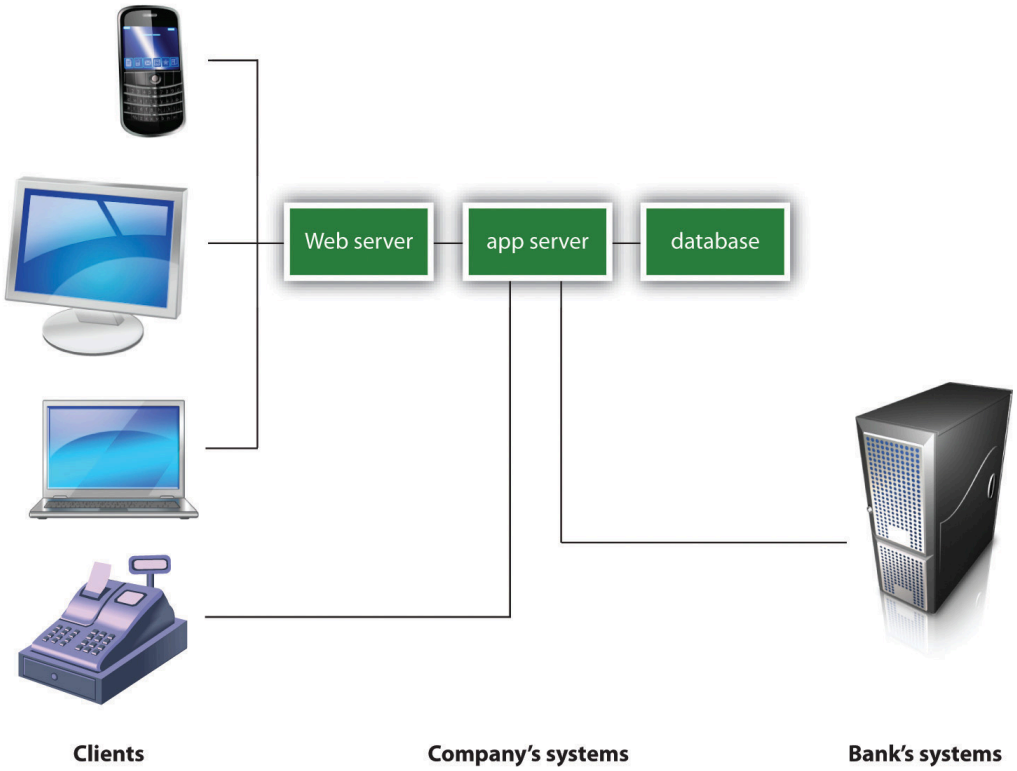
Small pieces of code that are accessed via the application server, and permit interoperable machine-to-machine interaction over a network.

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FIGURE 13.5 Multitiered Distributed System

In this multitiered distributed system, client browsers on various machines (desktop, laptop, mobile) access the system through the Web server. The cash register doesn't use a Web browser, so instead the cash register logic is programmed to directly access the services it needs from the app server. Web services accessed from the app server may be asked to do a variety of functions, including perform calculations, access corporate databases, or even make requests from servers at other firms (for example, to verify a customer's credit card).



APIs

Programming hooks, or guidelines, published by firms that tell other programs how to get a service to perform a task such as send or receive data. For example, Amazon.com provides APIs to let developers write their own applications and websites that can send the firm orders.

Those little chunks of code that are accessed via the application server are sometimes referred to as Web services. The World Wide Web consortium defines *Web services* as software systems designed to support interoperable machine-to-machine interaction over a network.[14] You might also hear the term **APIs** (or application programming interfaces) used to describe the same concept. There are deeper technical issues that precisely define Web services and the super-set of technologies known as APIs (and even IBM says existing definitions aren't especially precise),[15] but for managerial purposes you can think of Web services and APIs as doing pretty much the same thing; they are referring to pieces of code, and the request/response standards so that this code be summoned by other programs to perform a task (the term API is more in vogue today, so expect to hear that more). Have you seen firms other than Google using Google Maps? They can do this because Google publishes APIs so that others can use this service. Uber's API allowed United Airlines to build an app that can summon an Uber driver (either by deep-linking to the Uber app, or by completing a transaction over United's website if the app isn't installed).[16] Spotify's API allowed Uber to modify its app to play a rider's playlist through the driver's smartphone-connected car speakers. Alcohol delivery service Drizly has published an API that allows the whisky recommendation app Distiller to order booze right from Distiller screens.[17]

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Organizations that have created a robust set of Web services around their processes and procedures are said to have a **service-oriented architecture (SOA)**. Organizing systems like this, with separate applications in charge of client presentation, business logic, and database, makes systems more flexible. Code can be reused, and each layer can be separately maintained, upgraded, or migrated to new hardware—all with little impact on the others. And firms that invite other organizations to integrate with their systems via Web services and APIs are often thought of as turning their products into **platforms**. Firms that create platforms have the potential to make their products and services more useful, widen their reach, create switching costs, and enhance network effects (for more on this, see the Network Effects chapter).

service-oriented architecture (SOA)

A robust set of Web services built around an organization's processes and procedures.

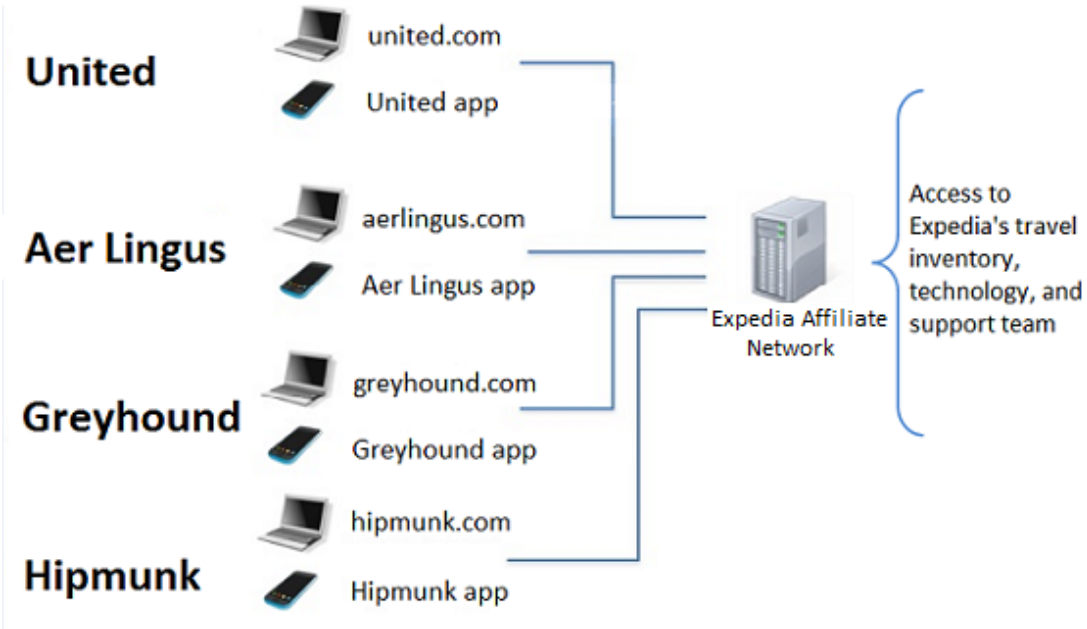
platforms

Products and services that allow for the development and integration of software products and other complementary goods. Windows, the iPhone, the Wii, and the standards that allow users to create Facebook apps are all platforms.

As an example of the business value of APIs in action, consider the Expedia Affiliate Network. Expedia sells a lot of travel through its own apps and website, but it realized that by sharing its inventory with partners (for a cut of the revenue), Expedia could sell even more. The Expedia Affiliate Network offers APIs that allow partner firms to integrate Expedia's technology and travel inventory into their own webites and apps. Partners that take advantage of these Expedia APIs include United,[18] Aer Lingus,[19] Greyhound,[20] and travel search tool Hipmunk.[21] These firms use the APIs so that their users can book hotel and other travel booking from within their own apps and websites, but without having to source inventory, work with suppliers, and create their own complete travel booking systems (all that's the stuff Expedia is so good at). For partners, this can be a great deal; they get to keep customers in their websites for a greater percentage of travel needs (booked your Aer Lingus flight to Ireland at aerlingus.com? Pick out a hotel and rental car, too). The partner firm's brand remains front and center with the customer. The partner firm continues to maintain the relationship with the customer (and gather critically important customer data), and they get a cut of Expedia's booking revenue. For its trouble, Expedia gets distribution—many more orders than it would otherwise get through its own sites and apps. How many? About $2 billion a year, even after sharing a percentage of bookings with API-using partners![22]

FIGURE 13.6 Expedia Affiliate Network

The Expedia Affiliate Network uses APIs to allow partner sites to book hotels and other travel services through their own apps and websites. This process lets partners provide more travel services to their customers, strengthen the customer relationship, gather additional data, and gain a cut of additional sales. Expedia gains some $2 billion in added sales funneled to it by partners that use its APIs.



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Formats to Facilitate Sharing Data

EDI (electronic data interchange)

A set of standards for exchanging messages containing formatted data between computer applications.

extensible markup language (XML)

A tagging language that can be used to identify data fields made available for use by other applications. Most APIs and Web services send messages where the data exchanged is wrapped in identifying XML tags.

JSON

JavaScript Object Notation (JSON)—a popular data interchange format, JSON is a technology standard often used to format data when being sent or received via APIs.

You might hear several additional terms within the context of distributed computing, including EDI, XML, and JSON. **EDI (electronic data interchange)** is a set of standards for exchanging information between computer applications. EDI is most often used as a way to send the electronic equivalent of structured documents between different organizations. Using EDI, each element in the electronic document, such as a firm name, address, or customer number, is coded so that it can be recognized by the receiving computer program. Eliminating paper documents makes businesses faster and lowers data entry and error costs. One study showed that firms that used EDI decreased their error rates by 82 percent, and their cost of producing each document fell by up to 96 percent.[23]

EDI is a very old standard, with roots stretching back to the 1948 Berlin Air Lift. While still in use, a new generation of more-flexible technologies for specifying data standards are taking its place. The two main technologies replacing EDI are **extensible markup language (XML)**, and JavaScript Object Notation (**JSON**, pronounced *jay*-sahn). XML has lots of uses, but in the context of distributed systems, it allows software developers to create a set of standards for common data elements that, like EDI messages, can be sent between different kinds of computers, different applications, and different organizations. Many computer programs also use XML as a way to export and import data in a common format that can be used regardless of the kind of computer hardware, operating system, or application program used. And if you design websites, you might encounter XML as part of the coding behind the cascading style sheets (CSS) that help maintain a consistent look and feel to the various Web pages in a given website. XML is often thought of as easier to code than EDI, and it's more robust because it can be extended—organizations can create formats to represent any kind of data (e.g., a common part number, photos, the complaint field collected by customer support personnel). XML was initially the go-to technology for specifying the format of data exchanged in Web services, but today's APIs are more likely to use an even more compact and simpler standard, JSON. While the name JSON contains JavaScript (a popular programming language for client and server software development), the standard is now used in a host of languages beyond JavaScript. While a discussion of the advantages and disadvantages of each is beyond the scope of this text, managers should know that when they encounter any of these terms, they refer to standards that facilitate the data exchange that make many distributed information systems possible.

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FIGURE 13.7 JSON and XML Examples
These examples both show an "employees" object with three employee records. The first is represented in JSON format, the second in XML.

JSON Example

```
{"employees":[
    {"firstName":"Grace", "lastName":"Hopper"},
    {"firstName":"Mary", "lastName":"Meeker"},
    {"firstName":"Helen", "lastName":"Greiner"}
]}
```

XML Example

```
<employees>
    <employee>
        <firstName>Grace</firstName> <lastName>Hopper</lastName>
    </employee>
    <employee>
        <firstName>Mary</firstName> <lastName>Meeker</lastName>
    </employee>
    <employee>
        <firstName>Helen</firstName> <lastName>Greiner</lastName>
    </employee>
</employees>
```

Source: Adapted from an example at W3Schools.com.

Connectivity has made our systems more productive and enables entire new strategies and business models. But these wonderful benefits come at the price of increased risk. When systems are more interconnected, opportunities for infiltration and abuse also increase. Think of it this way: each "connection" opportunity is like adding another door to a building. The more doors that have to be defended, the more difficult security becomes. It should be no surprise that the rise of the Internet and distributed computing has led to an explosion in security losses by organizations worldwide.

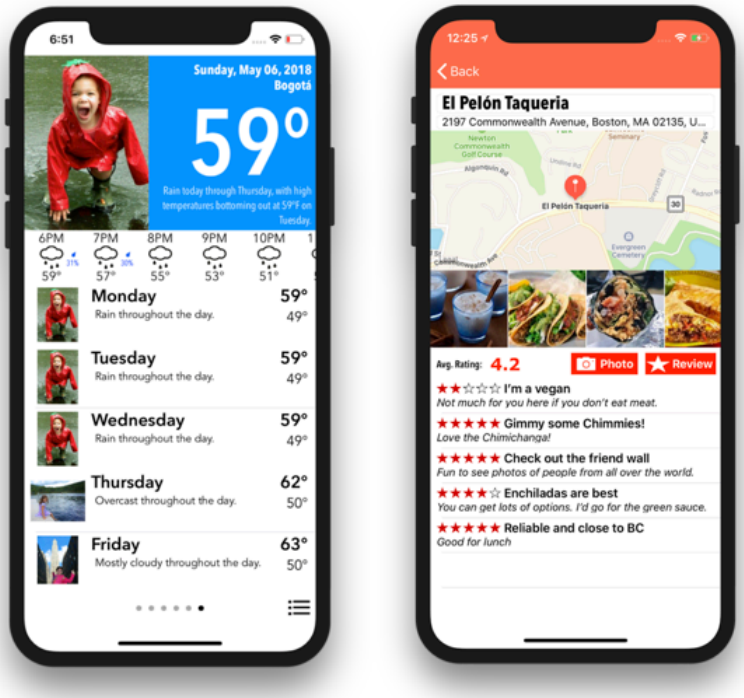
Want to learn more? The author's video-centric programming text: "Learn to Program Using Swift for iOS Development" introduces new-to-programming students to many concepts. By the end of the text, students are building apps accessing APIs and returning JSON, including apps that get weather data from Dark Sky, or that access databases of Star Wars movie trivia. Students also learn to use the cloud-based NoSQL database, Google Cloud Firestore, to build truly social apps. Find out more at http://gallaugher.com/swift

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FIGURE 13.8 ***Building Apps Accessing APIs***

The WeatherGift app on the left uses JSON data accessed from the DarkSky API, while the Snacktacular app on the right uses the Google Cloud Firestore database to share data, and accesses location data from the Google Place Autocomplete API.



Source: John Gallaugher

Key Takeaways

- Client-server computing is a method of distributed computing where one program (a client) makes a request to be fulfilled by another program (a server).
- Server is a tricky term and is sometimes used to refer to hardware. While server-class hardware refers to more powerful computers designed to support multiple users, just about any PC or notebook can be configured to run server software. Many firms choose to have their server software hosted "in the cloud" on the computers of third-party firms.
- Web servers serve up websites and can perform some scripting.
- Most firms serve complex business logic from an application server.
- Isolating a system's logic in three or more layers (presentation or user interface, business logic, and database) can allow a firm flexibility in maintenance, reusability, and in handling upgrades.
- Web services and APIs allow different applications to communicate with one another. The terms are imprecise and you'll often hear them used interchangeably. Web services and APIs define the method to call a piece of software (e.g., to get it to do something), and the kind of response the calling program can expect back.
- APIs and Web services make it easier to link applications as distributed systems, and can make it easier for firms to link their systems across organizations. Expedia uses APIs to expand its reach and bring in some $2 billion from revenue-sharing partners that use its technology.
- Popular messaging standards include EDI (older), XML, and JSON. Sending messages between machines instead of physical documents can speed processes, drastically cut the cost of transactions, and reduce errors.

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- Distributed computing can yield enormous efficiencies in speed, error reduction, and cost savings and can create entirely new ways of doing business.
- When computers can communicate with each other (instead of people), this often results in fewer errors, time savings, cost reductions, and can even create whole new ways of doing business.

Questions and Exercises

1. Differentiate the term "server" used in a hardware context, from "server" used in a software context.
2. Describe the "client-server" model of distributed computing. What products that you use would classify as leveraging client-server computing?
3. How are firms using APIs to transform from being a product to being a platform? How can APIs and web services enhance a firm's competitive advantage?
4. List the advantages that APIs have brought to Expedia and its partners.
5. What are the security risks associated with connectivity, the Internet, and distributed processing?

13.5 Writing Software

Learning Objectives

1. Understand, at a managerial level, what programming languages are and how software is developed.
2. Recognize that an operating system and microprocessor constrain the platform upon which most compiled application software will run.
3. Understand what Java is and why it is significant.
4. Know what scripting languages are.

So you've got a great idea that you want to express in software—how do you go about creating a program? Programmers write software in a **programming language**. While each language has its strengths and weaknesses, many commercial applications are written in a variant of the C programming language such as C++ (pronounced "see plus plus"), C# (pronounced "see sharp"), or Objective-C (the original language used for iOS app development). Visual Basic (from Microsoft) and Java (from Sun) are also among the more popular of the dozens of programming languages available. Web developers may favor specialty languages like Ruby and Python, SQL is a popular special-purpose language used in databases, R is popular for business analytics. And languages are constantly evolving. Apple has created Swift, a programming language to offer the power of Objective-C but in a language that is more powerful and feature-rich than Objective-C, yet has the simplicity and error handling of leaner, easier-to-use web programming languages. Swift is now open sourced and is used on many other platforms, including back-end server and database solutions from IBM.[24] Apple has created many intro-to-programming products, encouraging grade schoolers to learn Swift, including Swift Playgrounds on the iPad, and a "learn to code" grade school curriculum, so expect more students to arrive at university with Swift experience. Google has also embraced and extended a Swift-like language named Kotlin, offering developers a more updated approach for Android development.[25]

programming language

Provides the standards, syntax, statements, and instructions for writing computer software.

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Some programming languages are extended by frameworks. These are libraries, templates, and extensions that simplify and standardize common tasks, speeding software development, reducing errors, and prompting reuse. Programmers use frameworks to use a standardized set of code and techniques that others have developed and tested, rather than requiring every developer to create his or her own code for things many others have done before them (handle database interactions, manage cookies, etc.). Examples of popular frameworks used to develop websites include Rails (for Ruby), Django (for Python), AngularJS (for JavaScript), and ASP.NET (pronounced "ay-ess-pee dot net").

integrated development environment (IDE)

An application that includes an editor (a sort of programmer's word processor), debugger, and compiler, among other tools.

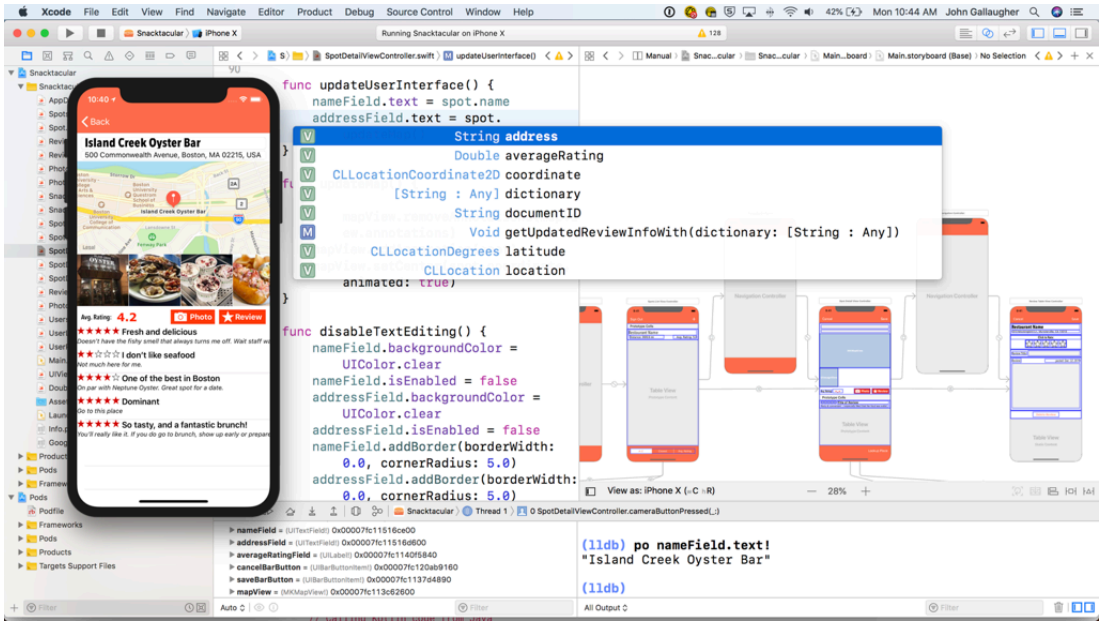
Most professional programmers use an **integrated development environment (IDE)** to write their code. The IDE includes a text editor, a debugger for sleuthing out errors, and other useful programming tools. Modern IDEs mean it's never been easier to be a programmer. Most systems provide code-completion, which makes suggestions while you type and helps avoid typos. Real-time debuggers can catch simple, common programming mistakes while writing code, and offer to fix them. The IDE will also **compile** a programmer's code, turning the higher-level lines of instructions that are readable by humans into lower-level instructions expressed as the patterns of ones and zeros that are readable by a computer's microprocessor. Many firms provide IDEs for free, in an effort to encourage software development for a platform. Popular IDEs include Xcode for Apple products, Android Studio from Google, Visual Studio from Microsoft, and several open source products, such as Eclipse and NetBeans.

compile

Step in which program code written in a language that humans can more easily understand, is then converted into a form (expressed in patterns of ones and zeros) that can be understood and executed by a microprocessor. Programmers using conventional programming languages must compile their software before making it available for execution.

FIGURE 13.9 Apple's Xcode IDE

Apple's free Xcode IDE allows anyone with a Mac to build software for iOS, Mac OS, AppleWatch, Apple TV, and more. Xcode comes with a simulator, and like most IDEs, includes an editor that makes code-completion suggestions as you type, a canvas to visually design an app, a debugger to find and correct problems, and more.



Source: Apple's Xcode IDE.

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Look at the side of a box or online order information from commercial software, and you're likely to see system requirements that specify the operating system and processor that the software is designed for (e.g., "this software works on computers with Windows 10 and Intel-compatible processors"). Wouldn't it be great if software could be written once and run everywhere? That was the original idea behind **Java**—a programming language developed by Sun Microsystems.

Java was initially designed so that programmers didn't write code with specific operating system commands (say for Windows, Mac OS X, or Linux). Instead there are special Java commands to control the user interface or interact with the display and other hardware. Java programs can run on any computer that has a Java Virtual Machine (JVM), a software layer that interprets Java code so that it can be understood by the operating system and processor of a given computer. Java's platform independence—the ability for developers to "write once, run everywhere"—is its biggest selling point. Many websites execute Java applets to run the animation you might see in advertisements or games. Java has also been deployed on billions of mobile phones worldwide, and is popular among enterprise programmers who want to be sure their programs can scale from smaller hardware up to high-end supercomputers. As long as the machine receiving the Java code has a JVM, then the Java application should run. However, Java has not been popular for desktop applications. Since Java isn't optimized to take advantage of interface elements specific to the Mac or Windows, most Java desktop applications look clunky and unnatural. Java code that runs through the JVM interpreter is also slower than code compiled for the native OS and processor that make up a platform.[26]

Java

A programming language, initially developed by Sun Microsystems, designed to provide true platform independence ("write once, run anywhere") for application developers. In most cases, Java apps are developed to be executed by a Java Virtual Machine—an interpreting layer that translates code as it executes, into the format required by the operating system and microprocessor. Without Java, application developers have to write and compile software to execute natively by a specific operating system / microprocessor combination (e.g., Windows/Intel, Linux PowerPC, Mac/Intel, Linux/Intel).

There are some caveats about the "write once, run anywhere" nature of Java. Java is also available as a language that can be compiled and executed for a specific operating system and processor, just like traditional programming languages. For example, Java is the default language for Android and some other systems. Because Android has its own standards for displaying interface elements and interacting with hardware, Java for Android "breaks" the initial "write once" promise of Java, and an Android app won't execute on non-Android devices. Google had adopted Java because it was very popular and many people were already familiar with the language, however like Apple moving to Swift to overcome Objective-C limitations, Google has created Kotlin as a more modern alternative to Java.

Scripting languages are the final category of programming tool that we'll cover. **Scripting languages** typically execute within an application. Microsoft offers a scripting language called VB Script (a derivative of Visual Basic) to automate functions in Office. And most browsers and Web servers support JavaScript, a language that helps make the Web more interactive (despite its name, JavaScript is unrelated to Java). Python is a popular language used in Web development and big data efforts, and R is a scripting language that is popularly used for analytics. Scripting languages are **interpreted** within their applications, rather than compiled to run directly by a microprocessor. This distinction makes them slower than the kinds of development efforts found in most commercial software. But most scripting languages are usually easy to use, and are often used both by professional programmers and power users. It's also possible to find additional products that provide some degree of compilation that speeds along certain scripting languages.

scripting languages

Programming tool that executes within an application. Scripting languages are interpreted within their applications, rather than compiled to run directly by a microprocessor.

interpreted

Languages where each line of written code is converted (by a software program, called an "interpreter") for execution at run-time. Most scripting languages are interpreted languages. Many programmers also write Java applications to be interpreted by the Java Virtual Machine.

Key Takeaways

- Programs are often written in a tool called an IDE, an application that includes an editor (a sort of programmer's word processor), debugger, and compiler, among other tools.
- Compiling takes code from the high-level language that humans can understand and converts them into the sets of ones and zeros in patterns representing instructions that microprocessors understand.
- Popular programming languages include C++, C#, Visual Basic, and Java.
- Most software is written for a platform—a combination of an operating system and microprocessor.

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- Java was originally designed to be platform independent. Computers running Java have a separate layer called a Java Virtual Machine that translates (interprets) Java code so that it can be executed on an operating system/processor combination. In theory, Java written using the standards of the virtual machine should be "write once, run everywhere," as opposed to conventional applications that are written for an operating system and compiled for an OS/processor combination.
- Some environments use the Java programming language, but "break" the write-once-run-anywhere promise by including proprietary code. This is the case with Java used for Android development. Google has its own standards for coding for the Android user interface and interacting with hardware that stand apart from what is available in the JVM, so an Android app won't run on other devices.
- Java is popular on mobile phones and enterprise computing, and is widely used to make websites more interactive. Java has never been a successful replacement for desktop applications, largely because user interface differences among the various operating systems are too great to be easily standardized.
- Scripting languages are interpreted languages, such as Python, R, VB Script and Java Script. Many scripting languages execute within an application (like the Office programs, a Web browser, or to support the functions of a Web server). They are usually easier to program, but are limited in scope (e.g., usually not used for desktop applications) and execute more slowly than compiled languages.

Questions and Exercises

1. List popular programming languages.
2. What are programming frameworks, and why would you use one? Name some of the more popular programming frameworks used for web development, and name the programming languages they are used with.
3. What's an IDE? Why do programmers use IDEs? Name IDEs popular for Windows and Mac users.
4. What is the difference between a compiled programming language and an interpreted programming language?
5. Name one advantage and one disadvantage of scripting languages.
6. In addition to computers, on what other technology has Java been deployed? Why do you suppose Java is particularly attractive for these kinds of applications?
7. What's a JVM? Why do you need it?
8. What if a programmer wrote perfect Java code, but there was a bug on the JVM installed on a given computer? What might happen?
9. Why would developers choose to write applications in Java? Why might they skip Java and choose another programming language?
10. Why isn't Java popular for desktop applications?
11. Go to http://www.java.com. Click on "Do I have Java?" Is Java running on your computer? Which version?
12. Interested in building apps? Your author has written a video-based online text to learn to program in the Swift programming language while also learning app development. The first three chapters are free. If you have a Mac you can download Apple's Xcode software and get started. Visit http://gallaugher.com/swift for more info. And if you like learning to code, encourage your university to adopt this product for a "flipped class." Students learn on their own through more than 100 video lectures and exercises, and spend classroom time on additional exercises that would be considered "homework" in a traditional class. It's never been easier for your school to offer an apps class, and if you're successful, maybe we'll profile your firm in a future version of this textbook!

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13.6 Software Development Methodologies: From Waning Waterfall to Ascending Agile, plus a Sprint through Scrum

Learning Objectives

1. Understand why firms use software methodologies.
2. Know the benefits and weaknesses of waterfall and agile methodologies.
3. Understand scrum and its various components.

A Brief Introduction to Popular Approaches to Developing Software

Firms are also well served to leverage established project planning and software development methodologies that outline critical business processes and stages when executing large-scale software development projects. The idea behind these methodologies is straightforward—why reinvent the wheel when there is an opportunity to learn from and follow blueprints used by those who have executed successful efforts? When methodologies are applied to projects that are framed with clear business goals and business metrics, and that engage committed executive leadership, success rates can improve dramatically.[27]

Software development methodologies (*sometimes referred to as the software development lifecycle, or SDLC*) are methods to divide tasks related to software creation and deployment up into tasks targeted at building better products with stronger product management guidelines and techniques. While software development methodologies are the topic of more advanced technology and project management courses, the savvy manager knows enough to inquire about the development methodologies and quality programs used to support large-scale development projects, and can use these investigations as further input when evaluating whether those overseeing large-scale efforts have what it takes to get the job done. There are many different software development methodologies, but it helps to know key terms and some key strengths and weaknesses to be better prepared for the inevitability of being involved in a software development project.

software development methodologies

Sometimes also referred to as the SDLC or software development life cycle—methods to divide tasks related to software creation and deployment up into tasks targeted at building better products with stronger product management guidelines and techniques.

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waterfall

A relatively linear sequential approach to software development (and other projects). Benefits include surfacing requirements up front and creating a blueprint to follow throughout a project. Often criticized for being too rigid, slow, and demanding project forethought that's tough to completely identify early on.

feature creep

An expansion of the scope of a project.

agile development

Developing work continually and iteratively, with a goal of more frequent product rollouts and constant improvement across smaller components of the larger project.

scrum

An approach to organizing and managing agile projects that breaks deliverables into "sprints" delivered in one to six week increments by teams of less than ten. Scrum defines functions (roles) for management and development, meetings (ceremonies), and how the process is documented and tracked (artifacts).

The waterfall method (*the classic, but increasingly out-of-favor approach*) is a relatively linear sequential approach to software development (and other projects). There are several variants of waterfall, but most see project progress flowing in largely one direction (downwards, from one step to another, like a waterfall) through the phases often listed as: requirements identification (documenting what it will take and showing use cases), design (what technologies should be used, who are the stakeholders impacted), implementation (building the product), verification (installation, testing, debugging), and maintenance (improving quality, fixing bugs). The goal of using these steps is to clarify what needs to be done and unearth problems early, before the project is built and deployed (which, as discussed, should reduce costs). The use of upfront documentation can help prevent "**feature creep**," or expansion of the scope of a project. And the plan helps provide strong documentation that can be helpful in future maintenance of the product.

The most significant criticism of the waterfall approach is that it is very rigid, can take a long time to implement, and requires precise forethought on all requirements needed at the end of the project. Waterfall has largely fallen out of favor, as many firms have found it restricts ongoing interaction and can take too much time, with needs in fast-changing industries shifting before a lengthy product can be completed.[28] Waterfall has even fallen out of favor in the US military, an organization often thought to use rigid planning and documentation.[29]

Agile development: While waterfall is on the way out in most organizations, the agile development approach (and variants) has become a dominant software development methodology.[30] Agile targets the weaknesses of waterfall, tackling work continually and iteratively, with a goal of more frequent product rollouts and constant improvement across smaller components of the larger project. Agile focuses on customer needs and organizational goals. Teams tackle smaller, targeted tasks with the hope of building products more quickly, with greater user input. Goals can evolve as needs unfold and new priorities come to the fore. Agile is popular due to its speed and flexibility. While some criticize the approach as one that might force products to develop too quickly and with less quality or documentation than classic approaches, there are several additional techniques often used in agile that target specific weaknesses, including test-driven design, behavior-driven development, pair programming, extreme programming, and refactoring. You may also hear other terms used with agile, including lean software (which provides additional methods for improved efficiency while cutting waste and excess), and scrum (which is a popular way to implement agile development).

Scrum is an approach to organizing and managing agile projects and is worth mentioning due to its popularity. Scrum breaks projects up into tasks called sprints that are meant to be completed in one to six weeks. Scrum teams are self-organizing and work cross-functionally, with managers, developers, designers, and users in regular contact. You'll often hear scrum described as having roles, artifacts, and ceremonies:

Roles (job functions):

- **Product owner**—represents the "voice of the customer," advocates for the needs of the organization, helps in setting requirements, and is ultimately held accountable for deliverables.
- **Scrum master**—serves the team by running meetings, keeping teams on process, and acting as a buffer to external team distractions. The scrum master may also coach the team, work with stakeholders, and partner with the product owner to manage task priority.
- **Team**—often held to a small number of task-focused workers (three to nine is common). The team provides analysis, design, development, testing, documentation, and more.

Artifacts (a way of documenting work and its current state):

1. *Product vision*—a business case for the task and value to be delivered.
2. *Product backlog*—a collection of user stories (product features described in natural language from the user's perspective). These describe a feature set. "As a user I need <something> so that <reason>." These are defined by the product owner in conjunction with other stakeholders.

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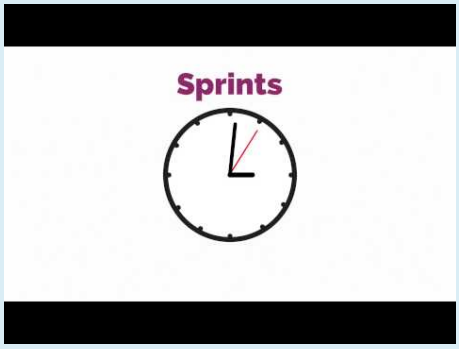
3. *Sprint backlog*—the stories that are incorporated into the next sprint—e.g., what needs to be done in the next one to three weeks.
4. Many firms implementing scrum will have a *task board* with Post-it notes that should move between columns "stories" (task requirements), "to do" (prioritized tasks, not yet started), "in-progress," "testing," and "done." Others may include a *burndown chart* or some other variant showing products completed until reaching zero. The goal is to keep everyone on task to move "stories" from "to do" to "done" within a one-to-six-week timeline.

Ceremonies (meetings):

1. *Sprint planning*—a team planning meeting where stories (requirements defined from user perspective) are fleshed out, and the goal and scope of the sprint is determined.
2. *Daily scrum*—a daily stand-up team meeting (standing keeps things quick—often limited to, or "time boxed" to no more than 15 minutes), to discuss what was completed since the previous meeting, what individuals are working on, and raising things that are blocked and need help. This meeting is meant to keep people in sync and on track, and surface insights and expertise to help.
3. *Sprint demo* and *review and retrospective* (sometimes separated)—team demonstrates completed work to product owner and discusses what worked and what can be improved for the next sprint.

Scrum in Two Minutes

A brief introduction to scrum concepts



View the video online at: http://www.youtube.com/embed/Qoa5CS9JJPQ?rel=0

Key Takeaways

- Software development methodologies seek to bring planning and structure to software development projects. When methodologies are applied to projects that are framed with clear business goals and business metrics, and that engage committed executive leadership, success rates can improve dramatically.
- The waterfall methodology is a relatively linear sequential approach to software development (and other projects). Benefits include surfacing requirements up front and creating a blueprint to follow throughout a project. Waterfall is often criticized for being too rigid, slow, and demanding project forethought that's tough to completely identify early on.
- The agile development approach (and variants) tackles work continually and iteratively, with a goal of more frequent product rollouts and constant improvement across smaller compo-

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nents of the larger project. Teams tackle smaller, targeted tasks with the hope of building products more quickly, with greater user input.

- Scrum is an approach to organizing and managing agile projects and is worth mentioning due to its popularity. Scrum breaks projects up into tasks called sprints that are meant to be completed in one to six weeks. Scrum teams are self-organizing and work cross-functionally, with managers, developers, designers, and users in regular contact.

Questions and Exercises

1. Interview a systems development person at your university or at another organization. Does the firm use software development methodologies? If so, do they use one approach for all projects? What factors went into their decision? What do they see as the pros and cons of each approach?
2. Investigate scrum. Is it possible to get scrum training online? What alternatives have you discovered? Does this seem like something you would want to pursue? Why or why not?
3. Scrum isn't limited to technology projects. Would scrum work for projects that you are working on—including school group projects or more complex tasks in other organizations? If so, try using scrum and report back to your class with results, if you have them before semester's end.
4. Investigate some of the other approaches that are sometimes combined with agile development, such as paired programming and team programming. Would you prefer to use these approaches? Why or why not?

13.7 Beyond the Price Tag: Total Cost of Ownership and the Cost of Tech Failure

Learning Objectives

1. List the different cost categories that comprise total cost of ownership.
2. Understand that once a system is implemented, the costs of maintaining and supporting the system continue.
3. List the reasons why technology development projects fail and the measures that can be taken to increase the probability of success.
4. Examine the failed launch and eventual fix associated with HealthCare.gov, understanding the factors associated with the system's botched rollout and techniques used to recover the effort.

Managers should recognize that there are a whole host of costs that are associated with creating and supporting an organization's information systems. Of course, there are programming costs for custom software as well as purchase, configuration, and licensing costs for packaged software, but there's much, much more.

There are costs associated with design and documentation (both for programmers and for users). There are also testing costs. New programs should be tested thoroughly across the various

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types of hardware the firm uses, and in conjunction with existing software and systems, *before* being deployed throughout the organization. Any errors that aren't caught can slow down a business or lead to costly mistakes that could ripple throughout an organization and its partners. Studies have shown that errors not caught before deployment could be one hundred times more costly to correct than if they were detected and corrected beforehand.[31]

Once a system is "turned on," the work doesn't end there. Firms need to constantly engage in a host of activities to support the system, which may also include:

- providing training and end user support;
- collecting and relaying comments for system improvements;
- auditing systems to ensure **compliance** (i.e., that the system operates within the firm's legal constraints and industry obligations);
- providing regular backup of critical data;
- planning for redundancy and disaster recovery in case of an outage; and
- vigilantly managing the moving target of computer security issues.

compliance

Ensuring that an organization's systems operate within required legal constraints, and industry and organizational obligations.

With so much to do, it's no wonder that firms spend 70 to 80 percent of their information systems (IS) budgets just to keep their systems running.[32] The price tag and complexity of these tasks can push some managers to think of technology as being a cost sink rather than a strategic resource. These tasks are often collectively referred to as the **total cost of ownership** (TCO) of an information system. Understanding TCO is critical when making technology investment decisions. TCO is also a major driving force behind the massive tech industry changes discussed in Chapter 14.

total cost of ownership

An economic measure of the full cost of owning a product (typically computing hardware and/or software). TCO includes direct costs such as purchase price, plus indirect costs such as training, support, and maintenance.

Why Do Technology Projects Fail?

Even though information systems represent the largest portion of capital spending at most firms, an astonishing one in three technology development projects fails to be successfully deployed.[33] Imagine if a firm lost its investment in one out of every three land purchases, or when building one in three factories. These statistics are dismal! Writing in *IEEE Spectrum*, risk consultant Robert Charette provides a sobering assessment of the cost of software failures, stating, "The yearly tab for failed and troubled software conservatively runs somewhere from $60 to $70 billion in the United States alone. For that money, you could launch the space shuttle one hundred times, build and deploy the entire twenty-four-satellite Global Positioning System, and develop the Boeing 777 from scratch—and still have a few billion left over."[34]

Why such a bad track record? Sometimes technology itself is to blame, other times it's a failure to test systems adequately, and sometimes it's a breakdown of process and procedures used to set specifications and manage projects. In one example, a multimillion-dollar loss on the NASA Mars Observer was traced back to a laughably simple oversight: Lockheed Martin contractors using English measurements, while the folks at NASA used the metric system.[35] Yes, a $125 million taxpayer investment was lost because a bunch of rocket scientists failed to pay attention to third grade math. When it comes to the success or failure of technical projects, the devil really is in the details.

Projects rarely fail for just one reason. Project postmortems often point to a combination of technical, project management, and business decision blunders. The most common factors include the following:[36]

- Unrealistic or unclear project goals
- Poor project leadership and weak executive commitment
- Inaccurate estimates of needed resources
- Badly defined system requirements and allowing "feature creep" during development
- Poor reporting of the project's status

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- Poor communication among customers, developers, and users
- Use of immature technology
- Unmanaged risks
- Inability to handle the project's complexity
- Sloppy development and testing practices
- Poor project management
- Stakeholder politics
- Commercial pressures (e.g., leaving inadequate time or encouraging corner-cutting)

Managers need to understand the complexity involved in their technology investments, and that achieving success rarely lies with the strength of the technology alone.

capability maturity model integration (CMMI)

A process-improvement approach (useful for but not limited to software engineering projects) that can assist in assessing the maturity, quality, and development of certain organizational business processes, and suggest steps for their improvement.

But there is hope. Information systems organizations can work to implement procedures to improve the overall quality of their development practices. Mechanisms for quality improvement include **capability maturity model integration (CMMI)**, which gauge an organization's process maturity and capability in areas critical to developing and deploying technology projects, and provides a carefully chosen set of best practices and guidelines to assist quality and process improvement.[37]

Firms are also well served to leverage established project planning and software development methodologies that outline critical business processes and stages when executing large-scale software development projects. The idea behind these methodologies is straightforward—why reinvent the wheel when there is an opportunity to learn from and follow blueprints used by those who have executed successful efforts.? When methodologies are applied to projects that are framed with clear business goals and business metrics, and that engage committed executive leadership, success rates can improve dramatically.[38]

Lessons Learned from the Failure and Rescue of HealthCare.gov

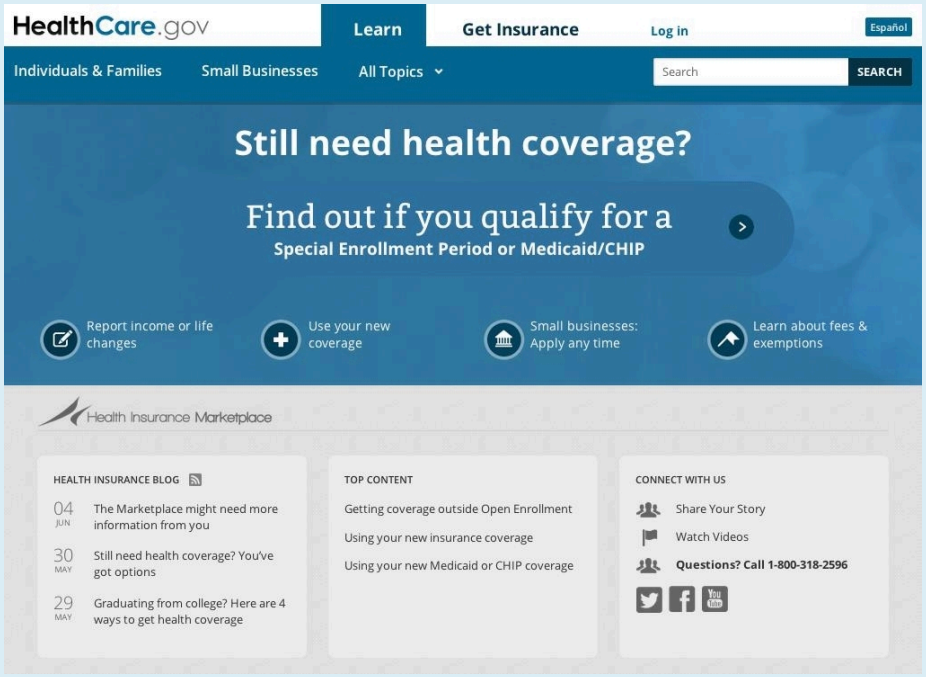
To say the Affordable Care Act was controversial is an understatement. What many regard as the signature legislation of President Obama's domestic agenda had barely passed the US Senate, squeaking by with just one vote. The US House of Representatives has voted at least fifty times to repeal or roll back parts of the law.[39] But politics aside, for the law to be successful, technology needed to work, and at rollout, it didn't.

The Affordable Care Act (a.k.a. Obamacare) called for a website, HealthCare.gov, that served as a national health care exchange where citizens could shop for, compare, and enroll in health care plans. The site would also offer subsidies for low-income enrollees and assist those eligible to sign up for Medicaid. Interest surged the first day the site went live.[40] Over 250,000 users were said to have visited HealthCare.gov on day one. What is the total enrollment after the first day? Eight.[41] That's not a typo. The system implementing HealthCare.gov was so full of bugs and design flaws that it had enrolled very few people, the number of which is enough to count using your two hands. And this is for a system where the government had agreed to pay the lead contractor $292 million.[42]

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FIGURE 13.10 Healthcare.gov Website
The HealthCare.gov website.



Source: https://www.healthcare.gov/.

The Problems

Problems with the website could have been predicted by anyone who read the previous section. The most critical issue was a lack of clear authority. Consultants brought in to fix the problem claimed they couldn't figure out who was in charge of the HealthCare.gov launch. What was seen after the launch were "multiple contractors bickering with one another and no one taking ownership for anything."[43] Technologists were also not involved in top-level planning. The president regularly ended meetings on the Affordable Care Act by saying, "I want to remind the team that this only works if the technology works." However, no one in the meetings had any idea whether the technology worked.[44] In fact, in the months leading up to the site's launch, the White House health-reform director kept the White House CTO (an executive who had previously launched two commercial health care firms), "off the invitation list for the planning meetings."

Most large-scale systems will have clear stages: requirements definition, design, development, and testing phases, but consultants brought in to survey HealthCare.gov pointed out that these phases were started on top of one another, where design and development began before requirements definition was even complete.[45]

While so-called "agile software development" methodologies allow for iterative development, they also rely on regular testing of modules developed along the way, but there were no such precautions taken with HealthCare.gov. Predeployment testing was minimal or nonexistent,[46] and the system was implemented in a single big bang rollout. One of the executives brought in to help diagnose problems and consult on fixes was former Twitter CTO Mike Abbott. Abbott knows how to fix websites in crisis. He's credited with getting Twitter past incessant "fail whale" site-down messages. Abbott said, "You never open a service like this to everyone at once. You open it in small concentric circles and expand"—such as one state first, then a few more—"so you can watch it, fix it and scale it."[47] The lack of testing also led to no credible verification on project status. The administration was so clueless to potential problems that even thirty-six hours beforehand, White House Chief of Staff Denis McDonough told a friend that "when we turn it on we're going to knock your socks off."[48]

There were also several technical and design problems with the implementation of the site. It was immediately obvious that HealthCare.gov could not scale to handle national demands. At best, the site could tolerate 1,100 simultaneous users at launch, nowhere near the 50,000–60,000 that was expected, or the 250,000 that had been reported as visiting the first day.[49] The site also

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lacked common measurement and reporting systems. Most consumer websites report data to a dashboard used by their technical staff, a summary screen that provides a quick way for engineers to measure a website's performance, showing things like access traffic and the number of times the page was loaded, and helping to pinpoint where system problems are occurring. HealthCare.gov lacked even the most basic performance dashboard. Common practices like caching frequently accessed data (storing high-demand items in memory so databases don't need to be repeatedly accessed) also weren't implemented. Also, from a design perspective, the user experience was horrible. For example, consumers were required to create an account before being able to compare plans, and the registration process created a bottleneck that further exacerbated issues, increasing wait times. Using the browser's "Back" button frequently broke the site, and users who were kicked off mid-enrollment often had to restart efforts from scratch.

The Fix

Fixing HealthCare.gov in a few weeks' time was a daunting challenge. No one knew the extent of problems or even if the system could be saved or needed to be scrapped entirely. Fixing the site required bringing in experienced management with clear leadership authority and responsibility. The White House tapped Jeff Zients, a highly regarded businessman, who at the time was deputy director of the Office of Management and Budget. Zients had experience running large bureaucratic programs (among them the "Cash for Clunkers" effort that spurred car sales following the 2008 US recession). Zients was also scheduled to take over as director of the president's National Economic Council.

A team of seasoned technologists was also brought in to lead the system triage and site fixes. Todd Park, the White House CTO, took a front-and-center role in helping assemble the team. In addition to on-site and remote consulting from Abbott, the team harnessed the expertise of Mikey Dickerson, Google's site reliability engineer. Dickerson was an administration ally and had taken a leave from Google in 2012 to help Obama staffers develop big data systems deemed responsible for getting out the winning vote.[50] Also part of the effort was Gabriel Burt, CTO at Chicago-based Civis Analytics, the firm founded by many of the analytics specialists involved in the 2012 campaign. Both men showed up in October and stayed into December.

The team needed more than leadership, they needed developer commitment. Abbott said, "The first red flag you look for is whether there is a willingness by the people there to have outside help. If not, then I'd say it's simpler to write it new than to understand the code base as it is, if the people who wrote it are not cooperating. But they were eager to cooperate."[51]

At times, it seemed that bureaucracy was conspiring to halt goodwill. Government regulations don't allow for volunteers to work on government projects for sustained periods of time. So new leadership actually had to be put on the payroll of contractor QSSI as hourly workers, earning Dickerson what he reported was "a fraction" of his Google pay.[52]

Clear priority setting, results reporting, and coordination were implemented through stand-up meetings, which is common among practitioners of agile development and popular inside the development groups of many leading tech firms and startups. In a stand-up meeting, technologists stand up (no sitting, be quick and to the point), identify a problem or a set of problems they're facing, identify obstacles to gaining a solution, gain quick feedback from the group, then disperse to solve presented problems, reporting back at the end of the day at a recap stand-up. An open phone line would connect people working on the website at other locations. The stand-ups helped everyone feel progress toward common goals and offered coordination that early project management lacked.

The Result

The nonpartisan Congressional Budget Office (CBO) originally projected seven million enrollees and revised that figure down to six million after persistent website glitches plagued HealthCare.gov. Despite what was likely the most disastrous and embarrassing rollout of a consumer-facing government technology initiative, HealthCare.gov had actually signed up over eight million insurance users by mid-April (roughly two weeks after the original deadline, which was extended due to rollout problems).

While the system's failure was large and public, it was by no means an anomaly. Research firm the Standish Group estimates that in the past ten years, some 94 percent of large federal information technology projects were unsuccessful: "More than half were delayed, over budget, or didn't meet user expectations, and 41.4 percent failed completely." The United States isn't alone

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in government technology failures. The United Kingdom's National Health Service wasted almost $20 billion to computerize medical records before eventually abandoning the project. Wise managers will learn from the lessons of HealthCare.gov.[53]

Key Takeaways

- The care and feeding of information systems can be complex and expensive. The total cost of ownership of systems can include software development and documentation, or the purchase price and ongoing license and support fees, plus configuration, testing, deployment, maintenance, support, training, compliance auditing, security, backup, and provisions for disaster recovery. These costs are collectively referred to as TCO, or a system's total cost of ownership.
- Information systems development projects fail at a startlingly high rate. Failure reasons can stem from any combination of technical, process, and managerial decisions.
- System errors that aren't caught before deployment can slow down a business or lead to costly mistakes that could ripple throughout an organization. Studies have shown that errors not caught before deployment could be 100 times more costly to correct than if they were detected and corrected beforehand.
- Firms spend 70 percent to 80 percent of their IS budgets just to keep their systems running.
- IS organizations can employ project planning and software development methodologies to implement procedures and to improve the overall quality of their development practices.
- IS organizations can leverage software development methodologies to improve their systems development procedures, and firms can strive to improve the overall level of procedures used in the organization through models like CMMI. However, it's also critical to engage committed executive leadership in projects, and to frame projects using business metrics and outcomes to improve the chance of success.
- A combination of managerial and technical issues conspired to undermine the rollout of HealthCare.gov. While the website was effectively unusable at launch, a systematic effort of management authority, communication, coordination, and expertise rescued the effort, allowing the site to exceed enrollment projections.

Questions and Exercises

1. Search online for examples of failed information systems development efforts. Come to class prepared to describe the failure, give its size and scope, the perceived reasons for the failure, and what managers could have done to prevent this failure. As a class, see if any key takeaways emerge. Are there any examples highlighting issues not mentioned in this chapter? If so, tweet links to any articles to #BizTechBook.
2. Healthcare.gov was clearly botched at the start. Some have claimed this suggests private enterprise is better suited to lead such projects than the government, but are there examples of corporations that have failed, as well? Are there any additional takeaways that would help both government planners as well as corporate managers?

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CHAPTER 14

Software in Flux: Open Source, Cloud, Virtualized, and App-Driven Shifts

14.1 Introduction

Learning Objectives

1. Understand how low marginal costs, network effects, and switching costs have combined to help create a huge and important industry.
2. Recognize that the software industry is undergoing significant and broadly impactful change brought about by several increasingly adopted technologies including open source software, cloud computing, and software as a service.

marginal costs

The costs associated with each additional unit produced.

For many, software has been a magnificent business. It is the $400 billion-per-year juggernaut[1] that placed Microsoft's Bill Gates and Oracle's Larry Ellison among the wealthiest people in the world. Increasingly, even defining the software industry is difficult. It powers everything from media consumption (Netflix, Spotify) to appliances (Nest, Apple Homekit). It drives modern farming, scientific discovery, and even the most mundane task such as driving (self-parking features have become commonplace, and software drives functions ranging from airbags to GPS). Once a successful software product has been written, the economics for a category-leading offering are among the best you'll find in any industry.[2] Unlike physical products assembled from raw materials, the **marginal cost** to produce an additional copy of a software product is effectively zero. Just duplicate, no additional input required. That quality leads to businesses that can gush cash. Microsoft generates one and a half billion dollars a month from Windows and Office alone.[3] Network effects and switching cost can also offer a leading software firm a degree of customer preference and lockin that can establish a firm as a standard and, in many cases, creates winner-take-all (or at least winner-take-most) markets.

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open source software (OSS)

Software that is free and where anyone can look at and potentially modify the code.

cloud computing

Replacing computing resources—either an organization's or individual's hardware or software—with services provided over the Internet.

software as a service (SaaS)

A form of cloud computing where a firm subscribes to a third-party software and receives a service that is delivered online.

virtualization

A type of software that allows a single computer (or cluster of connected computers) to function as if it were several different computers, each running its own operating system and software. Virtualization software underpins most cloud computing efforts, and can make computing more efficient, cost-effective, and scalable.

But as great as the business has been, the fundamental model powering the software industry is under assault. **Open source software (OSS)** offerings—free alternatives where anyone can look at and potentially modify a program's code—pose a direct challenge to the assets and advantages cultivated by market leaders. Giants shudder—"How can we compete with free?"—while others wonder, "How can we make money and fuel innovation on free?" And if free software wasn't enough of a shock, the way firms and users think about software is also changing. A set of services referred to as **cloud computing** is making it more common for a firm to move software out of its own IS shop so that it is run on someone else's hardware. In one variant of this approach known as **software as a service (SaaS)**, users access a *vendor's software* over the Internet, usually by simply starting up a Web browser. With SaaS, you don't need to own the program or install it on your own computer. Hardware clouds can let firms take *their software* and run it on someone else's hardware—freeing them from the burden of buying, managing, and maintaining the physical computing that programs need. Another software technology called **virtualization** can make a single computer behave like many separate machines. This function helps consolidate computing resources and creates additional savings and efficiencies.

Perhaps equally remarkable are the firms that are pioneering these efforts. A few years back you might have expected giants like IBM, HP, Microsoft, and Sun to drive the future of computing. But if you look at the leading contributors to many of the most widely used open source efforts or providers of widely used cloud infrastructure, you will see that major players include (as *BusinessWeek* put it) a retailer (Amazon), an entertainment company (Netflix), an advertiser (Google), a résumé site (LinkedIn), and a social network (Facebook).[4] And our notion of packaged software is also challenged by instant access to a cornucopia of offerings through device app stores, covering smartphones, tablets, televisions, smart speakers, and more. App offerings further change the underlying economics and possibilities of the software industry and have been a catalyst for the birth of several innovative, billion-dollar-plus businesses.

These transitions are important. They mean that smaller firms have access to the kinds of burly, sophisticated computing power that only giants had access to in the past. Startups can scale quickly and get up and running with less investment capital. Existing firms can leverage these technologies to reduce costs. Got tech firms in your investment portfolio? Understanding what's at work here can inform decisions you make on which stocks to buy or sell. If you make tech decisions for your firm or make recommendations for others, these trends may point to which firms have strong growth and sustainability ahead, or which may be facing troubled times.

Key Takeaways

- The software business is attractive due to near-zero marginal costs and an opportunity to establish a standard—creating the competitive advantages of network effects and switching costs.
- New trends in the software industry, including open source software (OSS), cloud computing, software as a service (SaaS), and virtualization are creating challenges and opportunities across tech markets. Understanding the impact of these developments can help a manager make better technology choices and investment decisions.

Questions and Exercises

1. What major trends, outlined in this section, are reshaping how we think about software? What industries and firms are potentially impacted by these changes? Why do managers, investors, and technology buyers care about these changes?
2. Which organizations might benefit from these trends? Which might be threatened? Why?

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3. What are marginal costs? Are there other industries that have cost economics similar to the software industry?
4. Investigate the revenues and net income of major software players: Microsoft, Google, Oracle, Red Hat, and Salesforce.com. Which firms have higher revenues? Net income? Which have better margins? What do the trends in OSS, SaaS, and cloud computing suggest for these and similar firms?
5. How might the rise of OSS, SaaS, and cloud computing impact hardware sales? How might it impact entrepreneurship and smaller businesses?

14.2 Open Source

Learning Objectives

1. Define open source software and understand how it differs from conventional offerings.
2. Provide examples of open source software and how firms might leverage this technology.

Who would have thought a twenty-one-year-old from Finland could start a revolution that continues to threaten the Microsoft Windows empire? But Linus Torvalds did just that. During a marathon six-month coding session, Torvalds created the first version of Linux[5] marshaling open source revolutionaries like no one before him. Instead of selling his operating system, Torvalds gave it away. Now morphed and modified into scores of versions by hundreds of programmers, **Linux** can be found just about everywhere, and most folks credit Linux as being the most significant product in the OSS arsenal. Today Linux powers everything from cell phones to stock exchanges, set-top boxes to supercomputers. You'll find the OS on the majority of smartphones, tablets,[6] and supercomputers,[7] and supporting most Web servers (including those at Google, Amazon, and Facebook). Linux makes up roughly 92 percent of servers in Amazon's AWS cloud business,[8] while even Microsoft's Azure cloud is over 40 percent Linux.[9] Linux forms the core of the TiVo operating system, it underpins Google's Android and Chrome OS offerings, and it has even gone interplanetary. Linux has been used to power the Phoenix Lander and to control the Spirit and Opportunity Mars rovers.[10] Yes, Linux is even on Mars!

Linux

An open source software operating system.

n00b

Written with two zeros, pronounced "newb." Geek-slang (leet speak), derogatory term for an uninformed or unskilled person.

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How Do You Pronounce Linux?

Most English speakers in the know pronounce Linux in a way that rhymes with "*cynics*." You can easily search online to hear video and audio clips of Linus (whose name is actually pronounced "Lean-us" in Finnish) pronouncing the name of his OS. In deference to Linux, some geeks prefer something that sounds more like "*lean-ooks*" (for example, see http://suseroot.com/about-suse-linux/how-do-you-pronounce-linux.php). Just don't call it "*line-ucks*," or the tech-savvy will think you're an open source **n00b**! Oh yeah, and while we're on the topic of operating system pronunciation, the Macintosh operating system OS X is pronounced "oh es ten."

FIGURE 14.1 Tux, the Linux Mascot



Source: lewing@isc.tamu.edu Larry Ewing and The GIMP [Attribution], via Wikimedia Commons.

Open source software (OSS) is often described as free. While most OSS can be downloaded for free over the Internet, it's also "free" as in liberated (you may even see the acronym FLOSS for free/libre/open source software). The source code for OSS products is openly shared. Anyone can look at the source code, change it, and even redistribute it, provided the modified software continues to remain open and free.[11] This openness is in stark contrast to the practice of conventional software firms, who treat their intellectual property as closely guarded secrets and who almost never provide the source code for their commercial software products. As the movement began to pick up steam, many software industry execs became downright hostile toward OSS. The former president of SAP once referred to the open source movement as "socialism," while a former Microsoft CEO has called Linux a "cancer."[12]

But while execs at some firms saw OSS as a threat undermining the lifeblood of their economic model, other big-name technology companies are now solidly behind the open source movement. The old notion of open source being fueled on the contributions of loners tooling away for the glory of contributing to better code is now largely inaccurate. The vast majority of people who work on efforts like Linux are now paid to do so by commercially motivated employers.[13] Nearly every major hardware firm and a list of tech giants (e.g., Apple, Box, Facebook, Google, IBM, LinkedIn, Netflix, and Twitter) have paid staff contributing to open source projects[14]—an open source workforce collectively numbers in the thousands.[15] Most firms also work together to fund foundations that set standards and coordinate the release of product revisions and improvements. Such coordination is critical—helping, for example, to ensure that various versions of products can work alike and operate together.

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Turn on the LAMP—It's Free!

FIGURE 14.2 The Lamp Stack



Open source is big on the Web. In fact, you'll often hear Web programmers and open source advocates refer to the LAMP stack. **LAMP** is an acronym that stands for the Linux operating system, the Apache Web server software, the MySQL database, and any of several programming languages that start with the letter "P"—Python, Perl, and PHP. From Facebook to YouTube, you'll find LAMP software powering many of the sites you visit each day.

LAMP

An acronym standing for **L**inux, the **A**pache Web server software, the **M**ySQL database, and any of several programming languages that start with **P** (e.g., Perl, Python, or PHP).

Key Takeaways

- OSS is not only available for free, but also makes source code available for review and modification (for the Open Source Initiatives list of the criteria that define an open source software product, see http://opensource.org/docs/osd).
- While open source alternatives are threatening to conventional software firms, some of the largest technology companies now support OSS initiatives and work to coordinate standards, product improvements, and official releases.
- The flagship OSS product is the Linux operating system, now available on all scales of computing devices from cell phones to supercomputers.
- The LAMP stack of open source products is used to power many of the Internet's most popular websites. Linux can be found on a large percentage of corporate servers; supports most Web servers, smartphones, tablets, and supercomputers; and is integral to TiVo and Android-based products.
- The majority of people who work on open source projects are paid by commercially motivated employers.

Questions and Exercises

1. Who developed Linux?
2. Who develops it today?
3. List the components of the LAMP stack. Which commercial products do these components compete with (investigate online, if necessary)?
4. Why do commercial firms contribute to open source consortia and foundations?
5. Free doesn't always win. Why might a firm turn down free software in favor of a commercial alternative?

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14.3 Why Open Source?

Learning Objectives

1. Know the primary reasons firms choose to use OSS.
2. Understand how OSS can beneficially impact industry and government.

There are many reasons why firms choose open source products over commercial alternatives:

Cost—Free alternatives to costly commercial code can be a tremendous motivator, particularly since conventional software often requires customers to pay for every copy used and to pay more for software that runs on increasingly powerful hardware. Banking giant Barclays has been able to reduce software costs by 90 percent by switching to open source products.[16] Online broker E*TRADE estimates that its switch to open source helped save over $13 million a year.[17] And Amazon claimed in SEC filings that the switch to open source was a key contributor to nearly $20 million in tech savings.[18] Firms like TiVo, which use OSS in their own products, eliminate a cost spent either developing their own operating system or licensing similar software from a vendor like Microsoft.

Reliability—There's a saying in the open source community, "Given enough eyeballs, all bugs are shallow."[19] What this means is that the more people who look at a program's code, the greater the likelihood that an error will be caught and corrected. The open source community harnesses the power of legions of geeks who are constantly trawling OSS products, looking to squash bugs and improve product quality. And studies have shown that the quality of popular OSS products outperforms proprietary commercial competitors.[20] In one study, Carnegie Mellon University's Cylab estimated the quality of Linux code to be less buggy than commercial alternatives by a factor of two hundred![21]

security-focused

Also known as "hardened." Term used to describe technology products that contain particularly strong security features.

Security—OSS advocates also argue that by allowing "many eyes" to examine the code, the security vulnerabilities of open source products come to light more quickly and can be addressed with greater speed and reliability.[22] High-profile hacking contests have frequently demonstrated the strength of OSS products. In one event, laptops running Windows and the Mac OS were both hacked (the latter in just two minutes), while a laptop running Linux remained uncompromised.[23] Government agencies and the military often appreciate the opportunity to scrutinize open source efforts to verify system integrity (a particularly sensitive issue among foreign governments leery of legislation like the USA PATRIOT Act of 2001).[24] Many OSS vendors offer **security-focused** (sometimes called *hardened*) versions of their products. These can include systems that monitor the integrity of an OSS distribution, checking file size and other indicators to be sure that code has not been modified and redistributed by bad guys who've added a back door, malicious routines, or other vulnerabilities.

scalability

Ability to either handle increasing workloads or to be easily expanded to manage workload increases. In a software context, systems that aren't scalable often require significant rewrites or the purchase or development of entirely new systems.

Scalability—Many major OSS efforts can run on everything from cheap commodity hardware to high-end supercomputing. **Scalability** allows a firm to grow from startup to blue chip without having to significantly rewrite their code, potentially saving big on software development costs. Not only can many forms of OSS be migrated to more powerful hardware, software like Linux has also been optimized to balance a server's workload among a large number of machines working in tandem. Brokerage firm E*TRADE claims that usage spikes following sweeping US Federal Reserve moves flooded the firm's systems, creating the highest utilization levels in five years. But E*TRADE credits its scalable open source systems for maintaining performance while competitors' systems struggled.[25]

Agility and Time to Market—Vendors who use OSS as part of product offerings may be able to skip whole segments of the software development process, allowing new products to reach the

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market faster than if the entire software system had to be developed from scratch, in-house. Motorola has claimed that customizing products built on OSS has helped speed time-to-market for the firm's mobile phones, while the team behind the Zimbra e-mail and calendar effort built their first product in just a few months by using some forty blocks of free code.[26]

When the Open Source Army Doesn't Show Up: Lessons from Heartbleed

Many open source projects are very well maintained, with tightly coordinated contribution armies overseen by well-funded, paid professionals. For example, Red Hat is one of many private firms helping maintain and improve Linux, the firm EnterpriseDB is heavily involved in supporting the PostgreSQL database product, and Google's many open source efforts include stewardship of the Python programming language. But some widely used open source products have been woefully neglected, and this became abundantly clear with the exposure of the Heartbleed bug in spring 2014.

Heartbleed was an error in the OpenSSL security toolkit, a product used by some two-thirds of Internet websites, and underpinning security related to the little padlock many Web browsers show when sending secure information over the Internet.[27] But for a product that handles a significant chunk of the thirty billion annual e-commerce transactions, OpenSSL was maintained by a pitifully undersourced effort. Most of the work was done by "two guys named Steve" who had never met and didn't have much of a budget to speak of. A routine coding error in the widely distributed software opened a hole that could potentially have been used to allow hackers to gather passwords, encryption keys, and other sensitive information, triggering "the largest security breach in the history of the human race."[28]

In order to help funnel money and resources to underserved and high-value open source projects, the Linux Foundation developed a multimillion-dollar project called the Core Infrastructure Initiative, designed "to fund open source projects that are in the critical path for core computing functions." Big name and deep-pocketed backers include Google, IBM, Facebook, and Microsoft. An initial earmark of $3.9 million was committed for the first three years of the effort, with larger firms committed to pay at least $100,000 into the annual funding pot. It shouldn't be surprising that OpenSSL is first up on the initiative's support list.

Heartbleed provides a cautionary tale to managers: Just because a tool is used by many doesn't mean one shouldn't audit its software products to understand the strength of support and potential risks associated with use.

Key Takeaways

- The most widely cited benefits of using OSS include low cost; increased reliability; improved security and auditing; system scalability; and helping a firm improve its time to market.
- Free OSS has resulted in cost savings for many large companies in several industries.
- OSS often has fewer bugs than its commercial counterparts due to the large number of software developers who have looked at the code.
- The huge exposure to scrutiny by developers and other people helps to strengthen the security of OSS.
- "Hardened" versions of OSS products often include systems that monitor the integrity of an OSS distribution, checking file size and other indicators to be sure that code has not been modified and redistributed by bad guys who have added a back door, malicious routines, or other vulnerabilities.
- OSS can be easily migrated to more powerful computers as circumstances dictate, and also can balance workload by distributing work over a number of machines.
- Vendors who use OSS as part of product offerings may be able to skip whole segments of the software development process, allowing new products to reach the market faster.

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Questions and Exercises

1. What advantages does OSS offer TiVo? What alternatives to OSS might the firm consider, and why do you suppose the firm decided on OSS?
2. What's meant by the phrase, "Given enough eyeballs, all bugs are shallow"? Provide evidence that the insight behind this phrase is an accurate one. How does this phrase relate to the Heartbleed bug?
3. How has OSS benefited E*TRADE? Amazon? Motorola? Zimbra? What benefits were achieved in each of these examples?
4. Describe how OSS provides a firm with scalability. What does this mean, and why does this appeal to a firm? What issues might a firm face if chosen systems aren't scalable?
5. The website NetCraft (http://www.netcraft.com) is one of many that provide a tool to see the kind of operating system and Web server software that a given site is running. Visit NetCraft or a similar site and enter the address of some of your favorite websites. How many run open source products (e.g., the Linux OS or Apache Web server)? Do some sites show their software as "unknown"? Why might a site be reluctant to broadcast the kind of software that it uses?

14.4 Examples of Open Source Software

Learning Objectives

1. Recognize that just about every type of commercial product has an open source equivalent.
2. Be able to list commercial products and their open source competitors.

Just about every type of commercial product has an open source equivalent. Want to take a look at what's out there, and get a gander at the code? Check out GitHub, where millions of projects are hosted and shared (coding students take note: today's employers assume you're GitHub savvy since this is a service many use for project collaboration). Many of these products come with the installation tools, support utilities, and full documentation that make them difficult to distinguish from traditional commercial efforts.[29] In addition to the LAMP products, some major examples include the following:

- WordPress—software for running a blog or website, powering about a third of websites.[30]
- Firefox—a Web browser that competes with Chrome, Safari, and Internet Explorer
- LibreOffice—a competitor to Microsoft Office
- Gimp—a graphic tool with features found in Photoshop
- Shotcut for video editing and Audacity for audio editing
- Magento—e-commerce software
- TensorFlow—open source machine learning software
- Alfresco—collaboration software that competes with Microsoft Sharepoint and EMC's Documentum
- Marketcetera—an enterprise trading platform for hedge fund managers that competes with FlexTrade and Portware

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- Zimbra—open source e-mail software that competes with Outlook server
- MySQL, Ingres, and PostgreSQL—open source relational database software packages that go head-to-head with commercial products from Oracle, Microsoft, SAP, and IBM
- MongoDB, HBase, and Cassandra—nonrelational distributed databases used to power massive file systems (used to power key features on Facebook, Twitter, LinkedIn, and Amazon)
- SugarCRM—customer relationship management software that competes with Salesforce.com and Siebel
- Docker–tools for "containerization," an evolution beyond virtualization.
- Asterisk—an open source implementation for running a PBX corporate telephony system that competes with offerings from Nortel and Cisco, among others
- Git—version control software, critical to managing most commercial software products.
- Free BSD and Sun's OpenSolaris—open source versions of the Unix operating system

Key Takeaways

- There are thousands of open source products available, covering nearly every software category. Many have a sophistication that rivals commercial software products.
- Not all open source products are contenders. Less popular open source products are not likely to attract the community of users and contributors necessary to help these products improve over time (again we see network effects are a key to success—this time in determining the quality of an OSS effort).
- Just about every type of commercial product has an open source equivalent.

Questions and Exercises

1. Make a brief list of commercial product categories that an individual or enterprise might use. Are there open source alternatives for these categories? Are well-known firms leveraging these OSS offerings? Which commercial firms do they compete with? Explore GitHub and do some additional research on top and rising open source projects. Report back to class with examples you find most interesting and promising.
2. Why is open source so important for software development and IS professionals? How should programming students leverage resources available to improve learning, job prospects, and their credibility when job hunting?
3. Are the OSS efforts you identified above provided by commercial firms, nonprofit organizations, or private individuals? Does this make a difference in your willingness to adopt a particular product? Why or why not? What other factors influence your adoption decision?
4. Download a popular, end-user version of an OSS tool that competes with a desktop application that you own, or that you've used (hint: choose something that's a smaller file or easy to install). What do you think of the OSS offering compared to the commercial product? Will you continue to use the OSS product? Why or why not?

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14.5 Why Give It Away? The Business of Open Source

Learning Objectives

1. Understand the disproportional impact OSS has on the IT market.
2. Understand how vendors make money on open source.

Open source is a $60 billion industry,[31] but it has a disproportionate impact on the trillion-dollar IT market. Some 95 percent of IT organizations use open-source software in mission-critical IT projects. By lowering the cost of computing, open source efforts make more computing options accessible to smaller firms. More reliable, secure computing also lowers costs for all users. OSS also diverts funds that firms would otherwise spend on fixed costs, like operating systems and databases, so that these funds can be spent on innovation or other more competitive initiatives. Think about Google, a firm that some estimate has over 1.4 million servers. Imagine the costs if it had to license software for each of those boxes!

Commercial interest in OSS has sparked an acquisition binge. Open source firms that are valued in excess of $1 billion include now-public Hortonworks, Cloudera, and MapR (all provide big data tools built on open source Hadoop), MongoDB (an open source NoSQL database leader), and Docker (a virtualization technology known as "containers").[32] Red Hat, the first open-source firm to go public, has a market cap of around $30 billion.[33]

But how do *vendors* make money on open source? One way is by selling support and consulting services. Red Hat brings in $3 billion a year from paying customers subscribing for access to software updates and support services, while Oracle, a firm that sells commercial ERP and database products, provides Linux for free, selling high-margin Linux support contracts for as much as $500,000.[34] The added benefit for Oracle? Weaning customers away from Microsoft—a firm that sells many products that compete head-to-head with Oracle's offerings. Service also represents the most important part of IBM's business. The firm now makes more from services than from selling hardware and software.[35] And every dollar saved on buying someone else's software product means more money IBM customers can spend on IBM computers and services. Many open firms also sell their premium add-ons on top of the free stuff. MongoDB, for example, charges firms that run its management software on more than eight servers. And others are leveraging the cloud, too. Docker will sell hosted services for firms that don't want to run their product in-house.[36]

Here's where we also can relate the industry's evolution to what we've learned about standards competition in our earlier chapters. In the pre-Linux days, nearly every major hardware manufacturer made its own, incompatible version of the Unix operating system. These fractured, incompatible markets were each so small that they had difficulty attracting third-party vendors to write application software. Now, much to Microsoft's dismay, all major hardware firms run Linux. That means there's a large, unified market that attracts software developers who might otherwise write for Windows.

To keep standards unified, several Linux-supporting hardware and software firms also back the Linux Foundation, the nonprofit effort where Linus Torvalds serves as a fellow, helping to oversee Linux's evolution. Sharing development expenses in OSS has been likened to going in on a pizza together. Everyone wants a pizza with the same ingredients. The pizza doesn't make you smarter or better. So why not share the cost of a bigger pie instead of buying by the slice?[37] With OSS, hardware firms spend less money than they would in the brutal, head-to-head competition where each once offered a "me too" operating system that was incompatible with rivals but offered little dif-

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ferentiation. Hardware firms now find their technical talent can be deployed in other value-added services mentioned above: developing commercial software add-ons, offering consulting services, and enhancing hardware offerings.

Linux on the Desktop?

While Linux is a major player in enterprise software, mobile phones, and consumer electronics, the Linux OS can only be found on a tiny fraction of desktop computers. There are several reasons for this. Some suggest Linux simply isn't as easy to install and use as Windows or the Mac OS. This complexity can raise the **total cost of ownership** (TCO) of Linux desktops, with additional end-user support offsetting any gains from free software. The small number of desktop users also dissuades third-party firms from porting popular desktop applications over to Linux. For consumers in most industrialized nations, the added complexity and limited desktop application availability of desktop Linux just it isn't worth the one to two hundred dollars saved by giving up Windows.

total cost of ownership

An economic measure of the full cost of owning a product (typically computing hardware and/or software). TCO includes direct costs such as purchase price, plus indirect costs such as training, support, and maintenance.

Legal Risks and Open Source Software: A Hidden and Complex Challenge

Open source software isn't without its risks. Competing reports cite certain open source products as being difficult to install and maintain (suggesting potentially higher total cost of ownership, or TCO). Adopters of OSS without support contracts may lament having to rely on an uncertain community of volunteers to support their problems and provide innovative upgrades. Another major concern is legal exposure. Firms adopting OSS may be at risk if they distribute code and aren't aware of the licensing implications. Some commercial software firms have pressed legal action against the users of open source products when there is a perceived violation of software patents or other unauthorized use of their proprietary code.

For example, Microsoft once suggested that Linux and other open source software efforts violated some two hundred thirty-five of its patents.[38] The firm then began collecting payments and gaining access to the patent portfolios of companies that use the open source Linux operating system in their products, including Fuji, Samsung, and Xerox.

Also complicating issues are the varying open source license agreements (these go by various names, such as GPL and the Apache License), each with slightly different legal provisions—many of which have evolved over time. Keeping legal with so many licensing standards can be a challenge, especially for firms that want to bundle open source code into their own products.[39] An entire industry has sprouted up to help firms navigate the mine field of open source legal licenses. Chief among these are products such as those offered by the firm Black Duck, which analyze the composition of software source code and report on any areas of concern so that firms can honor any legal obligations associated with their offerings. Keeping legal requires effort and attention, even in an environment where products are allegedly "free." This also shows that even corporate lawyers had best geek-up if they want to prove they're capable of navigating a twenty-first-century legal environment.

Key Takeaways

- Business models for firms in the open source industry are varied, and can include selling support services and add-on products, offering hosting to run and maintain customer projects "in the cloud," licensing OSS for incorporation into commercial products, and using OSS to fuel hardware sales.
- Many firms are trying to use OSS markets to drive a wedge between competitors and their customers.
- Linux has been very successful on mobile devices and consumer electronics, as well as on high-end server class and above computers. But it has not been as successful on the desk-

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top. The small user base for desktop Linux makes the platform less attractive for desktop software developers. Incompatibility with Windows applications, switching costs, and other network effects–related issues all suggest that Desktop Linux has an uphill climb in more mature markets.

- OSS also has several drawbacks and challenges that limit its appeal. These include complexity of some products and a higher total cost of ownership for some products, concern about the ability of a product's development community to provide support or product improvement, and legal and licensing concerns.

Questions and Exercises

1. Describe the impact of OSS on the IT market.
2. Show your understanding of the commercial OSS market. How do Red Hat, Oracle, Oracle's Sun division, and IBM make money via open source?
3. Visit Mozilla.org. Which open source products does this organization develop? Investigate how development of these efforts is financed. How does this organization differ from the ones mentioned above?
4. What is the Linux Foundation? Why is it necessary? Which firms are members, underwriting foundation efforts?
5. List the reasons why Linux is installed on only a very small fraction of desktop computers. Are there particular categories of products or users who might see Linux as more appealing than conventional operating systems? Do you think Linux's share of the desktop market will increase? Why or why not?
6. How is Microsoft combating the threat of open source software and other free tools that compete with its commercial products?
7. Conduct additional research online. What is the dominant open source database software product? How has stewardship of the leading OSS database effort changed in recent years? Who oversees the effort today? What questions does this raise for the product's future? Investigate the current status of this effort—reaction of the developer community, continued reception of the product—and be prepared to share your findings with the class.
8. List some of the risks associated with using OSS. Give examples of firms that might pass on OSS software, and explain why.

14.6 Defining Cloud Computing

Learning Objectives

1. Understand the concept of cloud computing.
2. Identify the major categories of cloud computing, including SaaS, PaaS, and IaaS.

When folks talk about cloud computing they're really talking about replacing computing resources—either an organization's or an individual's hardware or software—with *services* provided over the Internet. The name actually comes from the popular industry convention of drawing the Internet or other computer network as a big cloud. The various businesses that fall under the rubric of cloud computing are predicted to continue to grow tremendously from an estimated $260 billion in 2017 to over $411 billion by 2020.[40]

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Cloud computing encompasses a bunch of different efforts. We'll concentrate on describing, providing examples of, and analyzing the managerial implications of two separate categories of cloud computing: (1) *software as a service (SaaS)*, where a firm subscribes to a third-party software-replacing service that is delivered online, and (2) models often referred to as **utility computing**, which can include variants such as *platform as a service* (PaaS) and *infrastructure as a service* (IaaS). Think of SaaS as delivering end-user software to a firm over the Internet instead of on the organization's own computing resources. PaaS delivers tools (a.k.a., a platform) so an organization can develop, test, and deploy software in the cloud. These could include programming languages, database software, product testing and deployment software, and an operating system. IaaS offers an organization a more bare-bones set of services that are an alternative to buying its own physical hardware—that is, computing, storage, and networking resources are instead allocated and made available over the Internet and are paid for based on the amount of resources used. With IaaS firms get the most basic offerings but can also do the most customization, putting their own tools (operating systems, databases, programming languages) on top. Typically, the further down this stack you go, the more support and maintenance services your own organization needs to perform (less for SaaS, the most for IaaS since that's where a firm heavily customizes and runs its own tech). A later section on virtualization will discuss how some organizations are developing their own private clouds, pools of computing resources that reside inside an organization and that can be served up for specific tasks as need arrives.

utility computing

A form of cloud computing where a firm develops its own software, and then runs it over the Internet on a service provider's computers.

The benefits and risks of SaaS and the utility computing-style efforts are very similar, but understanding the nuances of each effort can help you figure out if and when the cloud makes sense for your organization. The evolution of cloud computing also has huge implications across the industry: from the financial future of hardware and software firms, to cost structure and innovativeness of adopting organizations, to the skill sets likely to be most valued by employers.

Key Takeaways

- Cloud computing refers to replacing computing resources—of either an organization or individual's hardware or software—with services provided over the Internet.
- Software as a service (SaaS) refers to a third-party software-replacing service that is delivered online.
- Platform as a service (PaaS) delivers tools (a.k.a., a platform) so an organization can develop, test, and deploy software in the cloud. These could include programming languages, database software, and product testing and deployment software.
- Infrastructure as a service (IaaS) offers an organization an alternative to buying its own physical hardware. Computing, storage, and networking resources are instead allocated and made available over the Internet and are paid for based on the amount of resources used. IaaS offers the most customization, with firms making their own choices on what products to install, develop, and maintain (e.g., operating systems, programming languages, databases) on the infrastructure they license.
- SaaS typically requires the least amount of support and maintenance; IaaS requires the most, since firms choose the tech they want to install, craft their own solution, and run it on what is largely a "blank canvas" of cloud-provided hardware.
- Cloud computing is reshaping software, hardware, and service markets and is impacting competitive dynamics across industries.

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Questions and Exercises

1. Define cloud computing.
2. Identify and contrast the categories of cloud computing. Which typically requires the most support and maintenance, and why? Why would firms choose a platform that requires more support and maintenance?

14.7 Software in the Cloud: Why Buy When You Can Rent?

Learning Objectives

1. Know how firms using SaaS products can dramatically lower several costs associated with their information systems.
2. Know how SaaS vendors earn their money.
3. Be able to list the benefits to users that accrue from using SaaS.
4. Be able to list the benefits to vendors from deploying SaaS.

If open source isn't enough of a threat to firms that sell packaged software, a new generation of products, collectively known as SaaS, can deliver your computing through your Web browser or app. Don't install software—let someone else run it for you and deliver the results over the Internet.

Software as a service (SaaS) refers to software that is made available by a third party online. You might also see the terms ASP (application service provider) or HSV (hosted software vendor) used to identify this type of offering, but those are now used less frequently. SaaS is potentially a very big deal. Firms using SaaS products can dramatically lower several costs associated with the care and feeding of their information systems, including software licenses, server hardware, system maintenance, and IT staff. Most SaaS firms earn money via a usage-based pricing model akin to a monthly subscription. Others offer free services that are supported by advertising, while others promote the sale of upgraded or premium versions for additional fees.

Make no mistake, SaaS is yet another direct assault on traditional software firms. The most iconic SaaS firm is Salesforce.com, an enterprise customer relationship management (CRM) provider. This "un-software" company even sports a logo featuring the word "software" crossed out, *Ghostbusters*-style.[41]

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Other enterprise-focused SaaS firms compete directly with the biggest names in software. Some of these upstarts are even backed by leading enterprise software executives. Examples include NetSuite (funded in part by Oracle's Larry Ellison, and which Oracle eventually bought for over $9 billion), which offers a comprehensive SaaS ERP suite; Workday (launched by founders of PeopleSoft), which has SaaS offerings for managing human resources; HubSpot, which provides marketing software; ServiceNow, which monitors and manages a firm's IT infrastructure via a SaaS model; and Splunk, which provides SaaS-based analytics tools. Several traditional software firms have countered startups by offering SaaS efforts of their own. IBM offers an SaaS version of its Cognos business intelligence products, Oracle offers CRM On Demand and also purchased NetSuite, and SAP's Business ByDesign includes a full suite of enterprise SaaS offerings. Even Microsoft has gone SaaS, with a variety of Web-based services that include CRM, Web meeting tools, collaboration, e-mail, and calendaring.

FIGURE 14.3 Salesforce.com Origina Logo
The antisoftware message is evident in the original logo of SaaS leader Salesforce.com.



Source: Used with permission from Salesforce.com.

SaaS is also taking on desktop applications. Intuit has online versions of its QuickBooks and TurboTax software, while the firm's cloud-based Mint is used by many instead of Intuit's Quicken desktop product. Adobe has moved the bulk of its business from desktop software to products delivered as SaaS subscription, and the move has been lauded as an overwhelming success.[42] Google, Apple, and Zoho offer office suites that compete with desktop alternatives, prompting Microsoft's own introduction of an online version of Office.

The Benefits of SaaS

Firms can potentially save big using SaaS. Organizations that adopt SaaS forgo the large upfront costs of buying and installing software packages. For large enterprises, the cost to license, install, and configure products like ERP and CRM systems can easily run into the hundreds of thousands or even millions of dollars. And these costs are rarely a one-time fee, with many products requiring an annual maintenance contract.[43]

Firms that adopt SaaS don't just save on software and hardware, either. There's also the added cost for the IT staff needed to run these systems. Forrester Research estimates that SaaS can bring cost savings of 25 to 60 percent if all these costs are factored in.[44]

There are also accounting and corporate finance implications for SaaS. Firms that adopt software as a service never actually buy a system's software and hardware, so these systems become a variable operating expense. This flexibility helps mitigate the financial risks associated with making a large capital investment in information systems. For example, if a firm pays Salesforce.com seventy-five dollars per month per user for its CRM software, it can reduce payments during a slow season with a smaller staff, or pay more during heavy months when a firm might employ temporary workers. At these rates, SaaS not only looks good to large firms, it makes very sophisticated technology available to smaller firms that otherwise wouldn't be able to afford expensive systems, let alone the IT staff and hardware required to run them.

service level agreement (SLA)
A negotiated agreement between the customer and the vendor. The SLA may specify the levels of availability, serviceability, performance, operation, or other commitment requirements.

In addition to cost benefits, SaaS offerings also provide the advantage of being highly scalable. This feature is important because many organizations operate in environments prone to wide variance in usage. Some firms might expect systems to be particularly busy during tax time or the period around quarterly financial reporting deadlines, while others might have their heaviest system loads around a holiday season. A music label might see spikes when an artist drops a new album. Using conventional software, an organization would have to buy enough computing capacity to ensure that it could handle its heaviest anticipated workload. But sometimes these loads are difficult to predict, and if the difference between high workloads and average use is great, a lot of that expensive computer hardware will spend most of its time doing nothing. In SaaS, however, the vendor is responsible for ensuring that systems meet demand fluctuation. Vendors frequently sign

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a **service level agreement (SLA)** with their customers to ensure a guaranteed uptime and define their ability to meet demand spikes.

When looking at the benefits of SaaS, also consider the potential for higher quality and service levels. SaaS firms benefit from economies of scale that not only lower software and hardware costs, but also potentially boost quality. The volume of customers and the diversity of their experiences mean that an established SaaS vendor is most likely an expert in dealing with all sorts of critical computing issues. SaaS firms handle backups, instantly deploy upgrades and bug fixes, and deal with the continual burden of security maintenance—all costly tasks that must be performed regularly and with care, although each offers little strategic value to firms that perform these functions themselves in-house. The breadth of an SaaS vendor's customer base typically pushes the firm to evaluate and address new technologies as they emerge, like quickly offering accessibility from smartphones and tablets. And many contend that cloud computing can actually be greener. SaaS and other cloud firms often have data centers that are better designed to pool and efficiently manage computing resources, and they are often located in warehouse-style buildings designed for computers, not people. Contrast that with corporate data centers that may have wasteful excess capacity to account for service spikes and may be crammed inside inefficiently cooled downtown high-rises. For all but the savviest of IT shops, an established SaaS vendor can likely leverage its scale and experience to provide better, cheaper, more reliable standard information systems than individual companies typically can.

Software developers who choose to operate as SaaS providers also realize benefits. While a packaged software company like SAP must support multiple versions of its software to accommodate operating systems like Windows, Linux, and various flavors of Unix, a SaaS provider develops, tests, deploys, and supports just one version of the software executing on its own servers.

Since SaaS firms run a customer's systems on the SaaS firm's own hardware, these firms have a tighter feedback loop in understanding how products are used (and why products may fail)—potentially accelerating their ability to enhance their offerings. And once made, enhancements or fixes are immediately available to customers the next time they log in.

vertical niches

Sometimes referred to as vertical markets. Products and services designed to target a specific industry (e.g., pharmaceutical, legal, apparel retail).

SaaS applications also impact distribution costs and capacity. As much as 30 percent of the price of traditional desktop software is tied to the cost of distribution—pressing CD-ROMs, packaging them in boxes, and shipping them to retail outlets.[45] Going direct to consumers can cut out the middleman, so vendors can charge less or capture profits that they might otherwise share with a store or other distributor. Going direct also means that SaaS applications are available anywhere someone has an Internet connection, making them truly global applications. This feature has allowed many SaaS firms to address highly specialized markets (sometimes called **vertical niches**). For example, the Internet allows a company writing specialized legal software, or a custom package for the pharmaceutical industry, to have a national deployment footprint from day one. Vendors of desktop applications that go SaaS benefit from this kind of distribution, too.

Finally, SaaS allows a vendor to counter the vexing and costly problem of software piracy. It's just about impossible to make an executable, illegal copy of a subscription service that runs on an SaaS provider's hardware.

Key Takeaways

- SaaS firms may offer their clients several benefits including the following:
  - *lower costs* by eliminating or reducing software, hardware, maintenance, and staff expenses
  - *financial risk mitigation* since startup costs are so low
  - potentially *faster deployment times* compared with installed packaged software or systems developed in-house
  - costs that are a *variable operating expense* rather than a large, fixed capital expense

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  - *scalable systems* that make it easier for firms to ramp up during periods of unexpectedly high system use
  - *higher quality and service levels* through instantly available upgrades, vendor scale economies, and expertise gained across its entire client base
  - *remote access and availability*—most SaaS offerings are accessed through any Web browser, and often even by phone or other mobile device
- Vendors of SaaS products benefit from the following:
  - *limiting development to a single platform*, instead of having to create versions for different operating systems
  - *tighter feedback loop* with clients, helping fuel innovation and responsiveness
  - ability to *instantly deploy bug fixes and product enhancements* to all users
  - *lower distribution costs*
  - *accessibility* to anyone with an Internet connection
  - greatly *reduced risk of software piracy*
- SaaS (and the other forms of cloud computing) are also thought to be better for the environment, since cloud firms more efficiently pool resources and often host their technologies in warehouses designed for cooling and energy efficiency.

Questions and Exercises

1. Firms that buy conventional enterprise software spend money buying software and hardware. What additional and ongoing expenses are required as part of the "care and feeding" of enterprise applications?
2. In what ways can firms using SaaS products dramatically lower costs associated with their information systems?
3. How do SaaS vendors earn their money?
4. Give examples of enterprise-focused SaaS vendors and their products. Visit the websites of the firms that offer these services. Which firms are listed as clients? Does there appear to be a particular type of firm that uses its services, or are client firms broadly represented?
5. Give examples of desktop-focused SaaS vendors and their products. If some of these are free, try them out and compare them to desktop alternatives you may have used. Be prepared to share your experiences with your class.
6. List the cost-related benefits to users that accrue from using SaaS.
7. List the benefits other than cost-related that accrue to users from using SaaS.
8. List the benefits realized by vendors that offer SaaS services instead of conventional software.
9. Why might cloud computing be greener than conventional computing alternatives? Research online and share examples suggesting that cloud firms could be less environmentally taxing than if a firm built and ran its own corporate data center.

14.8 SaaS: Not without Risks

Learning Objective

1. Be able to list and appreciate the risks associated with SaaS.

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Like any technology, we also recognize there is rarely a silver bullet that solves all problems. A successful manager is able to see through industry hype and weigh the benefits of a technology against its weaknesses and limitations. And there are still several major concerns surrounding SaaS.

The largest concerns involve the tremendous dependence a firm develops with its SaaS vendor. While some claim that the subscription-based SaaS model means that you can simply walk away from a vendor if you become dissatisfied, in fact there is quite a bit of lockin with SaaS vendors, too. Having all of your eggs in one basket can leave a firm particularly vulnerable. If a traditional software company goes out of business, in most cases its customers can still go on using its products. But if your SaaS vendor goes under, you're hosed. They've got all your data, and even if firms could get their data out, most organizations don't have the hardware, software, staff, or expertise to quickly absorb an abandoned function.

Beware with whom you partner. Any hot technology is likely to attract a lot of startups, and most of these startups are unlikely to survive. In just a single year, the leading trade association found the number of SaaS vendors dropped from seven hundred members to four hundred fifty.[46] One of the early efforts to collapse was Pandesic, a joint venture between SAP and Intel—two large firms that might have otherwise instilled confidence among prospective customers. In another example, Danish SaaS firm "IT Factory" was declared "Denmark's Best IT Company" by *Computerworld*, only to follow the award one week later with a bankruptcy declaration.[47] Indeed, despite the benefits, the costs of operating as an SaaS vendor can be daunting. NetSuite's founder claimed it "takes ten years and $100 million to do right"[48]—maybe that's why the firm still wasn't profitable, even three and a half years after going public.

Firms that buy and install packaged software usually have the option of sticking with the old stuff as long as it works, but organizations adopting SaaS may find they are forced into adopting new versions. This fact is important because any radical changes in an SaaS system's user interface or system functionality might result in unforeseen training costs, or increase the chance that a user might make an error.

Keep in mind that SaaS systems are also reliant on a network connection. If a firm's link to the Internet goes down, its link to its SaaS vendor is also severed. Relying on an Internet connection also means that data is transferred to and from an SaaS firm at Internet speeds, rather than the potentially higher speeds of a firm's internal network. Solutions to many of these issues are evolving as Internet speeds become faster and Internet service providers become more reliable. Many SaaS offerings also allow for offline use of data that is typically stored in SaaS systems. With these products a user can download a subset of data to be offline (say, on a plane flight or other inaccessible location) and then sync the data when the connection is restored. Ultimately, though, SaaS users have a much higher level of dependence on their Internet connections.

And although a SaaS firm may have more security expertise than your organization, that doesn't mean that security issues can be ignored. Any time a firm allows employees to access a corporation's systems and data assets from a remote location, a firm is potentially vulnerable to abuse and infiltration. Some firms may simply be unacceptably uncomfortable with critical data assets existing outside their own network. There may also be contractual or legal issues preventing data from being housed remotely, especially if an SaaS vendor's systems are in another country operating under different laws and regulations. "We're very bound by regulators in terms of client data and country-of-origin issues, so it's very difficult to use the cloud," says Rupert Brown, a chief architect at Merrill Lynch.[49]

SaaS systems are often accused of being less flexible than their installed software counterparts—mostly due to the more robust configuration and programming options available in traditional software packages. It is true that many SaaS vendors have improved system customization options and integration with standard software packages. And at times a lack of complexity can be a blessing—fewer choices can mean less training, faster startup time, and lower costs associated with system use. But firms with unique needs may find SaaS restrictive.

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Here's another challenge for a firm and its IT staff: SaaS means a greater *consumerization* of technology. Employees, at their own initiative, can go to firms such as Atlassian or PBworks and set up a wiki, WordPress to start blogging, and subscribe to an SaaS offering like Salesforce.com and start storing potentially sensitive corporate files in Dropbox, all without corporate oversight and approval. This work can result in employees operating outside established firm guidelines and procedures, potentially introducing operational inconsistencies or even legal and security concerns.

The consumerization of corporate technology isn't all bad. Employee creativity can blossom with increased access to new technologies, costs might be lower than home-grown solutions, and staff could introduce the firm to new tools that might not otherwise be on the radar of the firm's IS department. But all this creates an environment that requires a level of engagement between a firm's technical staff and the groups that it serves that is deeper than that employed by any prior generation of technology workers. Those working in an organization's information systems group must be sure to conduct regular meetings with representative groups of employees across the firm to understand their pain points and assess their changing technology needs. Non-IT managers should regularly reach out to IT to ensure that their needs are on the tech staff's agenda. Organizations with internal IT staff R&D functions that scan new technologies and critically examine their relevance and potential impact on the firm can help guide an organization through the promise and peril of new technologies. Now more than ever, IT managers must be deeply knowledgeable about business areas, broadly aware of new technologies, and able to bridge the tech and business worlds. Similarly, any manager looking to advance his or her organization has to regularly consider the impact of new technologies.

Key Takeaways

The risks associated with SaaS include the following:

- *dependence on a single vendor*
- concern about the long-term *viability of partner firms*
- users *may be forced to migrate to new versions*—possibly incurring unforeseen training costs and shifts in operating procedures
- *reliance on a network connection*—which may be slower, less stable, and less secure
- *data asset stored off-site*—with the potential for security and legal concerns
- *limited configuration, customization, and system integration options* compared to packaged software or alternatives developed in-house
- *The user interface of Web-based software is often less sophisticated and lacks the richness of most desktop alternatives.*
- Ease of adoption *may lead to pockets of unauthorized IT* being used throughout an organization.

Questions and Exercises

1. Consider the following two firms: a consulting startup and a defense contractor. Leverage what you know about SaaS and advise whether each might consider SaaS efforts for CRM or other enterprise functions? Why or why not?
2. Think of firms you've worked for, or firms you would like to work for. Do SaaS offerings make sense for these firms? Make a case for or against using certain categories of SaaS.
3. What factors would you consider when evaluating an SaaS vendor? Which firms are more appealing to you and why?

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4. Discuss problems that may arise because SaaS solutions rely on Internet connections. Discuss the advantages of through-the-browser access.
5. Evaluate trial versions of desktop SaaS offerings (offered by Adobe, Apple, Google, Microsoft, or others). Do you agree that the interfaces of Web-based versions are not as robust as desktop rivals? Are they good enough for you? For most users?

14.9 Understanding Cloud Computing Models: PaaS, IaaS, and Motivations and Risks

Learning Objectives

1. Distinguish between SaaS and hardware clouds.
2. Provide examples of firms and uses of hardware clouds.
3. Understand the concepts of cloud computing, cloudbursting, and black swan events.
4. Understand the challenges and economics involved in shifting computing hardware to the cloud.

While SaaS provides the software *and* hardware to replace an internal information system, sometimes a firm develops its own custom software but wants to pay someone else to run it for them. That's where cloud offerings such as PaaS and IaaS come in. In these models, a firm replaces software and hardware that it might otherwise run on-site with a service provided by a third party online. While the term utility computing was fashionable a few years back (and old timers claim it shares a lineage with terms like hosted computing or even time sharing), now most in the industry have begun referring to this as an aspect of cloud computing. Hardware and software used in such scenarios exist "in the cloud," meaning somewhere on the Internet. The costs of systems operated in this manner look more like a utility bill—you only pay for the amount of processing, storage, and telecommunications used. Tech research firm Gartner has estimated that 80 percent of corporate tech spending goes toward data center maintenance.[50] Hardware-focused cloud computing provides a way for firms to chip away at these costs.

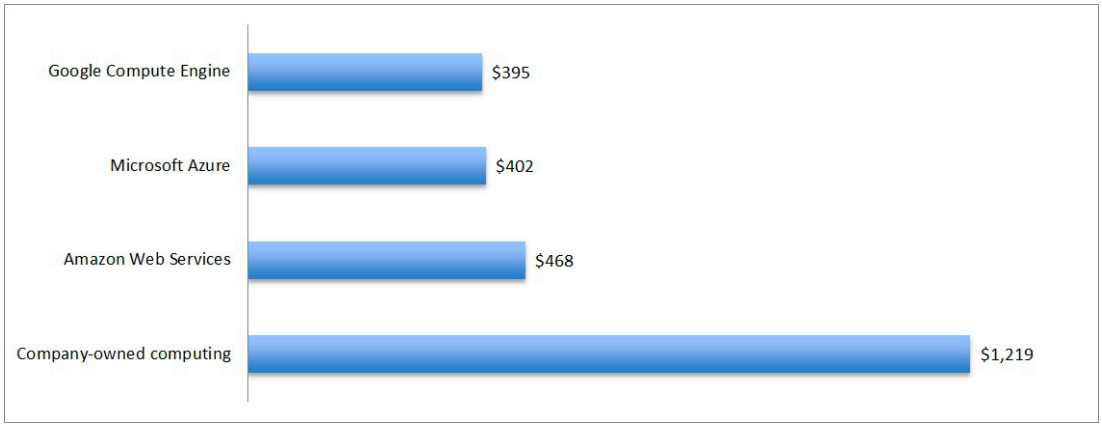
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Major players are spending billions building out huge data centers to take all kinds of computing out of the corporate data center and place it in the cloud. While cloud vendors typically host your software on their systems, many of these vendors offer additional tools to help in creating and hosting apps in the cloud. Salesforce.com offers Force.com, which includes not only a hardware cloud but also several cloud-supporting tools, such as a programming environment (IDE) to write applications specifically tailored for Web-based delivery. Google's App Engine offers developers several tools, including a database product called Bigtable. And Microsoft offers the Windows Azure cloud platform that runs several tools including the SQL Azure database. These efforts are often described by the phrase **platform as a service (PaaS)** since the cloud vendor provides a more complete platform (e.g., hosting hardware, operating system, database, and other software), which clients use to build their own applications.

Another alternative is called **infrastructure as a service (IaaS)**. This is a good alternative for firms that want even more control. In IaaS, clients can select their own operating systems, development environments, underlying applications like databases, or other software packages (i.e., clients, and not cloud vendors, get to pick the platform), while the cloud firm usually manages the infrastructure (providing hardware and networking). IaaS services are offered by a wide variety of firms, including Amazon, CSC, Rackspace, HP, IBM, and VMware.

FIGURE 14.4 Estimated Monthly Costs to Run a Website with 50 Million Monthly Page Views



Source: Data from *Wall Street Journal,* S. Ovide, "A Price War Erupts in Cloud Services," April 15, 2014.

Still other cloud computing efforts focus on providing a virtual replacement for a subset of operational hardware like storage and backup solutions. These include the cloud-based backup efforts like EMC's Mozy, and corporate storage services like Box and Amazon's Simple Storage Solution (S3). Consumer services like Apple's iCloud that provide storage as a service and sync user data across devices (phone, multiple desktops) also fall into this camp. The common theme in all of this is leveraging computing delivered over the Internet to satisfy the computing needs of both users and organizations.

platform as a service (PaaS)

Where cloud providers offer services that include the hardware, operating system, development tools, testing, and hosting (i.e., the platform) that its customers use to *build their own applications* on the provider's infrastructure. In this scenario, the cloud firm usually manages the platform (hosting, hardware, and supporting software), while the client has control over the creation and deployment of their application.

infrastructure as a service (IaaS)

Where cloud providers offer services that include running the remote hardware, storage, and networking (i.e., the infrastructure), but client firms can choose software used (which may include operating systems, programming languages, databases, and other software packages). In this scenario, the cloud firm usually manages the infrastructure (keeping the hardware and networking running), while the client has control over most other things (operating systems, storage, deployed applications, and perhaps even security and networking features like firewalls and security systems).

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cloudbursting

Describes the use of cloud computing to provide excess capacity during periods of spiking demand. Cloudbursting is a scalability solution that is usually provided as an overflow service, kicking in as needed.

black swans

Unpredicted, but highly impactful events. Scalable computing resources can help a firm deal with spiking impact from black swan events. The phrase entered the managerial lexicon from the 2007 book of the same name by Nassim Taleb.

Clouds in Action: A Snapshot of Diverse Efforts

Large, established organizations, small firms, and startups are all embracing the cloud. Examples are wide ranging. The examples below illustrate the wide range of these efforts.

Journalists refer to the *New York Times* as, "The Gray Lady," but it turns out that the venerable paper is a cloud-pioneering whippersnapper. When the *Times* decided to make roughly one hundred fifty years of newspaper archives (over fifteen million articles) available over the Internet, it realized that the process of converting scans into searchable PDFs would require more computing power than the firm had available.[51] To solve the challenge, a *Times* IT staffer simply broke out a credit card and signed up for Amazon's EC2 cloud computing and S3 cloud storage services. The *Times* then started uploading terabytes of information to Amazon, along with a chunk of code to execute the conversion. While anyone can sign up for services online without speaking to a rep, someone from Amazon eventually contacted the *Times* to check in after noticing the massive volume of data coming into its systems. Using one hundred of Amazon's Linux servers, the *Times* job took just twenty-four hours to complete. In fact, a coding error in the initial batch forced the paper to rerun the job. Even the blunder was cheap—just two hundred forty dollars in extra processing costs. Says a member of the *Times* IT group: "It would have taken a month at our facilities, since we only had a few spare PCs.…It was cheap experimentation, and the learning curve isn't steep."[52]

Big data cloud specialist Cloudera is helping make sure that news isn't fake. Thomson Reuters, which provides tools for researchers and journalists, uses products from Cloudera—a big data and machine learning specialist—to process about thirteen million tweets daily, determining in real time if an event is true, if it's newsworthy, the scope and impact of that event, if it was tweeted by a trusted source, if it is opinion or based on fact, and more. Analysis happens in about 40 milliseconds, and the system has identified news events before any agency or human reporter. Without tools like Cloudera's, Thomson Reuters would have had difficulty skilling up in machine learning and building its own analysis infrastructure.[53]

Sometimes organizations can't give up ownership of their own hardware, software, or data, so they create what are called "private clouds." These are pools of computing resources that an organization owns or leases and which it doesn't share with other customers. Private clouds still use cloud computing technologies for fast service provisioning (e.g., quickly spinning up servers and storage as demand spikes). Amazon has provided its own software and data center management expertise to the US Central Intelligence Agency, allowing the CIA to run a private cloud that it owned and only it can occupy, but that could take advantage of Amazon tools, expertise, and management.[54]

Some firms provide so-called hybrid clouds, the ability to allocate computing assets from a pool of resources an organization owns (e.g., the private cloud) to resources provided off-site by a cloud computing provider that serves other customers as well (e.g., the public cloud). IBM's cloud efforts, which count Elizabeth Arden and the US Golf Association among their customers, offer several hybrid-cloud services, including so-called **cloudbursting**. In a cloudbursting scenario a firm's data center running at maximum capacity can seamlessly shift part of the workload to IBM's cloud, with any spikes in system use metered, utility style. Cloudbursting is appealing because forecasting demand is difficult and can't account for the ultra-rare, high-impact events sometimes called **black swans**. Planning to account for usage spikes explains why the servers at many conventional corporate IS shops run at only 10 to 20 percent capacity.[55] While Cloud Labs cloudbursting service is particularly appealing for firms that already have a heavy reliance on IBM hardware in-house, it is possible to build these systems using the hardware clouds of other vendors, too.

Salesforce.com's Force.com cloud is especially tuned to help firms create and deploy custom Web applications. The firm makes it possible to piece together projects using premade Web services that provide software building blocks for features like calendaring and scheduling. The integration with the firm's SaaS CRM effort, and with third-party products like Google Maps allows enterprise mash-ups that can combine services from different vendors into a single application that's run on Force.com hardware. The platform even includes tools to help deploy Facebook applications. Intuitive Surgical used Force.com to create and host a custom application to gather clinical trial data for the firm's surgical robots. An IS manager at Intuitive noted, "We could build it using just their tools, so in essence, there was no programming."[56] Other users

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include Jobscience, which used Force.com to launch its online recruiting site; and Caesars Entertainment, which uses Force.com applications to manage room reservations, air travel programs, and player relations.

And while advanced AI and machine learning was out of reach of many IT shops a few years back, firms like Google are making this tech available as pay-as-you-go cloud services. Google's Cloud AI products include tools for video, image, speech, and text analysis, tools to build conversational bots, to hunt for job candidates, and a suite of training tools to build custom machine learning applications using your own data, but Google's tested algorithms (many of which are also open source). Google's cloud is even powered by custom chips optimized for machine learning (so, called TPU or tensor processing units that leverage the open source TensorFlow machine learning software that Google heavily supports).[57] Airbus uses Google AI to analyze satellite imagery to do things like distinguish clouds from terrain features. Google's tools allowed Airbus to reduce error rate over using human screeners from 11 percent to 3 percent, a 72 percent improvement.[58]

Challenges Remain

Cloud computing efforts categorized as PaaS and IaaS share similar benefits and risks with SaaS, and as our discussion of SaaS showed, cloud efforts aren't for everyone. Some additional examples illustrate the challenges in shifting computing hardware to the cloud.

For all the hype about cloud computing, it doesn't work in all situations. From an architectural standpoint, most large organizations run a hodgepodge of systems that include both package applications and custom code written in-house. Installing a complex set of systems on someone else's hardware can be a brutal challenge, and in many cases is just about impossible. For that reason we can expect most cloud computing efforts to focus on new software development projects rather than options for old software (sometimes called legacy systems). Even for efforts that can be custom-built and cloud-deployed, other roadblocks remain. For example, some firms face stringent regulatory compliance issues. To quote one tech industry executive, "How do you demonstrate what you are doing is in compliance when it is done outside?"[59]

Firms considering cloud computing need to do a thorough financial analysis, comparing the capital and other costs of owning and operating their own systems over time against the variable costs over the same period for moving portions to the cloud. For high-volume, low-maintenance systems, the numbers may show that it makes sense to buy rather than rent. Cloud costs can seem super cheap, and they're getting cheaper. The intensity of competition among leading cloud players, including Google, Amazon, and Microsoft, led each firm to cut various services by up to 85 percent in a single month.[60] A quarter a gigabyte a month may seem like a small amount, but system maintenance costs often include the need to clean up old files or put them on tape. If unlimited data is stored in the cloud, these costs can add up.

Firms should enter the cloud cautiously, particularly where mission-critical systems are concerned. Problems at Amazon have caused a cloud collapse, impacting a number of firms, especially startups looking to ramp up leanly by avoiding buying and hosting their own hardware.[61] An Adobe problem with the firm's Creative Cloud suite left graphics professionals locked out for over a day.[62] If a cloud vendor fails you and all your eggs are in one basket, then you're down, too. Vendors with multiple data centers that are able to operate with fault-tolerant provisioning, keeping a firm's efforts at more than one location to account for any operating interruptions, will appeal to firms with stricter uptime requirements, but even this isn't a guarantee. A human configuration error hosed Amazon's clients, despite the fact that the firm had confirmed redundant facilities in multiple locations.[63] Cloud firms often argue that their expertise translates into less downtime and failure than conventional corporate data centers, but no method is without risks.

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Key Takeaways

- It's estimated that 80 percent of corporate tech spending goes toward data center maintenance. Cloud computing helps tackle these costs by allowing firms to run their own software on the hardware of the provider, paying only for services that are used.
- Amazon, Google, IBM, Microsoft, Oracle/Sun, Rackspace, Salesforce.com, and VMware are among firms offering cloud computing services.
- Cloud computing varieties include platform as a service (PaaS), where vendors provide a platform (e.g., the operating system and supporting software like database management systems, a software development environment, testing, and application service) but where client firms write their own code; and infrastructure as a service (IaaS), where cloud vendors provide and manage the underlying infrastructure (hardware, storage, and networking), while clients can create their own platform, and choose operating systems, applications, and configurations.
- Some firms use cloud computing technology on hardware they own or lease as a sole customer. This is referred to as a private cloud. Other firms allocate resources between their own systems (the private cloud) and the public cloud (where resources may be shared with other clients). This is referred to as a hybrid-cloud strategy.
- Amazon provides software and services, helping the CIA build and maintain its own private cloud.
- Users of cloud computing run the gamut of industries, including publishing (the *New York Times*), finance (NASDAQ), and cosmetics and skin care (Elizabeth Arden).
- Benefits and risks are similar to those discussed in SaaS efforts. Benefits include the use of the cloud for handling large batch jobs or limited-time tasks, offloading expensive computing tasks, and cloudbursting efforts that handle system overflow when an organization needs more capacity.
- Most legacy systems can't be easily migrated to the cloud, meaning most efforts will be new efforts or those launched by younger firms.
- Cloud (utility) computing doesn't work in situations where complex legacy systems have to be ported or where there may be regulatory compliance issues.
- Some firms may still find TCO and pricing economics favor buying over renting—scale sometimes suggests an organization is better off keeping efforts in-house.

Questions and Exercises

1. What is cloud computing? What kinds of services are described by this term? What are other names for this phenomenon?
2. Which firms are the leading providers of cloud computing services? How are clients using these efforts?
3. List the circumstances where cloud computing works best and where it works poorly. When would each alternative make more sense—SaaS, PaaS, and IaaS? What sorts of firms would use a private cloud? A hybrid cloud? What sorts of issues should firms consider, and what sorts of expertise would be necessary when adopting each alternative?
4. Research cloud-based alternatives for backing up your hard drive. Which are among the best reviewed products or services? Why? Do you or would you use such a service? Why or why not?
5. Can you think of "black swan" events that have caused computing services to become less reliable? Describe the events and their consequences for computing services. Suggest a method and vendor for helping firms overcome the sorts of events that you encountered.

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14.10 Clouds and Tech Industry Impact

Learning Objectives

1. Understand how cloud computing's impact across industries is proving to be broad and significant.
2. Know the effects of cloud computing on high-end server sales and the influence on the trend shifting from hardware sales to service.
3. Know the effects of cloud computing on innovation and the influence on the changes in the desired skills mix and job outlook for IS workers.
4. Know that by lowering the cost to access powerful systems and software, cloud computing can decrease barriers to entry.
5. Understand the importance, size, and metrics of server farms.

Cloud computing is affecting the competitive dynamics of the hardware, software, and consulting industries. In the past, firms seeking to increase computing capacity invested heavily in expensive, high-margin server hardware, creating a huge market for computer manufacturers. But now, hardware firms find these markets may be threatened by the cloud. IBM saw server sales fall from 20 to 30 percent in recent years, finally selling its low-end server business off to Lenovo (the same firm that bought Big Blue's PC and laptop business years earlier).[64] Barclays estimates that for every dollar that flows into cloud computing, several dollars are cut out of traditional hardware sales and other IT end markets.[65] Michael Dell has stated that after taking his firm private, he will sell off several hardware businesses and refocus the firm on cloud computing, an area where Dell lags significantly behind rivals.

The shift to cloud computing also alters the margin structure for many in the computing industry. While Moore's Law has made servers cheap, deploying SaaS and operating a commercial cloud is still very expensive—much more so than simply making additional copies of conventional, packaged software. Microsoft surprised Wall Street when it announced it would need to pour at least $2 billion more than analysts expected into its annual **server farm** capital spending. The firm's stock—among the world's most widely held—sank 11 percent in a day.[66] As a result, many portfolio managers started paying closer attention to the business implications of the cloud.

server farm

A massive network of computer servers running software to coordinate their collective use. Server farms provide the infrastructure backbone to SaaS and hardware cloud efforts, as well as many large-scale Internet services.

Cloud computing can accelerate innovation and therefore changes the desired skills mix and job outlook for IS workers. If cloud computing customers spend less on expensive infrastructure investments, they potentially have more money to reinvest in strategic efforts and innovation. IT careers are changing, too. Demand for nonstrategic skills like hardware operations and maintenance are decreasing.[67] Organizations will need more business-focused technologists who intimately understand a firm's competitive environment, and can create systems that add value and differentiate the firm from its competition.[68] While these tech jobs require more business training, they're also likely to be more durable and less likely to be outsourced to a third party with a limited understanding of the firm.

By lowering the cost to access powerful systems and software, barriers to entry also decrease. Firms need to think about the strategic advantages they can create, even as technology is easily duplicated. This trend means the potential for more new entrants across industries, and since startups can do more with less, it's also influencing entrepreneurship and venture capital. The CTO of SlideShare, a startup that launched using Amazon's S3 storage cloud, offers a presentation on his firm's site labeled "Using S3 to Avoid VC." Similarly, the CEO of online payments startup Zuora claims to have saved between half a million and $1 million by using cloud computing: "We have

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no servers, we run the entire business in the cloud."[69] And the sophistication of these tools lowers development time. Enterprise firm Apttus claims it was able to perform the equivalent of six months of development in a couple of weekends by using cloud services. The firm scored its first million-dollar deal in three months, and was break-even in nine months, a ramp-up time that would have been unheard of, had they needed to plan, purchase, and deploy their own data center, and create from scratch the Web services that were provided by its cloud vendor.[70] Venture capitalist Mark Suster claims that the cost to start an Internet company fell from $5 million in 2000 to just $5,000 in 2011, due in large part to advances in cloud computing and open source software.[71]

So What's It Take to Run This Thing?

In the countryside surrounding the Columbia River in the Pacific Northwest, potato farms are yielding to server farms. Turns out the area is tailor-made for creating the kinds of massive data installations that form the building blocks of cloud computing. The land is cheap, the region's hydroelectric power costs a fraction of Silicon Valley rates, and the area is served by ultrafast fiber-optic connections. Even the area's mild temperatures cut cooling costs.

Most major players in cloud computing have server farms in the region, each with thousands of processors humming away simultaneously. Microsoft's Quincy, Washington, facility is as big as ten American football fields and has nearly six hundred miles of wiring, 1.5 metric tons of battery backup, and three miles of chiller piping to keep things cool. Storage is big enough to store 6.75 trillion photos. Just a short drive away, Yahoo! has two facilities on fifty acres, including one that runs at a zero carbon footprint. Google has a thirty-acre site sprawled across former farmland in The Dalles, Oregon. And in Boardman, Oregon, Amazon has a three building petabyte palace that sports its own ten-megawatt electrical substation.[72]

While US activity has been particularly intense in the Pacific Northwest, server farms that support cloud computing are popping up from Shanghai to São Paulo. Not only does a diverse infrastructure offer a degree of fault tolerance and disaster recovery (Oregon down? Shift to North Carolina), the myriad national laws and industry-specific regulatory environments may require some firms to keep data within a specific country or region. To meet the challenge, cloud vendors are racing to deploy infrastructure worldwide and allowing customers to select regional availability zones for their cloud computing needs.

The build-out race has become so intense that many firms have developed rapid-deployment server farm modules that are preconfigured and packed inside shipping containers. Some of these units contain as many as three thousand servers each. Just drop the containers on-site, link to power, water, and telecom, and presto—you've got yourself a data center. More than two hundred containers can be used on a single site. One Microsoft VP claimed the configuration has cut the time to open a data center to just a few days, claiming Microsoft's San Antonio facility was operational in less time than it took a local western wear firm to deliver her custom-made cowboy boots![73] Microsoft's Dublin-based fourth generation data center was built entirely of containers—no walls or roof—using the outside air for much of the cooling.[74]

FIGURE 14.5 Server-Packed Shipping Container
This server-packed shipping container from Oracle's Sun unit is designed for rapid data center deployment.



Source: John Gallaugher.

While firms are buying less hardware, cloud vendors have turned out to be the computing industry's best customers. Amazon has spent well over $2 billion on its cloud infrastructure. Google reportedly has 1.4 million servers operating across three dozen data centers.[75] Demonstrating it won't be outdone, Microsoft plans to build as many as twenty server farms, at costs of up to

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$1 billion each.[76] Look for the clouds to pop up in unexpected places. Microsoft has scouted locations in Siberia, while Google has applied to patent a method for floating data centers on an offshore platform powered by wave motions.[77]

Key Takeaways

- Cloud computing's impact across industries is proving to be broad and significant.
- Clouds can lower barriers to entry in an industry, making it easier for startups to launch and smaller firms to leverage the backing of powerful technology.
- Clouds may also lower the amount of capital a firm needs to launch a business, shifting power away from venture firms in those industries that had previously needed more VC money.
- Clouds can shift resources out of capital spending and into profitability and innovation.
- Hardware and software sales may drop as cloud use increases, while service revenues will increase.
- Cloud computing can accelerate innovation and therefore changes the desired skills mix and job outlook for IS workers. Tech skills in data center operations, support, and maintenance may shrink as a smaller number of vendors consolidate these functions.
- Demand continues to spike for business-savvy technologists. Tech managers will need even stronger business skills and will focus an increasing percentage of their time on strategic efforts. These latter jobs are tougher to outsource, since they involve an intimate knowledge of the firm, its industry, and its operations.
- The market for expensive, high-margin, server hardware is threatened by companies moving applications to the cloud instead of investing in hardware.
- Server farms require plenty of cheap land, low-cost power, and ultrafast fiber-optic connections, and benefit from mild climates.
- Google, Oracle's Sun, Microsoft, IBM, and HP have all developed rapid-deployment server farm modules that are preconfigured and packed inside shipping containers.

Questions and Exercises

1. Describe how the shift to cloud computing may impact traditional computing hardware firms.
2. Describe the shift in skill sets required for IT workers that is likely to result from the widespread adoption of cloud computing.
3. Why do certain entry barriers decrease as a result of cloud computing? What is the effect of lower entry barriers on new entrants, entrepreneurship, and venture capital? On existing competitors?
4. What factors make the Columbia River region of the Pacific Northwest an ideal location for server farms?
5. Why did Microsoft's shift to cloud computing create an unexpected shock among stock analysts who cover the firm? What does this tell you about the importance of technology understanding among finance and investment professionals?
6. Why do cloud computing vendors build regional server farms instead of one mega site?
7. Why would a firm build a container-based data center?

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14.11 Virtualization: Software That Makes One Computer Act Like Many

Learning Objectives

1. Know what virtualization software is and its impact on cloud computing.
2. Be able to list the benefits to a firm from using virtualization.

virtualization

A type of software that allows a single computer (or cluster of connected computers) to function as if it were several different computers, each running its own operating system and software. Virtualization software underpins most cloud computing efforts, and can make computing more efficient, cost-effective, and scalable.

Perhaps the most important software tool in the cloud computing toolbox is **virtualization**. Think of virtualization as being a kind of operating system for operating systems. A server running virtualization software can create smaller compartments in memory that each behave as a separate computer with its own operating system and resources. The key benefit: firms can stop buying separate servers for each application they want to run. Instead, organizations can create many virtual computers on a single machine (or cluster of machines that provide a pool of capacity) so hardware is used more efficiently.[78]

This means virtualization can save firms big bucks. Most server computers aren't running at anywhere near a full load. Some studies have shown that, on average, conventional data centers run at 15 percent or less of their maximum capacity. Since virtualization allows firms to cram more of their computing into this unused space, data centers using virtualization software have increased utilization to 80 percent or more.[79] This increased efficiency means cost savings in hardware, staff, and real estate. Plus it reduces a firm's IT-based energy consumption, cutting costs, lowering its carbon footprint, and boosting "green cred."[80] Using virtualization, firms can buy and maintain fewer servers, each running at a greater capacity. It can also power down servers until demand increases require them to come online. Virtualization also helps firms scale up. Find you need more capacity for a specific function, like a spike in online orders sent by a new app? The virtual representation of any computer can be transferred to more burly hardware that has fewer additional virtual machines running on it so it can handle the load as demand spikes.

containers

A type of virtualization that allows for shared operating systems for more resource savings and faster execution. However, containers still isolate applications so they execute and move to different computing hardware, just like conventional virtualization.

There's another term that's increasingly appearing in the tech and business press, **containers**. This is a type of virtualization that allows applications to share an operating system, but it still lets resources be shuttled around from low-powered hardware to massive pools of servers if capacity spikes. Since containers don't need their own separate operating system, they use even less resources and execute faster.[81] The big dog in this space is the open-source firm Docker, a technology that's getting wide use from Silicon Valley to Wall Street.[82]

virtual desktops

When a firm runs an instance of a PC's software on another machine and simply delivers the image of what's executing to the remote device. Using virtualization, a single server can run dozens of PCs, simplifying backup, upgrade, security, and administration.

While virtualization is a key software building block that makes public cloud computing happen, it can also be used in-house to reduce an organization's hardware needs, and even to create a firm's own private cloud of scalable assets. Bechtel, BT, Merrill Lynch, and Morgan Stanley are among the firms with large private clouds enabled by virtualization.[83] Another kind of virtualization, **virtual desktops**, allow a server to run what amounts to a copy of a PC—OS, applications, and all—and simply deliver an image of what's executing to a PC or other connected device. This allows firms to scale, back up, secure, and upgrade systems far more easily than if they had to maintain each individual PC. Google Project Yeti reportedly hopes to remove the high-powered game console hardware attached to your television and instead put the console in the cloud, delivering games to your TV as they execute remotely on superfast server hardware.[84] Virtualization can even live on your desktop. Anyone who's ever run Windows in a window on Mac OS X is using virtualization software; these tools inhabit a chunk of your Mac's memory for running Windows and actually fool this foreign OS into thinking that it's on a PC.

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Interest in virtualization has exploded in recent years. VMware, the publicly traded firm that is majority-owned by software giant EMC, is the current leader in virtualization software, really defining the commercialization of the software category. But its niche is getting crowded. Microsoft has entered the market, building virtualization into its server offerings. Dell bought a virtualization software firm for $1.54 billion, and Xen is an open source virtualization product.[85] Containers champ Docker is also open source, and new funding valued the firm at over $1 billion.[86]

Key Takeaways

- Virtualization software allows one computing device to function as many. The most sophisticated products also make it easy for organizations to scale computing requirements across several servers.
- Virtualization software can lower a firm's hardware needs, save energy, and boost scalability.
- Data center virtualization software is at the heart of many so-called private clouds and scalable corporate data centers, as well as the sorts of public efforts described earlier.
- Virtualization also works on the desktop, allowing multiple operating systems (Mac OS X, Linux, Windows) to run simultaneously on the same platform.
- Virtualization software can increase data center utilization to 80 percent or more.
- While virtualization is used to make public cloud computing happen, it can also be used in-house to create a firm's own private cloud.
- While traditional virtualization acts as a software representation of hardware where each virtual machine requires its own operating system, a type of virtualization known as containers performs many of the functions of virtualization without requiring a separate operating system. This saves even more power and computer space, and helps resources execute even faster.
- A number of companies, including Microsoft and Dell, have entered the growing virtualization market. Container startup Docker is seeing widespread adoption across industries and leading firms.

Questions and Exercises

1. List the benefits to a firm from using virtualization.
2. What is the average utilization rate for conventional data centers?
3. List companies that have virtualization-enabled private clouds.
4. Give an example of desktop virtualization.
5. Name three companies that are players in the virtualization software industry.

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14.12 Apps and App Stores: Further Disrupting the Software Industry on Smartphones, Tablets, and Beyond

Learning Objective

1. Understand the benefits and challenges of app stores and how these products are also changing the way we conceive software and the opportunities for firms to offer value-added services to consumers.

More monumental changes are being brought about by app stores, specifically the use of apps on smartphones. Smartphones have surpassed the one-billion-unit-sales-per-year milestone,[87] and costs are plummeting. For many worldwide, the smartphone is the primary screen for engaging in a series of tasks or entire new categories of software and services. And while smartphones use the web, most smartphone functionality is delivered via custom apps.

By 2017, Apple claimed its iOS app store had seen over 200 billion downloads of the over 2.2 million apps offered.[88] Apps have several advantages over packaged software and browser-based alternatives. The app store is *always open*, and apps are distributed at a fraction of the cost of conventional packaged software, completely cutting out costs associated with printing discs, boxes, and shipping product to retailers. Apps offer richer, more interactive interface options than simple web-based applications. Most smartphones also allow apps to integrate with the OS and send out direct message to users, whereas the Web provides no such OS-level integration. Many products will upgrade apps in the background, ensuring that users regularly have the latest features and bug-squashing editions on their devices, further lowering software maintenance costs. And several businesses simply would not exist without apps to engage with customers. Uber, Instagram, and WhatsApp are among the billion-dollar firms that exist because of smartphones and the rapid proliferation of apps. Innovative retailers such as the high-fashion rental firm Rent the Runway are also leveraging apps to capture impulse orders when consumers have a top-of-mind task, not when they return to a desktop. And new offerings that leverage tools (such as the app-engaging, location-based technology, iBeacon) are allowing venues to guide consumers to deals, products, and even parking spaces.

While apps and smartphones are also contributing to "software in flux," some are critical of our app-centric future. Apps can lock a user into a given platform. They often require software developers to create a package using developer tools provided by mobile device manufacturers, further deepening switching costs. Apps also have software development disadvantages when compared to browser-based services. If a bug is detected, code served to users via a browser is available next time they visit the site, while apps need to be downloaded and installed, potentially allowing harmful bugs and security flaws to linger in the wild. Browser-based applications can also perform A/B testing more easily, sending different versions to the browsers of different users. Smartphone users would require an app that can serve either option, again requiring a software update. Others lament the walled garden created within apps where data is more tightly controlled by a service provider and where firms must comply to the usage policies of the platform provided (e.g., Apple, Google, Amazon, or Microsoft). Finally, while the app store allows a firm, in theory, to reach millions, crowded app stores increasingly make it more challenging for a potential star to rise above the din of the crowd and get recognized.

While our app store discussion has focused on smartphones and tablets, it's important to realize these are not the only platforms for software distribution. Apple and Microsoft offer app stores

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for their desktop operating systems. Google has an app store for Chrome browser extensions. New computing platforms, such as Google Glass and Facebook's Oculus Rift also sport app stores that extend their offerings and provide new alternatives to entrepreneurs. Televisions, smart watches, and even automobiles will all provide new opportunities to reach consumers with innovative, app-powered offerings.

Key Takeaways

- Over one billion smartphones are sold a year, providing a rich platform for app deployment.
- Compared with packaged software, apps lower the cost of software distribution and maintenance.
- Apps offer a richer user interface and integrate more tightly with a device's operating system, enabling more functionality and services such as app-delivered alerts.
- Several billion-dollar firms have leveraged smartphone apps as their only, or primary, interface with consumers.
- Mobile apps do provide additional challenges for developers, especially when compared against browser-based alternatives. Among them, more challenging updates, version control, and A/B testing.
- Critics of apps say they force consumers into smartphone-walled gardens and raise consumer-switching costs.
- While development and distribution costs are cheaper for apps than packaged software, discovery poses a problem, and it can be increasingly difficult for high-quality firms to generate consumer awareness among the growing crowd of app offerings.

Questions and Exercises

1. How big is the worldwide smartphone market? Do you use a smartphone? Which one, and why did you choose that product?
2. How are smartphone cost trends and capabilities changing over time?
3. Are smartphones the only products with app stores? What other app stores are available? Do they have the same dynamics at work as those described previously?
4. If you were developing a product or service today, would you go "mobile first," concentrating on an app as the customer interface rather than a web-based interface? Why or why not?
5. In what ways are apps superior to browser-based alternatives? In what ways is app development and maintenance more challenging than writing code for the browser?

14.13 Make, Buy, or Rent

Learning Objectives

1. Know the options managers have when determining how to satisfy the software needs of their companies.
2. Know the factors that must be considered when making the make, buy, or rent decision.

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So now you realize managers have a whole host of options when seeking to fulfill the software needs of their firms. An organization can purchase packaged software from a vendor, use open source offerings, leverage SaaS or other types of cloud computing, outsource development or other IT functions to another firm either domestically or abroad, or a firm can develop all or part of the effort themselves. When presented with all of these options, making decisions about technologies and systems can seem pretty daunting.

First, realize that that for most firms, technology decisions are not binary options for the whole organization in all situations. Few businesses will opt for an IT configuration that is 100 percent in-house, packaged, or SaaS. Being aware of the parameters to consider can help a firm make better, more informed decisions. It's also important to keep in mind that these decisions need to be continuously reevaluated as markets and business needs change. What follows is a summary of some of the key variables to consider.

Competitive Advantage—*Do we rely on unique processes, procedures, or technologies that create vital, differentiating competitive advantage?* If so, then these functions aren't good candidates to outsource or replace with a packaged software offering. Amazon had originally used recommendation software provided by a third party, and Netflix and Dell both considered third-party software to manage inventory fulfillment. But in all three cases, these firms felt that mastery of these functions was too critical to competitive advantage, so each firm developed proprietary systems unique to the circumstances of each firm.

Security—*Are there unacceptable risks associated with using the packaged software, OSS, cloud solution, or an outsourcing vendor? Are we convinced that the prospective solution is sufficiently secure and reliable? Can we trust the prospective vendor with our code, our data, our procedures and our way of doing business? Are there noncompete provisions for vendor staff that may be privy to our secrets? For off-site work, are there sufficient policies in place for on-site auditing?* If the answers to any of these questions is no, outsourcing might not be a viable option.

Legal and Compliance—*Is our firm prohibited outright from using technologies? Are there specific legal and compliance requirements related to deploying our products or services?* Even a technology as innocuous as instant messaging may need to be deployed in such a way that it complies with laws requiring firms to record and reproduce the electronic equivalent of a paper trail. For example, SEC Rule 17a-4 requires broker dealers to retain client communications for a minimum of three years. HIPAA laws governing health care providers state that electronic communications must also be captured and stored.[89] While tech has gained a seat in the board room, legal also deserves a seat in systems planning meetings.

Skill, Expertise, and Available Labor—*Can we build it?* The firm may have skilled technologists, but they may not be sufficiently experienced with a new technology. Even if they are skilled, managers must consider the costs of allocating staff away from existing projects for this effort.

Cost—*Is this a cost-effective choice for our firm?* A host of factors must be considered when evaluating the cost of an IT decision. The costs to build, host, maintain, and support an ongoing effort involve labor (software development, quality assurance, ongoing support, training, and maintenance), consulting, security, operations, licensing, energy, and real estate. Any analysis of costs should consider not only the aggregate spending required over the lifetime of the effort but also whether these factors might vary over time.

Time—*Do we have time to build, test, and deploy the system?*

Vendor Issues—*Is the vendor reputable and in a sound financial position? Can the vendor guarantee the service levels and reliability we need? What provisions are in place in case the vendor fails or is acquired? Is the vendor certified via the Carnegie Mellon Software Institute or other standards organizations in a way that conveys quality, trust, and reliability?*

The list above is a starter. It should also be clear that these metrics are sometimes quite tough to estimate. Welcome to the challenges of being a manager! At times an environment in flux can make an executive feel like he or she is working on a surfboard, constantly being buffeted about

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by unexpected currents and waves. Hopefully the issues outlined in this chapter will give you the surfing skills you need for a safe ride that avoids the organizational equivalent of a wipeout.

Key Takeaways

- The make, buy, or rent decision may apply on a case-by-case basis that might be evaluated by firm, division, project, or project component. Firm and industry dynamics may change in a way that causes firms to reassess earlier decisions, or to alter the direction of new initiatives.
- Factors that managers should consider when making a make, buy, or rent decision include the following: competitive advantage, security, legal and compliance issues, the organization's skill and available labor, cost, time, and vendor issues.
- Factors must be evaluated over the lifetime of a project, not at a single point in time.
- Managers have numerous options available when determining how to satisfy the software needs of their companies: purchase packaged software from a vendor, use OSS, use SaaS or utility computing, outsource development, or develop all or part of the effort themselves.
- If a company relies on unique processes, procedures, or technologies that create vital, differentiating, competitive advantages, the functions probably aren't a good candidate to outsource.

Questions and Exercises

1. What are the options available to managers when seeking to meet the software needs of their companies?
2. What are the factors that must be considered when making the make, buy, or rent decision?
3. What are some security-related questions that must be asked when making the make, buy, or rent decision?
4. What are some vendor-related questions that must be asked when making the make, buy, or rent decision?
5. What are some of the factors that must be considered when evaluating the cost of an IT decision?
6. Why must factors be evaluated over the lifetime of a project, not at a single point in time?

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CHAPTER 15

Data and Competitive Advantage: Databases, Analytics, AI and Machine Learning

15.1 Introduction

Learning Objectives

1. Understand how increasingly standardized data, access to third-party data sets, cheap/fast computing, and easier-to-use software are collectively enabling a new age of decision-making.
2. Be familiar with some of the enterprises that have benefited from data-driven, fact-based decision making.

The planet is awash in data. Cash registers ring up transactions worldwide. Web browsers leave a trail of cookie crumbs nearly everywhere they go. Fitness trackers, health monitors, and smartphone apps are collecting data on the behavior of millions. And with radio frequency identification (RFID), inventory can literally announce its presence so that firms can precisely journal every hop their products make along the value chain: "I'm arriving in the warehouse," "I'm on the store shelf," "I'm leaving out the front door."

Data collected within our "digital universe" is expected to grow fifty-fold from 2010 to 2020,[1] while research firm IDC states that the collective number of those bits already exceeds the number of stars in the universe.[2] You'll hear managers today broadly refer to this torrent of bits as "**big data**." Each hour, Walmart alone gathers data on over a million transactions and crunches over 2.5 petabytes of data for continued insights.[3] To put that amount in perspective, two petabytes is a data amount greater than the combined contents of all of the academic research libraries in the United States. Walmart claims it has built "the world's biggest private cloud," with over 40 petabytes of total data, and growing. The world's largest retailer isn't content with just its own data stash—the firm amplifies insights by combining its data with over 200 additional sources, including "meteorological data, economic data, Nielsen data, telecom data, social media data, gas prices, and local events."[4]

big data

A general term used to describe the massive amount of data available to today's managers. Big data are often unstructured and are too big and costly to easily work through use of conventional databases, but new tools are making these massive datasets available for analysis and insight.

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business intelligence (BI)

A term combining aspects of reporting, data exploration and ad hoc queries, and sophisticated data modeling and analysis.

analytics

A term describing the extensive use of data, statistical and quantitative analysis, explanatory and predictive models, and fact-based management to drive decisions and actions.

machine learning

A type of artificial intelligence that leverages massive amounts of data so that computers can improve the accuracy of actions and predictions on their own without additional programming.

And with this flood of data comes a tidal wave of opportunity. Research has found that companies ranked in the top third of their industry in the use of data-driven decision making were on average 5 percent more productive and 6 percent more profitable than competitors.[5] Increasingly standardized corporate data, and access to rich, third-party datasets—all leveraged by cheap/fast computing and easier-to-use software—are collectively enabling a new age of data-driven, fact-based decision-making. You're less likely to hear old-school terms like "decision support systems" used to describe what's going on here. The phrase of the day is **business intelligence (BI)**, a catchall term combining aspects of reporting, data exploration and ad hoc queries, and sophisticated data modeling and analysis. Alongside business intelligence in the new managerial lexicon is the phrase **analytics**, a term describing the extensive use of data, statistical and quantitative analysis, explanatory and predictive models, and fact-based management to drive decisions and actions (and in our ever-imprecise world of business buzzwords, you'll often hear business intelligence and analytics used interchangeably to mean the same thing—using data for better decision making).[6] Another trend, **machine learning**, refers to a sophisticated category of software applications known as artificial intelligence that leverage massive amounts of data so that computers can "learn" and improve the accuracy of actions and predictions on their own without additional programming.[7] The implications are wide ranging, with machine learning insights making voice assistants and image recognition more accurate and fraud-fighting more comprehensive, and improving the reliability of self-driving cars.

The benefits of all this data and number crunching are very real, indeed. Data leverage lies at the center of competitive advantage in many of the firms that we've studied, including Amazon, Netflix and Zara. Data mastery has helped vault Walmart to the top of the *Fortune* 500 list. It helps Spotify craft you a killer playlist for your run. And it helps make Google's voice recognition a better listener and Google Search a better detective, so that the service can accurately show you what you've asked it to look up. There's even something here for poli sci majors, since data-driven insights are increasingly being credited with helping politicians win elections.[8] To quote from a *BusinessWeek* cover story on analytics, "Math Will Rock Your World!"[9]

Sounds great, but it can be a tough slog getting an organization to the point where it has a leveragable data asset. In many organizations data lies dormant, spread across inconsistent formats and incompatible systems, unable to be turned into anything of value. Many firms have been shocked at the amount of work and complexity required to pull together an infrastructure that empowers its managers. But not only can this be done, it must be done. Firms that are basing decisions on hunches aren't managing, they're gambling. And today's markets have no tolerance for uninformed managerial dice rolling.

While we'll study technology in this chapter, our focus isn't as much on the technology itself as it is on what you can do with that technology. Consumer products giant P&G believes in this distinction so thoroughly that the firm renamed its IT function as "Information and Decision Solutions."[10] Solutions drive technology decisions, not the other way around.

In this chapter we'll study the data asset, how it's created, how it's stored, and how it's accessed and leveraged. We'll also study many of the firms mentioned above, and more, providing a context for understanding how managers are leveraging data to create winning models, and how those that have failed to realize the power of data have been left in the dust.

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Data, Analytics, and Competitive Advantage

Anyone can acquire technology—but data is oftentimes considered a defensible source of competitive advantage. The data a firm can leverage is a true strategic asset when it's rare, valuable, imperfectly imitable, and lacking in substitutes (see Chapter 2).

If more data brings more accurate modeling, moving early to capture this rare asset can be the difference between a dominating firm and an also-ran. But be forewarned, there's no monopoly on math. Advantages based on formulas, algorithms, and data that others can also acquire will be short-lived. Moneyball advances in sports analytics originally pioneered by the Oakland A's and are now used by nearly every team in the major leagues.

This doesn't mean that firms can ignore the importance data can play in lowering costs, increasing customer service, and other ways that boost performance. But differentiation will be key in distinguishing operationally effective data use from those efforts that can yield true strategic positioning.

That Seat Will Cost You $8–Wait, Make That $45.50

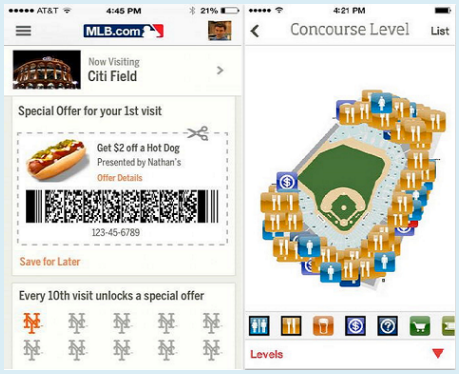
For some games it's tough to fill the stands. A Wednesday night game against a mediocre rival will prompt thousands to stay home unless they get a really compelling deal. But many fans are ready to pay big bucks for a rivalry game on a weekend. To optimize demand, over thirty teams in Major League Baseball (MLB), the National Basketball Association (NBA), National Hockey League (NHL), and Major League Soccer (MLS) are using data analytics from Austin-based Qcue to fill seats and maximize revenue.[11]

Take the San Francisco Giants as an example. The baseball standout draws big crowds when playing crosstown, interleague rivals the Oakland As. A seat in the left field, upper deck of AT&T Park will cost above $45 for a Saturday afternoon game. But when the Diamondbacks are in town on a work or school night, that very same seat can be had for $8. Changing pricing based on demand conditions is known as dynamic pricing, and the Giants credits analytics-driven demand pricing with helping bump ticket revenues by at least 6 percent in a single year[12] and fuel a 250-plus sellout streak.[13] And getting fans in the stands is critical since once there, those fans usually rack up even more revenue in the form of concessions and merchandise sales. Dynamic pricing can be tricky. In some cases, it can leave consumers feeling taken advantage of (it is especially tricky in situations where consumers make repeated purchases and are more likely to remember past prices, and when they have alternative choices, like grocery or department store shopping). But dynamic pricing often works in markets where supply is constrained and subject to demand spikes. Firms from old-school airlines to app-savvy Uber regularly let data analytics set a supply-demand equilibrium through dynamic pricing, while also helping boost their bottom line. Sports teams are even leveraging weather insights and other data to drive the pricing of concession specials and to set the cost of a beer. New technologies, such as iBeacon (a tech that sends messages to iPhones using a low-energy Bluetooth signal) are being rolled out throughout MLB, making it easier to let consumers know a deal is in effect and guiding them to the quickest counter for quenching thirst and satisfying cravings.[14]

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FIGURE 15.1 At the Ballpark App
Major League Baseball's At the Ballpark app will use iBeacon technology to distribute deals and guide you to concessions.



Source: Alex Colon, "MLB Completes iBeacon Installations at Dodger Stadium and Petco Park," *GigaOM*, February 14, 2014, https://gigaom.com/2014/02/14/mlb-completes-ibeacon-installations-at-dodger-stadium-and-petco-park.

Key Takeaways

- The amount of data being created doubles every two years.
- In many organizations, available data is not exploited to advantage. However new tools supporting *big data*, business intelligence, analytics, and machine learning are helping managers make sense of this data torrent.
- Data is oftentimes considered a defensible source of competitive advantage; however, advantages based on capabilities and data that others can acquire will be short-lived.

Questions and Exercises

1. Name and define the terms that are supplanting discussions of decision support systems in the modern IS lexicon.
2. Is data a source of competitive advantage? Describe situations in which data might be a source for sustainable competitive advantage. When might data not yield sustainable advantage?
3. Are advantages based on analytics and modeling potentially sustainable? Why or why not?
4. Think about the amount of data that is collected about you every day. Make a list of various technologies and information systems you engage with and the organizations that use these technologies, systems, and services to learn more about you. Does this information serve you better as a consumer? What, if any, concerns does broad data collection leave you with?
5. What role do technology and timing play in realizing advantages from the data asset?
6. What do you think about dynamic pricing? Is it good or bad for consumers? Is it good or bad for businesses? Explain your answer.
7. Have you visited a retailer or other venue using iBeacons? If so, describe your experience. If not, research the technology and come to class prepared to discuss its implications for collecting data and for driving consumer actions.
8. Research firms that are effectively using analytics, "big data," or machine learning for competitive advantage. Share interesting examples with your class and tweet links to the #BizTechBook hashtag. Do you think such tools are only available to large firms, or can smaller firms benefit, too?

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15.2 Data, Information, and Knowledge

Learning Objectives

1. Understand the difference between data and information.
2. Know the key terms and technologies associated with data organization and management.

Data refers simply to raw facts and figures. Alone, it tells you nothing. The real goal is to turn data into **information**. Data becomes information when it's presented in a context so that it can answer a question or support decision-making. And it's when this information can be combined with a manager's **knowledge**—their insight from experience and expertise—that stronger decisions can be made.

data
Raw facts and figures.

information
Data presented in a context so that it can answer a question or support decision making.

knowledge
Insight derived from experience and expertise.

Trusting Your Data

The ability to look critically at data and assess its validity is a vital managerial skill. When decision makers are presented with wrong data, the results can be disastrous. And these problems can get amplified if bad data is fed to automated systems. As an example, look at the series of man-made and computer-triggered events that brought about a billion-dollar collapse in United Airlines stock.

In the wee hours one Sunday morning, a single reader browsing several years of old back stories on the *Orlando Sentinel*'s website viewed a 2002 article on the bankruptcy of United Airlines (UAL went bankrupt in 2002, but emerged from bankruptcy four years later). That lone Web surfer's access of this story during such a low-traffic time was enough for the *Sentinel*'s Web server to briefly list the article as one of the paper's "most popular." Google crawled the site and picked up this "popular" news item, feeding it into Google News.

Early that morning, a worker in a Florida investment firm came across the Google-fed story, assumed United had yet again filed for bankruptcy, then posted a summary on Bloomberg. Investors scanning Bloomberg jumped on what looked like a reputable early warning of another United bankruptcy, dumping UAL stock. Blame the computers again—the rapid plunge from these early trades caused automatic sell systems to kick in (event-triggered, computer-automated trading is responsible for about 30 percent of all stock trades). Once the machines took over, UAL dropped like a rock, falling from twelve to three dollars. That drop represented the vanishing of $1 billion in wealth, and all this because no one checked the date on a news story. Welcome to the new world of paying attention![15]

Understanding How Data Is Organized: Key Terms and Technologies

A **database** is simply a list (or more likely, several related lists) of data. Most organizations have several databases—perhaps even hundreds or thousands. And these various databases might be focused on any combination of functional areas (sales, product returns, inventory, payroll), geographical regions, or business units. Firms often create specialized databases for recording transactions, as well as databases that aggregate data from multiple sources in order to support reporting and analysis.

database
A single table or a collection of related tables.

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database management system

Sometimes referred to as database software; software for creating, maintaining, and manipulating data.

Databases are created, maintained, and manipulated using programs called **database management systems** (DBMS), sometimes referred to as *database software*. DBMS products vary widely in scale and capabilities. They include the single-user, desktop versions of Microsoft Access or Filemaker Pro, Web-based offerings like Intuit QuickBase, and industrial strength products from Oracle, IBM (DB2), Microsoft (SQL Server), the popular open-source product MySQL (also stewarded by Oracle), and others. Oracle is the world's largest database software vendor, and database software has meant big bucks for Oracle co-founder and CEO Larry Ellison. Ellison perennially ranks in the Top 10 of the *Forbes* 400 list of wealthiest Americans.

structured query language (SQL)

A language used to create and manipulate databases.

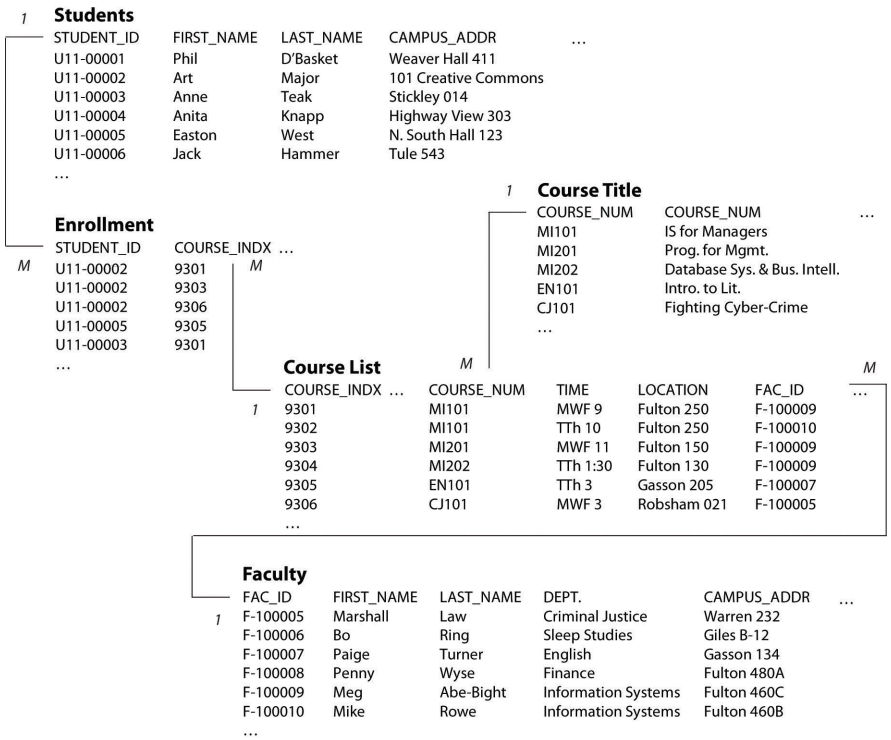
The acronym SQL (often pronounced *sequel*) also shows up a lot when talking about databases. **Structured query language (SQL)** is by far the most common language for creating and manipulating databases. You'll find variants of SQL inhabiting everything from lowly desktop software, to high-powered enterprise products. Given this popularity, if you're going to learn one language for database use, SQL's a pretty good choice. And for a little inspiration, visit LinkedIn, Monster.com, or another job site and search for openings that mention SQL. You'll find page after page of listings, suggesting that while database systems have been good for Ellison, learning more about them might be pretty good for you, too.

database administrator (DBA)

Job title focused on directing, performing, or overseeing activities associated with a database or set of databases. These may include (but not necessarily be limited to): database design, creation, implementation, maintenance, backup and recovery, policy setting and enforcement, and security.

Even if you don't become a database programmer or **database administrator (DBA)**, you're almost surely going to be called upon to dive in and use a database. You may even be asked to help identify your firm's data requirements. It's quite common for nontech employees to work on development teams with technical staff, defining business problems, outlining processes, setting requirements, and determining the kinds of data the firm will need to leverage. Database systems are powerful stuff, and can't be avoided, so a bit of understanding will serve you well.

FIGURE 15.2 A Simplified Relational Database for a University Course Registration System



A complete discourse on technical concepts associated with database systems is beyond the scope of our managerial introduction, but here are some key concepts to help get you oriented, and that all managers should know.

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- A **table or file** refers to a list of data.
- A *database* is either a single table or a collection of related tables. The course registration database above depicts five tables.
- A **column or field** defines the data that a table can hold. The "Students" table above shows columns for STUDENT_ID, FIRST_NAME, LAST_NAME, CAMPUS_ADDR (the "..." symbols above are meant to indicate that, in practice, there may be more columns or rows than are shown in this simplified diagram).
- A **row or record** represents a single instance of whatever the table keeps track of. In the example above, each row of the "Students" table represents a student, each row of the "Enrollment" table represents the enrollment of a student in a particular course, and each row of the "Course List" represents a given section of each course offered by the university.
- A key is the field or fields used to relate tables in a database. Look at how the STUDENT_ID key is used above. There is *one* unique STUDENT_ID for each student, but the STUDENT_ID may appear *many* times in the "Enrollment" table, indicating that each student may be enrolled in many classes. The "1" and "M" in the diagram above indicate the one-to-many relationships among the keys in these tables.
- These one-to-many relationships are sometimes referred to as a *primary key* and *foreign key*. There's only one unique STUDENT_ID value for each record (row) in the "Student" table, so STUDENT_ID is a *primary key* in the student table. But in the "Enrollment" table, STUDENT_ID is the *foreign key*. It appears several times and relates back to the primary key in the "Student" table, so we can find out more information about each unique student that is enrolled in a particular course.

table or file

A list of data, arranged in columns (fields) and rows (records).

column or field

A column in a database table. Columns represent each category of data contained in a record (e.g., first name, last name, ID number, date of birth).

row or record

A row in a database table. Records represent a single instance of whatever the table keeps track of (e.g., student, faculty, course title).

Databases organized like the one above, where multiple tables are related based on common keys, are referred to as **relational databases**. There are many other database formats (sporting names like *hierarchical*, and *object-oriented*), but relational databases are far and away the most popular. And all SQL databases are relational databases.

relational database

The most common standard for expressing databases, whereby tables (files) are related based on common keys.

Even though SQL and the relational model are hugely popular and dominate many corporate environments, other systems exist. An increasingly popular set of technologies known as *NoSQL* avoid SQL and the rigid structure of relational databases. NoSQL technologies are especially popular with Internet firms that rely on massive, unwieldy, and disparately structured data; and this technology is often at the heart of what are often characterized as "big data" efforts. Unlike SQL, there is not one clear standard or set of technologies for NoSQL configuration, use, and query—it's more of a catchall phrase, and you'll find incompatible products labeled "NoSQL" from a variety of vendors. Those students learning to build apps through my "Learn to Program Using Swift for iOS Development" offering use a NoSQL database from Google called Cloud Firestore.

We've just scratched the surface for a very basic introduction. Expect that a formal class in database systems will offer you far more detail and better design principles than are conveyed in the elementary example above. But you're already well on your way!

Key Takeaways

- Data includes raw facts that must be turned into information in order to be useful and valuable.
- Databases are created, maintained, and manipulated using programs called database management systems (DBMS), sometimes referred to as database software.
- Relational database management systems (RDBMS) are the most common database standard by far, and SQL (or structured query language) is the most popular standard for relational database systems.
- In relational database systems, several data fields make up a data record, multiple data records make up a table or data file, and one or more tables or data files make up a database. Files that are related to one another are linked based on a common field (or fields)

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known as a key. If the value of a key is unique to a record in a table, and that value can never occur in that field while referring to another record in that table, then it is a primary key. If a key can occur many times over multiple records in a table but relates back to a primary key in another table, then it is a foreign key.

Questions and Exercises

1. Define the following terms: table, record, and field. Provide another name for each term along with your definition.
2. Answer the following questions using the course registration database system, diagramed earlier:
    a. Imagine you also want to keep track of student majors. How would you do this? Would you modify an existing table? Would you add new tables? Why or why not?
    b. Why do you suppose the system needs a "Course Title" table?
    c. This database is simplified for our brief introduction. What additional data would you need to keep track of if this were a real course registration system? What changes would you make in the database above to account for these needs?
    d. Why do you need a STUDENT_ID? Why don't you just use a student's last name?
    e. Could you use Social Security number as a STUDENT_ID? Why or why not? (Hint: feel free to search on the Internet for additional insights.)
3. Research to find additional examples of organizations that made bad decisions based on bad data. Report your examples to your class, and tweet links to the most interesting examples to #BizTechBook. What was the end result of the examples you're citing (e.g., loss, damage, or other outcome)? What could managers have done to prevent problems in the cases that you cited? What role did technology play in the examples that you cite? What role did people or procedural issues play?
4. Why is an understanding of database terms and technologies important, even for nontechnical managers and staff? Consider factors associated with both system use and system development. What other skills, beyond technology, may be important when engaged in data-driven decision-making?
5. SQL is considered one of the most valuable skills to empower managers as data analysts. Search the web for free resources that teach SQL. Try a free introductory lesson (you might find these in sites like Khan Academy, and Code Academy, among others). Is this something you might continue to explore on your own? Does your university offer classes where you can learn SQL and other methods and technologies used in data analytics?

15.3 Where Does Data Come From?

Learning Objectives

1. Understand various internal and external sources for enterprise data.
2. Recognize the function and role of data aggregators, the potential for leveraging third-party data, the strategic implications of relying on externally purchased data, and key issues associated with aggregators and firms that leverage externally sourced data.

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Organizations can pull together data from a variety of sources. While the examples that follow aren't meant to be an encyclopedic listing of possibilities, they will give you a sense of the diversity of options available for data gathering.

Transaction Processing Systems

For most organizations that sell directly to their customers, **transaction processing systems (TPS)** represent a fountain of potentially insightful data. Every time a consumer uses a point-of-sale system, an ATM, or a service desk, there's a **transaction** (some kind of business exchange) occurring, representing an event that's likely worth tracking.

The cash register is the data generation workhorse of most physical retailers, and the primary source that feeds data to the TPS. But while TPS can generate a lot of bits, it's sometimes tough to match this data with a specific customer. For example, if you pay a retailer in cash, you're likely to remain a mystery to your merchant because your name isn't attached to your money. Grocers and retailers can tie you to cash transactions if they can convince you to use a **loyalty card**. Use one of these cards and you're in effect giving up information about yourself in exchange for some kind of financial incentive. The explosion in retailer cards is directly related to each firm's desire to learn more about you and to turn you into a more loyal and satisfied customer.

Some cards provide an instant discount (e.g., the CVS Pharmacy ExtraCare card), while others allow you to build up points over time (Best Buy's Reward Zone). The latter has the additional benefit of acting as a switching cost. A customer may think "I could get the same thing at Target, but at Best Buy, it'll increase my existing points balance and soon I'll get a cash back coupon."

transaction processing systems (TPS)

Systems that record a transaction (some form of business-related exchange), such as a cash register sale, ATM withdrawal, or product return.

transaction

Some kind of business exchange.

loyalty card

Systems that provide rewards and usage incentives, typically in exchange for a method that provides a more detailed tracking and recording of customer activity. In addition to enhancing data collection, loyalty cards can represent a significant switching cost.

Enterprise Software (CRM, SCM, and ERP)

Firms increasingly set up systems to gather additional data beyond conventional purchase transactions or website monitoring. CRM, or customer relationship management systems, are often used to empower employees to track and record data at nearly every point of customer contact. Someone calls for a quote? Brings a return back to a store? Writes a complaint e-mail? A well-designed CRM system can capture all these events for subsequent analysis or for triggering follow-up events.

Enterprise software includes not just CRM systems but also categories that touch every aspect of the value chain, including supply chain management (SCM) and enterprise resource planning (ERP) systems. More importantly, enterprise software tends to be more integrated and standardized than the prior era of proprietary systems that many firms developed themselves. This integration helps in combining data across business units and functions, and in getting that data into a form where it can be turned into information (for more on enterprise systems, see Chapter 13).

Surveys

Sometimes firms supplement operational data with additional input from surveys and focus groups. Oftentimes, direct surveys can tell you what your cash register can't. Zara store managers informally survey customers in order to help shape designs and product mix. Online grocer FreshDirect (see Chapter 2) surveys customers weekly and has used this feedback to drive initiatives from reducing packaging size to including star ratings on produce.[16] Many CRM products also have survey capabilities that allow for additional data gathering at all points of customer contact.

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artificial intelligence

Computer software that seeks to reproduce or mimic (perhaps with improvements) human thought, decision-making, or brain functions.

Can Technology "Cure" US Health Care?

The US health care system is broken. It's costly and inefficient, and problems seem to be getting worse. Estimates suggest that health care spending makes up a whopping 18 percent of US gross domestic product.[17] US automakers spend more on health care than they do on steel.[18] Even more disturbing, it's believed that medical errors are the third leading cause of death in the United States and are responsible for as many as 250,000 unnecessary deaths in the United States each year, more than motor vehicle accidents, breast cancer, or AIDS.[19]

For years it's been claimed that technology has the potential to reduce errors, improve health care quality, and save costs. Now pioneering hospital networks and technology companies are partnering to help tackle cost and quality issues. For a look at possibilities for leveraging data throughout the doctor-patient value chain, consider the "event-driven medicine" system built by Dr. John Halamka and his team at Boston's Beth Israel Deaconess Medical Center (part of the Harvard Medical School network).

When docs using Halamka's system encounter a patient with a chronic disease, they generate a decision support "screening sheet." Each event in the system—an office visit, a lab results report (think the medical equivalent of transactions and customer interactions)—updates the patient database. Combine that electronic medical record information with **artificial intelligence** on best practice, and the system can offer recommendations for care, such as, "Patient is past due for an eye exam," or "Patient should receive pneumovax [a vaccine against infection] this season."[20] The systems don't replace decision-making by doctors and nurses, but they do help to ensure that key issues are on a provider's radar.

More efficiencies and error checks show up when prescribing drugs. Docs are presented with a list of medications covered by that patient's insurance, allowing them to choose quality options while controlling costs. Safety issues, guidelines, and best practices are also displayed. When correct, safe medication in the right dose is selected, the electronic prescription is routed to the patient's pharmacy of choice. As Halamka puts it, going from "doctor's brain to patient's vein" without any of that messy physician handwriting, all while squeezing out layers where errors from human interpretation or data entry might occur.

Nearly every major technology company now has a health solutions group. And with the rise of efforts such as Apple's HealthKit and ResearchKit, expect even more solutions to allow consumers to gather data on their own health, with organizations offering insights on data-driven lifestyle improvements. At the introduction of ResearchKit, five apps were launched in conjunction with leading US health care institutions, including Dana-Farber, Massachusetts General Hospital, Stanford Medicine, Weill Cornell Medical College, and the Mayo Clinic. Apps focused on studying Parkinson's disease, diabetes, breast cancer, and heart health. Users opt-in to share data with research institutions, which can come from user input, quizzes, smartphone monitoring, the Apple Watch, or other external devices. Apple doesn't hold the data, it is encrypted, and names are not associated with results. Initial results suggest an influx of valuable data at a lower cost from these sorts of efforts. The asthma study app received more than 3,500 people within 72 hours, whereas it had previously taken about two years to recruit 500 to 1,000 participants in comparable efforts.[21] If systems like Halamka's, Apple's platform, and others realize their promise, big benefits may be just around the corner.

External Sources

Sometimes it makes sense to combine a firm's data with bits brought in from the outside. Many firms, for example, don't sell directly to consumers (this includes most drug companies and packaged goods firms). If your firm has partners that sell products for you, then you'll likely rely heavily on data collected by others.

Data bought from sources available to all might not yield competitive advantage on its own, but it can provide key operational insight for increased efficiency and cost savings. And when combined with a firm's unique data assets, it may give firms a high-impact edge.

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Consider restaurant chain Brinker, a firm that runs seventeen hundred eateries in twenty-seven countries under the Chili's, On The Border, and Maggiano's brands. Brinker (whose ticker symbol is EAT), supplements its own data with external feeds on weather, employment statistics, gas prices, and other factors, and uses this in predictive models that help the firm in everything from determining staffing levels to switching around menu items.[22]

In another example, Carnival Cruise Lines combines its own customer data with third-party information tracking household income and other key measures. This data helps the firm target limited marketing dollars on those past customers that are more likely to be able to afford to go on a cruise. So far it's been a winning approach. For three years in a row, the firm has experienced double-digit increases in bookings by repeat customers.[23]

data aggregators

Firms that collect and resell data.

Who's Collecting Data about You?

There's a thriving industry collecting data about you. Buy from a catalog, fill out a warranty card, or have a baby, and there's a very good chance that this event will be recorded in a database somewhere, added to a growing digital dossier that's made available for sale to others. If you've ever gotten catalogs, coupons, or special offers from firms you've never dealt with before, this was almost certainly a direct result of a behind-the-scenes trafficking in the "digital you."

Firms that trawl for data and package them up for resale are known as **data aggregators**. These are companies that you've likely never heard of but that are thought to "have more data on you than Facebook or Google"[24]—information they are willing to make available to others, for a price. A report by the US Federal Trade Commission[25] highlighted Acxiom, CoreLogic, Datalogix, eBureau, ID Analytics, Intelius, PeekYou, Rapleaf, and Recorded Future. The report lists categories of information collected, including a lot of what you'd expect—name, address, Social Security number, and a category labeled "ability to afford products," but also all sorts of granular categorization. Quartz highlighted some of the more noteworthy ones, including: thrifty elders, new age/organic lifestyle adherents, bikers/Hell's Angels, people who do a lot of medical Googling (an "ailment and prescription online search propensity"), and even purchasers of "Novelty Elvis" products.[26]

The Internet also allows for easy access to data that had been public but is otherwise difficult to access. For one example, consider home sale prices and home value assessments. While technically in the public record, someone wanting this information previously had to traipse down to their Town Hall and speak to a clerk, who would hand over a printed log book. Not exactly a Google-speed query. Contrast this with a visit to Zillow.com. The free site lets you pull up a map of your town and instantly peek at how much your neighbors paid for their homes. And it lets them see how much you paid for yours, too.

Computerworld's Robert Mitchell uncovered a more disturbing issue when public record information is made available online. His New Hampshire municipality had digitized and made available some of his old public documents without obscuring that holy grail for identity thieves, his Social Security number.[27]

Then there are accuracy concerns. A record incorrectly identifying you as a cat lover is one thing, but being incorrectly named to the terrorist watch list is quite another. During a five-week period airline agents tried to block a particularly high-profile US citizen from boarding airplanes on five separate occasions because his name resembled an alias used by a suspected terrorist. That citizen? The late Ted Kennedy, who at the time was the senior US senator from Massachusetts.[28]

For the data trade to continue, firms will have to treat customer data as the sacred asset it is. Step over that "creep-out" line, and customers will push back, increasingly pressing for tighter privacy laws. Data aggregator Intelius used to track cell phone customers, but backed off in the face of customer outrage and threatened legislation.

Another concern—sometimes data aggregators are just plain sloppy, committing errors that can be costly for the firm and potentially devastating for victimized users. This was the case in the massive breach of credit reporting agency Equifax (for details, see Chapter 17—Barbarians at the Gateway). The firm has records on nearly everyone living in the US who has a bank account or credit card, yet Equifax's flawed policies and vulnerable software allowed hackers to steal names, addresses, Social Security numbers, driver's license information, and more, something that has the potential to plague victims with fraud and identity theft for years to come. Nearly every Amer-

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ican adult and hundreds of thousands outside the country were victims. Equifax is estimated to have spent a quarter billion dollars in the months following the breach, with eventual costs expected to run into the billions.[29] Just because you can gather data and traffic in bits doesn't mean that you should. Any data-centric effort should involve input not only from business and technical staff, but from the firm's legal team as well (for more, see the box "Privacy Regulation: A Moving Target").

Privacy Regulation: A Moving Target

New methods for tracking and gathering user information appear daily, testing user comfort levels. For example, the firm Umbria uses software to analyze millions of blog and forum posts every day, using sentence structure, word choice, and quirks in punctuation to determine a blogger's gender, age, interests, and opinions. While Google refused to include facial recognition as an image search product ("too creepy," said its chairman),[30] Facebook, with great controversy, turned on facial recognition by default.[31] It's quite possible that in the future, someone will be able to upload a photo to a service and direct it to find all the accessible photos and video on the Internet that match that person's features. And while targeting is getting easier, a Carnegie Mellon study showed that it doesn't take much to find someone with a minimum of data. Simply by knowing gender, birth date, and postal zip code, 87 percent of people in the United States could be pinpointed by name.[32] Another study showed that publicly available data on state and date of birth could be used to predict US Social Security numbers—a potential gateway to identity theft.[33]

Some feel that Moore's Law, the falling cost of storage, and the increasing reach of the Internet have us on the cusp of a privacy train wreck. And that may inevitably lead to more legislation that restricts data-use possibilities. Noting this, strategists and technologists need to be fully aware of the legal environment their systems face and consider how such environments may change in the future. Unregulated firms seen as violating the public trust through poor policies or lax enforcement will be called to task, as is evidenced by Mark Zuckerberg's multi-hour grilling by US legislators following revelations that one-time partner firm Cambridge Analytica gathered data without consumer consent by using seemingly innocuous online quizzes to harvest data not only from test-takers, but also from their friends. The data was used in targeted political advertising, but also came to light when 13 Russians were indicted by the US special counsel, saying they'd used Facebook to perpetrate "information warfare" against the US. Many industries have strict guidelines on what kind of information can be collected and shared.[34]

While many large-scale data collection efforts remain unregulated, strict rules do apply to certain organizations and circumstances. For example, HIPAA (the US Health Insurance Portability and Accountability Act) includes provisions governing data use and privacy among health care providers, insurers, and employers. The financial industry has strict requirements for recording and sharing communications between firm and client (among many other restrictions). There are laws limiting the kinds of information that can be gathered on younger Web surfers. And there are several laws operating at the state level as well.

International laws also differ from those in the United States. Europe, in particular, has a strict European Privacy Directive. The directive includes governing provisions that limit data collection, require notice and approval of many types of data collection, and require firms to make data available to customers with mechanisms for stopping collection efforts and correcting inaccuracies at customer request. Australia is among the nations that mimic much of what it finds in European laws.[35] Data-dependent efforts plotted for one region may not fully translate to another effort if the law limits key components of technology use. The constantly changing legal landscape also means that what works today might not be allowed in the future.

Firms beware—the public will almost certainly demand tighter controls if the industry is perceived as behaving recklessly or inappropriately with customer data.

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Key Takeaways

- For organizations that sell directly to their customers, transaction processing systems (TPS) represent a source of potentially useful data.
- Grocers and retailers can link you to cash transactions if they can convince you to use a loyalty card which, in turn, requires you to give up information about yourself in exchange for some kind of financial incentive such as points or discounts.
- Enterprise software (CRM, SCM, and ERP) is a source for customer, supply chain, and enterprise data.
- Survey data can be used to supplement a firm's operational data.
- Data obtained from outside sources, when combined with a firm's internal data assets, can give the firm a competitive edge.
- Data aggregators are part of a multibillion-dollar industry that provides genuinely helpful data to a wide variety of organizations.
- Data that can be purchased from aggregators may not in and of itself yield sustainable competitive advantage since others may have access to this data, too. However, when combined with a firm's proprietary data or integrated with a firm's proprietary procedures or other assets, third-party data can be a key tool for enhancing organizational performance.
- Data aggregators can also be quite controversial. Among other things, they represent a big target for identity thieves, are a method for spreading potentially incorrect data, and raise privacy concerns.
- Firms that mismanage their customer data assets risk lawsuits, brand damage, lower sales and fleeing customers, and can prompt more restrictive legislation.
- Further raising privacy issues and identity theft concerns, recent studies have shown that in many cases it is possible to pinpoint users through allegedly anonymous data, and to guess Social Security numbers from public data.
- New methods for tracking and gathering user information are raising privacy issues, which possibly will be addressed through legislation that restricts data use.

Questions and Exercises

1. Why would a firm use a loyalty card? What is the incentive for the firm? What is the incentive for consumers to opt in and use loyalty cards? What kinds of strategic assets can these systems create?
2. Make a list of the kind of data you might give up when using a cash register, a website, or a loyalty card, or when calling a firm's customer support line. How might firms leverage this data to better serve you and improve their performance?
3. Are you concerned by any of the data-use possibilities that you outlined in prior questions, discussed in this chapter, or that you've otherwise read about or encountered? If you are concerned, why? If not, why not? What might firms, governments, and consumers do to better protect consumers?
4. What are some of the sources data aggregators tap to collect information?
5. Privacy laws are in a near constant state of flux. Conduct research to identify the current state of privacy law. Has major legislation recently been proposed or approved? What are the implications for firms operating in effected industries? What are the potential benefits to consumers? Do consumers lose anything from this legislation?
6. Self-regulation is often proposed as an alternative to legislative efforts. What kinds of efforts would provide "teeth" to self-regulation? Are there steps firms could take to make you believe in their ability to self-regulate? Why or why not?
7. What is HIPAA? What industry does it impact?

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8. How do international privacy laws differ from US privacy laws?
9. Many firms, including Google and Facebook, allow you to access the data they collect on you, or see how they've classified your Internet use. Search online to see what data these or other firms have on you. Come to class prepared to discuss your findings. Were you surprised at what you found? Do you feel these efforts should be regulated? Why or why not?

15.4 Data Rich, Information Poor

Learning Objectives

1. Know and be able to list the reasons why many organizations have data that can't be converted to actionable information.
2. Understand why transactional databases can't always be queried and what needs to be done to facilitate effective data use for analytics and business intelligence.
3. Recognize key issues surrounding data and privacy legislation.

Despite being awash in data, many organizations are data rich but information poor. A survey by consulting firm Accenture found 57 percent of companies reporting that they didn't have a beneficial, consistently updated, companywide analytical capability. Among major decisions, only 60 percent were backed by analytics—40 percent were made by intuition and gut instinct.[36] The big culprit limiting BI initiatives is getting data into a form where it can be used, analyzed, and turned into information. Here's a look at some factors holding back information advantages.

Incompatible Systems

legacy system

Older information systems that are often incompatible with other systems, technologies, and ways of conducting business. Incompatible legacy systems can be a major roadblock to turning data into information, and they can inhibit firm agility, holding back operational and strategic initiatives.

Just because data is collected doesn't mean it can be used. This limit is a big problem for large firms that have **legacy systems**, outdated information systems that were not designed to share data, aren't compatible with newer technologies, and aren't aligned with the firm's current business needs. The problem can be made worse by mergers and acquisitions, especially if a firm depends on operational systems that are incompatible with its partner. And the elimination of incompatible systems isn't just a technical issue. Firms might be under extended agreement with different vendors or outsourcers, and breaking a contract or invoking an escape clause may be costly. Folks working in M&A (the area of investment banking focused on valuing and facilitating mergers and acquisitions) beware—it's critical to uncover these hidden costs of technology integration before deciding if a deal makes financial sense.

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Legacy Systems: A Prison for Strategic Assets

The experience of one *Fortune* 100 firm that your author has worked with illustrates how incompatible information systems can actually hold back strategy. This firm was the largest in its category, and sold identical commodity products sourced from its many plants worldwide. Being the biggest should have given the firm scale advantages. But many of the firm's manufacturing facilities and international locations developed or purchased separate, incompatible systems. Still more plants were acquired through acquisition, each coming with its own legacy systems.

The plants with different information systems used *different* part numbers and naming conventions even though they sold *identical* products. As a result, the firm had no timely information on how much of a particular item was sold to which worldwide customers. The company was essentially operating as a collection of smaller, regional businesses, rather than as the worldwide behemoth that it was.

After the firm developed an information system that standardized data across these plants, it was, for the first time, able to get a single view of worldwide sales. The firm then used this data to approach their biggest customers, negotiating lower prices in exchange for increased commitments in worldwide purchasing. This trade let the firm take share from regional rivals. It also gave the firm the ability to shift manufacturing capacity globally, as currency prices, labor conditions, disasters, and other factors impacted sourcing. The new information system in effect liberated the latent strategic asset of scale, increasing sales by well over a billion and a half dollars in the four years following implementation.

Operational Data Can't Always Be Queried

Another problem when turning data into information is that most transactional databases aren't set up to be simultaneously accessed for reporting and analysis. When a customer buys something from a cash register, that action may post a sales record and deduct an item from the firm's inventory. In most TPS systems, requests made to the database can usually be performed pretty quickly—the system adds or modifies the few records involved and it's done—in and out in a flash.

But if a manager asks a database to analyze historic sales trends showing the most and least profitable products over time, they may be asking a computer to look at thousands of transaction records, comparing results, and neatly ordering findings. That's not a quick in-and-out task, and it may very well require significant processing to come up with the request. Do this against the very databases you're using to record your transactions, and you might grind your computers to a halt.

Getting data into systems that can support analytics is where data warehouses and data marts come in, the topic of our next section.

Airbnb: Better Pricing Through Data

Airbnb might not own any of the properties that it rents, but the firm invests some serious coin in its analytics infrastructure. The firm's 150-plus data scientists crunch 15 petabytes of data daily. Over 3.5 million listings across nearly 200 countries generate upwards of 15 billion logged events that help maximize satisfaction from both property hosts and and their renting customers.[37]

Unique offerings, with different amenities, locations, and varying demand over time, make pricing a challenge, especially for new property listers. But Airbnb's data models allow little-guy property hosts to have the same sort of dynamic pricing that hotels might use. Airbnb's "smart pricing" feature uses machine learning to constantly tweak the accuracy of models that suggest the perfect rate.[38] While the data and the resulting, constantly updated model are proprietary to Airbnb, the firm uses, and heavily contributes to, an open source machine learning tool available to all—a product known as Aerosolve. All sorts of data can influence a price. Is there an event happening in the city that puts a property in demand? Is the property close to public transportation? The

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beach? Local attractions? What about amenities? A hair dryer adds around $10 per night. A hot tub? $26. Wi-Fi? $8. Cable TV? $16. Don't have many reviews? Data will advise you to cut your price. Properties with 10 or more reviews get booked 10 times as often.[39] While hosts can override smart pricing suggestions, most hosts use the firm's pricing dashboard to set a minimum and maximum price, then allow Airbnb to automatically adjust the prices for them.[40] Hosts ranked higher in likelihood of accepting accommodation request will rank higher in search result, so data smarts help renters have a better experience, as well. Impact is significant, boosting rentals by 13 percent on average.

Having numerate employees capable of crunching numbers and interpreting results prompted Airbnb to create an internal "data university" where employees can learn skills like SQL, R programming, how to use the firm's proprietary tools and dashboards, and learn best practices.[41] For Silicon Valley's second most-valuable startup, this constantly refined big data asset yields big results that keep rental properties full and owner wallets fat, and cements renter loyalty.

Key Takeaways

- A major factor limiting business intelligence initiatives is getting data into a form where it can be used (i.e., analyzed and turned into information).
- Legacy systems often limit data utilization because they were not designed to share data, aren't compatible with newer technologies, and aren't aligned with the firm's current business needs.
- Most transactional databases aren't set up to be simultaneously accessed for reporting and analysis. In order to run analytics the data must first be ported to a data warehouse or data mart.

Questions and Exercises

1. How might information systems impact mergers and acquisitions? What are the key issues to consider?
2. Discuss the possible consequences of a company having multiple plants, each with a different information system using different part numbers and naming conventions for identical products.
3. Why does it take longer, and require more processing power, to analyze sales trends by region and product, as opposed to posting a sales transaction?

15.5 Data Warehouses, Data Marts, and Technology behind "Big Data"

Learning Objectives

1. Understand what data warehouses and data marts are and the purpose they serve.

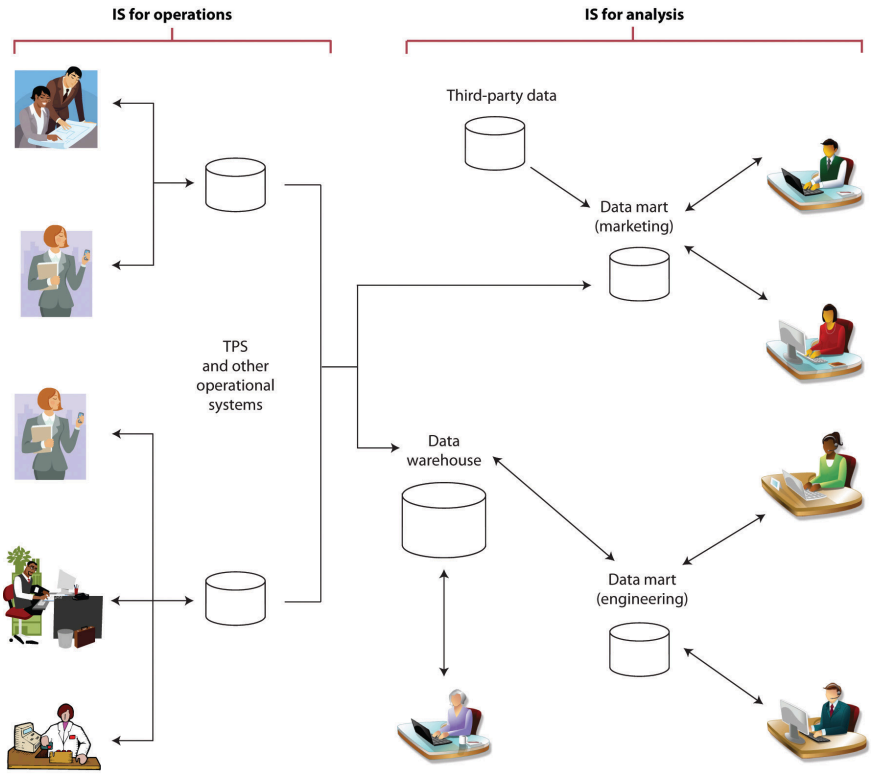
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2. Know the issues that need to be addressed in order to design, develop, deploy, and maintain data warehouses and data marts.
3. Recognize and understand technologies behind "Big Data," how they differ from conventional data management approaches, and how they are currently being used for organizational benefit.

Since running analytics against transactional data can bog down a system, and since most organizations need to combine and reformat data from multiple sources, firms typically need to create separate data repositories for their reporting and analytics work. Such data repositories act as a kind of staging area from which to turn that data into information.

FIGURE 15.3 Information Systems for Operations and Analysis
Information systems supporting operations (such as TPS) are typically separate, and "feed" information systems used for analytics (such as data warehouses and data marts).



Two terms you'll hear for these kinds of repositories are **data warehouse** and **data mart**. A data warehouse is a set of databases designed to support decision-making in an organization. It is structured for fast online queries and exploration. Data warehouses may aggregate enormous amounts of data from many different operational systems.

A data mart is a database focused on addressing the concerns of a specific problem (e.g., increasing customer retention, improving product quality) or business unit (e.g., marketing, engineering).

Marts and warehouses may contain huge volumes of data. For example, a firm may not need to keep large amounts of historical point-of-sale or transaction data in its operational systems, but it might want past data in its data mart so that managers can hunt for patterns and trends that occur over time.

It's easy for firms to get seduced by a software vendor's demonstration showing data at your fingertips, presented in pretty graphs. But as mentioned earlier, getting data in a format that can be used for analytics is hard, complex, and challenging work. Large data warehouses can cost millions

data warehouse
A set of databases designed to support decision-making in an organization.

data mart
A database or databases focused on addressing the concerns of a specific problem (e.g., increasing customer retention, improving product quality) or business unit (e.g., marketing, engineering).

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and take years to build. Every dollar spent on technology may lead to five to seven more dollars on consulting and other services.[42]

Most firms will face a trade-off—do we attempt a large-scale integration of the whole firm, or more targeted efforts with quicker payoffs? Firms in fast-moving industries or with particularly complex businesses may struggle to get sweeping projects completed in enough time to reap benefits before business conditions change. Most consultants now advise smaller projects with narrow scope driven by specific business goals.[43]

Firms can eventually get to a unified data warehouse, but it may take time. Even analytics king Walmart has spent years getting to that point. The retail giant once reported having over seven hundred different data marts and hired Hewlett-Packard for help in bringing the systems together to form a more integrated data warehouse.[44]

The old saying from the movie *Field of Dreams*, "If you build it, they will come," doesn't hold up well for large-scale data analytics projects. This work should start with a clear vision with business-focused objectives. When senior executives can see objectives illustrated in potential payoff, they'll be able to champion the effort and, experts agree, having an executive champion is a key success factor. Focusing on business issues will also drive technology choice, with the firm better able to focus on products that best fit its needs.

Once a firm has business goals and hoped-for payoffs clearly defined, it can address the broader issues needed to design, develop, deploy, and maintain its system:[45]

- *Data relevance.* What data do we need in order to compete on analytics? What data do we need to meet our current and future goals?
- *Data sourcing.* Can we obtain all the data we'll need? From where? Can we get it through our internal systems or from third-party data aggregators, suppliers, or sales partners? Do we need to set up new collection efforts, surveys, or systems to obtain the data we need?
- *Data quantity.* How much data do we need?
- *Data quality.* Can this data be trusted; is it accurate, clean, complete, and reasonably free of errors? How can our data be made more accurate and valuable for analysis? Will we need to "scrub," calculate, and consolidate data so that it can be used?
- *Data hosting.* Where will the data systems be housed? What are the hardware and networking requirements for that effort?
- *Data governance.* What rules and processes are needed to manage this data, from creation through retirement? Are there operational (backup, disaster recovery), legal or privacy concerns? How should the company handle access and security ?

For some perspective on how difficult this can be, consider that an executive from one of the largest US banks once lamented how difficult it was to get his systems to do something as simple as properly distinguishing between men and women. The company's customer-focused data warehouse drew data from thirty-six separate operational systems—bank teller systems, ATMs, student loan reporting systems, car loan systems, mortgage loan systems, and more. Collectively these legacy systems expressed gender in *seventeen* different ways: "M" or "F"; "m" or "f"; "Male" or "Female"; "MALE" or "FEMALE"; "1" for man, "0" for woman; "0" for man, "1" for woman and more, plus various codes for "unknown." The best math in the world is of no help if the values used aren't any good. There's a saying in the industry, "Garbage in, garbage out."

Hadoop: Big Insights from Unstructured "Big Data"

Having neatly structured data warehouses and data marts are great—the tools are reliable and can often be turned over to end-users or specialists who can rapidly produce reports and other

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analyses. But roughly 80 percent of corporate data is messy and unstructured, and it is not stored in conventional, relational formats—think of data stored in office productivity documents, e-mail, call center conversations, and social media.[46] It's the three Vs of "Big Data"—volume, velocity, and variety—that distinguish it from conventional data analysis problems and require a new breed of technology. Big data is forcing companies to rethink both the technology infrastructure and the necessary skills needed to successfully interpret and act on the information.[47] Conventional tools often choke when trying to sift through the massive amounts of data collected by many of today's firms. The open source project known as Hadoop was created to analyze massive amounts of raw information better than traditional, highly structured databases. While there are other technologies that can be leveraged for big data projects, Hadoop is the clear leader, growing alongside big data trends to analyze massive amounts of unstructured data, so it merits distinct mention in this discussion.

Hadoop is made up of some half-dozen separate software pieces and requires the integration of these pieces to work. Hadoop-related projects have names such as Hive, Pig, and Zookeeper. Several commercial firms provide support, add-on products, or proprietary technology for big data implementations leveraging these technologies, including fast-growing Hadoop specialists such as Cloudera (which, after Red Hat, is only the second open source firm in history to crack $100 million in revenues), Hortonworks (which went public in 2014), and MapR. Amazon, IBM, and Pivotal (which is a venture by EMC and its VMware subsidiary) are among established tech giants that provide Hadoop products and services. Hadoop use is catching on like wildfire, with some expecting that within five years, more than half of the world's data will be stored in Hadoop environments.[48]

There are four primary advantages to Hadoop, although these advantages may also apply to competing big data technologies:[49]

- *Flexibility*: Hadoop can absorb any type of data, structured or not, from any type of source (geeks would say such a system is *schema-less*). But this disparate data can still be aggregated and analyzed.
- *Scalability*: Hadoop systems can start on a single PC, but thousands of machines can eventually be combined to work together for storage and analysis.
- *Cost effectiveness*: Since the system is open source and can be started with low-end hardware, the technology is cheap by data-warehousing standards. Many vendors also offer Hadoop as a cloud service, allowing firms to avoid hardware costs altogether.
- *Fault tolerance*: One of the servers running your Hadoop cluster just crashed? No big deal. Hadoop is designed in such a way so that there will be no single point of failure. The system will continue to work, relying on the remaining hardware.

Financial giant Morgan Stanley is a big believer in Hadoop. One senior technology manager at the firm contrasts Hadoop with highly structured systems, saying that in the past, "IT asked the business what they want, creates a data structure and writes structured query language, sources the data, conforms it to the table and writes a structured query. Then you give it to them and they often say that is not what they wanted." But with Hadoop overseeing a big pile of unstructured (or less structured) data, technical staff can now work with users to carve up and combine data in lots of different ways, or even set systems loose in the data to hunt for unexpected patterns (see the discussion of data mining later in this chapter). Morgan Stanley's initial Hadoop experiments started with a handful of old servers that were about to be retired, but the company has steadily ramped up its efforts. Now by using Hadoop, the firm sees that it is able to analyze data on a far larger scale ("petabytes of data, which is unheard of in the traditional database world") with potentially higher-impact results. The bank is looking at customers' financial objectives and trying to come up with investment insights to help them invest appropriately, and it is seeking "Big Data" insights to help the firm more effectively manage risk.[50]

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FIGURE 15.4 The Hadoop Logo
The project was named after a toy elephant belonging to the son of Hadoop Developer Doug Cutting.



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Other big-name firms using Hadoop for "Big Data" insights include Bank of America, Disney, GE, LinkedIn, Nokia, Twitter, and Walmart. Hadoop is an open source project overseen by the Apache Software Foundation. It has an Internet pedigree and is based on ideas by Google and lots of software contributed by Yahoo! (two firms that regularly need to dive into massive and growing amounts of unstructured data—Web pages, videos, images, social media, user account information, and more). IBM used Hadoop as the engine that helped power Watson to defeat human opponents on *Jeopardy*, further demonstrating the technology's ability to analyze wildly different data for accurate insight. Other tech firms embracing Hadoop and offering some degree of support for the technology include HP, EMC, and Microsoft.

Over 91 percent of *Fortune* 1000 senior executives surveyed said big data initiatives were planned or under way, with half of these execs expecting efforts to cost $10 million or more.[51] Yet while success stories for big data abound, many organizations lack the skills required to exploit big data.[52] McKinsey estimates a US talent shortfall of 140,000 to 190,000 data scientists and a further need for 1.5 million more managers and analysts who will have to be savvy consumers of big data analytics.[53] Time to double-down on studying big data and analytics.

Spotify: Your DJ in the Cloud

In 2014, the top music streaming service in the world, Stockholm-based Spotify, plunked down undisclosed millions for The Echo Nest, a Somerville, Massachusetts-based firm that had essentially created an automated music geek. While Apple's Beats 1 radio station uses a handful of charismatic human DJs to line up tracks,[54] Echo Nest is building a better hipster. According to Jim Lucchese, Echo Nest CEO at the time of acquisition, the firm systems do "what a great deejay does, or the friend that you rely on musically: to better understand who you are as a fan, understand all the music that's out there and make that connection."[55]

The Echo Nest was founded by the musically and technically talented team of Brian Whitman and Tristan Jehan, researchers who honed their craft at MIT's Media Lab. The duo built systems that could do two things: The first was to "listen" to music—analyze it to break down its characteristics: pitch, key, tempo, vocals or instrumental, live or studio, energy level, mood, and more.[56] While Pandora has human beings rating music, the idea struggles to scale and be consistent.[57] The Echo Nest, by contrast, created precision and speed. Over 30 million songs in that great musical catalog in the cloud[58] have been devoured and detailed, and 20,000 new ones are added each day.[59] And, with machine learning, the service only gets better the more data it's fed.[60]

The second big Echo Nest trick is to pay attention to what the world is saying about music. The firm's software constantly scours the Web, "reading" music blogs, news reports, and more—as many as 10 million documents each day. The firm's homegrown technology analyzes descriptions of artists, albums, tracks, and developing insight into trends and genres. In this, The Echo Nest has essentially built a cool hunting machine that listens to the world's music reviewers, music mavens, and rabid fans, constantly and planet-wide.[61]

Using The Echo Nest, Spotify is helping to curate the cloud according to your taste. Spotify's "Discover Weekly" is essentially a custom-built "station for you" created by examining your playlists, your listening habits, and what it learns about its millions of other users.[62] New services hint at where this can go. If you run, Spotify's smartphone app can pay attention to your running tempo, examine your song preferences, and build a playlist cued up based on how fast you move. Using The Echo Nest, Spotify is helping to curate the cloud according to your taste.[63] The future could be even more extraordinarily predictive. Does your phone tell Spotify you're at work? Queue up some non-distracting instrumental music to listen to in the background. Home cooking dinner? You'll get something smooth and relaxing. Gym patterns kicking in? Power mix. Big data, droppin' beats.[64]

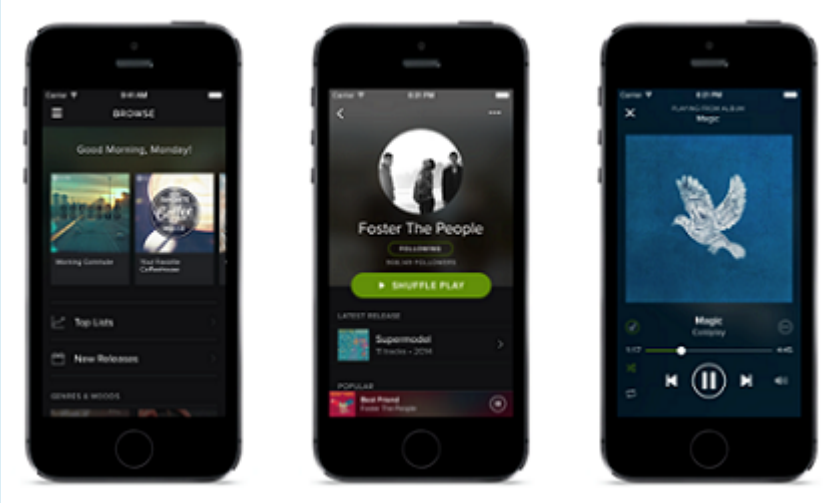
Spotify has also launched tools to bring big data insights to its artists. The Spotify for Artists app gives all sorts of analytics, including overall streams and what playlists are creating new fans. The firm's Fans First program allows musicians to target their most rabid fans with special offers.

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And the firm hasn't stopped with Echo Nest. Four acquisitions in 2017 alone fuel the firm's skill in APIs, machine learning, audio detection, and television recommendation. The firm even bought a blockchain company to help artists and labels with licensing and copyright issues.[65]

FIGURE 15.5 Spotify App
With over 70 million paying subscribers and an additional 90 million using the free service, Spotify is by far the world's most popular streaming music service. Big data leveraged by the firm's subsidiary, The Echo Nest, promises to leverage everything the firm knows about music, and about you, to queue up the best listening experience at exactly the right time.



Source: Spotify's public archive for media use at: https://press.spotify.com/no/pictures/application/.

e-discovery: Supporting Legal Inquiries

e-discovery
The process of identifying and retrieving relevant electronic information to support litigation efforts.

Data archiving isn't just for analytics. Sometimes the law requires organizations to dive into their electronic records. **e-discovery** refers to identifying and retrieving relevant electronic information to support litigation efforts. e-discovery is something a firm should account for in its archiving and data storage plans. Unlike analytics that promise a boost to the bottom line, there's no profit in complying with a judge's order—it's just a sunk cost. But organizations can be compelled by court order to scavenge their bits, and the cost to uncover difficult-to-access data can be significant, if not planned for in advance.

In one recent example, the Office of Federal Housing Enterprise Oversight (OFHEO) was subpoenaed for documents in litigation involving mortgage firms Fannie Mae and Freddie Mac. Even though the OFHEO wasn't a party in the lawsuit, the agency had to comply with the search—an effort that cost $6 million, a full 9 percent of its total yearly budget.[66]

Key Takeaways

- Data warehouses and data marts are repositories for large amounts of transactional data awaiting analytics and reporting.
- Large data warehouses are complex, can cost millions, and take years to build.
- The open source Hadoop effort provides a collection of technologies for manipulating massive amounts of unstructured data. The system is flexible, scalable, cost-effective, and

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fault-tolerant. Hadoop grew from large Internet firms but is now being used across industries.

Questions and Exercises

1. List the issues that need to be addressed in order to design, develop, deploy, and maintain data warehouses and data marts.
2. What is meant by "data relevance"?
3. What is meant by "data governance"?
4. What is the difference between a data mart and a data warehouse?
5. Why are data marts and data warehouses necessary? Why can't an organization simply query its transactional database?
6. How can something as simple as customer gender be difficult for a large organization to establish in a data warehouse?
7. What is Hadoop? Why would a firm use Hadoop instead of conventional data warehousing and data mart technologies?
8. Research the current state of "Big Data" analysis. Identify major firms leveraging Hadoop or similar technologies and share high-impact examples with your classmates and professor.
9. Think about examples where "Big Data" seems to have been used to target you or improve your experience with a firm or organization. Research the effort online to see if you can uncover any details. How does this make you feel on the spectrum spanning from "great service" to "creeped out"?

15.6 The Business Intelligence Toolkit

Learning Objectives

1. Know the tools that are available to turn data into information.
2. Identify the key areas where businesses leverage data mining.
3. Understand some of the conditions under which analytical models can fail.

So far we've discussed where data can come from, and how we can get data into a form where we can use it. But how, exactly, do firms turn that data into information? That's where the various software tools of business intelligence (BI) and analytics come in. Potential products in the business intelligence toolkit range from simple spreadsheets to ultrasophisticated data mining packages leveraged by teams employing "rocket-science" mathematics.

Query and Reporting Tools

The idea behind query and reporting tools is to present users with a subset of requested data, selected, sorted, ordered, calculated, and compared, as needed. Managers use these tools to see and explore what's happening inside their organizations.

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Canned reports provide regular summaries of information in a predetermined format. They're often developed by information systems staff, and formats can be difficult to alter. By contrast, **ad hoc reporting tools** allow users to dive in and create their own reports, selecting fields, ranges, and other parameters to build their own reports on the fly. **Dashboards** provide a sort of heads-up display of critical indicators, letting managers get a graphical glance at key performance metrics. Some tools may allow data to be exported into spreadsheets. Yes, even the lowly spreadsheet can be a powerful tool for modeling "what if" scenarios and creating additional reports (of course, be careful: if data can be easily exported, then it can potentially leave the firm dangerously exposed, raising privacy, security, legal, and competitive concerns).

canned reports

Reports that provide regular summaries of information in a predetermined format.

ad hoc reporting tools

Tools that put users in control so that they can create custom reports on an as-needed basis by selecting fields, ranges, summary conditions, and other parameters.

dashboards

A heads-up display of critical indicators that allow managers to get a graphical glance at key performance metrics.

FIGURE 15.6 The Federal IT Dashboard

The Federal IT Dashboard offers federal agencies, and the general public, information about the government's IT investments.



Source: USASpending.gov

A subcategory of reporting tools is referred to as **online analytical processing (OLAP)** (pronounced "oh-lap"). Data used in OLAP reporting is usually sourced from standard relational databases, but it's calculated and summarized in advance, across multiple dimensions, with the data stored in a special database called a **data cube**. This extra setup step makes OLAP fast (sometimes one thousand times faster than performing comparable queries against conventional relational databases). Given this kind of speed boost, it's not surprising that data cubes for OLAP access are often part of a firm's data mart and data warehouse efforts.

A manager using an OLAP tool can quickly explore and compare data across multiple factors such as time, geography, product lines, and so on. In fact, OLAP users often talk about how they can "slice and dice" their data, "drilling down" inside the data to uncover new insights. And while conventional reports are usually presented as a summarized list of information, OLAP results look more like a spreadsheet, with the various dimensions of analysis in rows and columns, with summary values at the intersection.

online analytical processing (OLAP)

A method of querying and reporting that takes data from standard relational databases, calculates and summarizes the data, and then stores the data in a special database called a data cube.

data cube

A special database used to store data in OLAP reporting.

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FIGURE 15.7 Tableau

Business Intelligence tools such as Tableau (shown here) can gather data from multiple resources, and allow users to explore relationships and create powerful, consolidated reports and charts. For those interested, the questions at the end of the chapter include an exercise where you can download and try Tableau for free.



Source: Copyright SAS Institute, Inc, at https://www.tableau.com/about/media-download-center.

Public Sector Reporting Tools in Action: Fighting Crime and Fighting Waste

Access to ad hoc query and reporting tools can empower all sorts of workers. Consider what analytics tools have done for the police force in Richmond, Virginia. The city provides department investigators with access to data from internal sources such as 911 logs and police reports, and combines this with outside data including neighborhood demographics, payday schedules, weather reports, traffic patterns, sports events, and more.

Experienced officers dive into this data, exploring when and where crimes occur. These insights help the department decide how to allocate its limited policing assets to achieve the biggest impact. While IT staffers put the system together, the tools are actually used by officers with expertise in fighting street crime—the kinds of users with the knowledge to hunt down trends and interpret the causes behind the data. And it seems this data helps make smart cops even smarter—the system is credited with delivering a single-year crime-rate reduction of 20 percent.[67]

As it turns out, what works for cops also works for bureaucrats. When administrators for Albuquerque were given access to ad hoc reporting systems, they uncovered all sorts of anomalies, prompting excess spending cuts on everything from cell phone usage to unnecessarily scheduled overtime. And once again, BI performed for the public sector. The Albuquerque system delivered the equivalent of $2 million in savings in just the first three weeks it was used.[68]

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L.L. Bean: Data Master

For a look at data-driven prowess, head to Maine and visit the over 100-year-old clothing and equipment retailer L.L. Bean. Bean's world has changed dramatically since the 1990s, when it had a highly structured, mostly relational information system to support a single marketing channel (catalog sales). Today Bean has retail stores, an adventure travel business, websites, apps, buying through Google Shopping and affiliates, social media, loyalty programs, and more—engaging customers through roughly 30 different channels overall. All of this inflates data collection—website traffic, app stats, A/B testing, purchases, items viewed but not purchased, returns, repairs, ad impressions, online marketing response, to name just a few.

Structured data didn't cut it any more. The business was changing too fast and data was flooding in like water from a firehose. So the firm began shifting from structured SQL to massive stores of unstructured data harnessed with Hadoop technology. Outside consultants were brought in to help develop a new systems architecture with new technologies.[69] The firm's classic 10TB enterprise data warehouse, stored onsite, was augmented with a 100TB cloud-based system. The conversation changed from the cost-focused "what data can we afford to keep" to the value-focused "what data can we afford to throw away." IT staff learned new skills, with the firm "turning its SQL developers into Hive and Impala NoSQL experts."[70] Marketing managers and new analytics team members were schooled in "Big Data Boot Camps" to show them how to dive deep into unstructured data to hunt down valuable insights. OLAP cubes and easy-to-use reporting tools were also made available to non-technical team members. One goal was to empower Bean staff for better insight and decision-making, increasing the users of firm data by at least ten times those who had prior reporting access.

Automated tools were also developed to leverage this data in real-time (making it not just "big data" but also "fast data"), allowing Bean to serve customers online, on the phone or in stores based on what the firm knows about them. This kind of integrated shopping experience and unified customer view across channels is sometimes referred to as **omnichannel**. Bean's web and app stores leverage these insights for on-the-fly personalization with a sharpshooter aim at what the customer wants. Additionally, iPad-wielding store staff and info-armed phone reps now have access to a deeply detailed real-time view of each customer, and these profiles are served up to create more relevant offers and better-received recommendations, and to deliver overall customer delight.[71] Need proof that customers see the benefit? Bean tied with Amazon as best in online retail customer satisfaction.[72]

Sources include: C. Wilson and D. Bryan, "Talk: Transitioning from Original Big Data to the New Big Data: L.L. Bean's Journey," at Strata+Hadoop World, Oct. 15-17, 2014, New York, NY (stream available at https://www.safaribooksonline.com/library/view/strata-conference-new/9781491900352/part110.html). And V. Heffernan, "Big Moose is Watching You," *Medium*, Oct. 31, 2014.

omnichannel

Providing customers with a unified experience across customer channels, which may include online, mobile, catalog, phone, and retail. Pricing, recommendations, and incentives should reflect a data-driven, accurate, single view of the customer.

Data Mining

While reporting tools can help users explore data, modern datasets can be so large that it might be impossible for humans to spot underlying trends. That's where data mining can help. **Data mining** is the process of using computers to identify hidden patterns and to build models from large datasets.

Some of the key areas where businesses are leveraging data mining include the following:

- *Customer segmentation*—figuring out which customers are likely to be the most valuable to a firm.
- *Marketing and promotion targeting*—identifying which customers will respond to which offers at which price at what time.
- *Market basket analysis*—determining which products customers buy together, and how an organization can use this information to cross-sell more products or services.

data mining

The process of using computers to identify hidden patterns in, and to build models from, large datasets.

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- *Collaborative filtering*—personalizing an individual customer's experience based on the trends and preferences identified across similar customers.
- *Customer churn*—determining which customers are likely to leave, and what tactics can help the firm avoid unwanted defections.
- *Fraud detection*—uncovering patterns consistent with criminal activity.
- *Financial modeling*—building trading systems to capitalize on historical trends.
- *Hiring and promotion*—identifying characteristics consistent with employee success in the firm's various roles.

For data mining to work, two critical conditions need to be present: (1) the organization must have clean, consistent data, and (2) the events in that data should reflect current and future trends. The recent financial crisis provides lessons on what can happen when either of these conditions isn't met.

First let's look at problems with using bad data. A report in the *New York Times* has suggested that in the period leading up to the 2008 financial crisis, some banking executives deliberately deceived risk management systems in order to skew capital-on-hand requirements. This deception let firms load up on risky debt while carrying less cash for covering losses.[73] Deceive your systems with bad data and your models are worthless. In this case, wrong estimates from bad data left firms grossly overexposed to risk. When debt defaults occurred, several banks failed, and we entered the worst financial crisis since the Great Depression.

Now consider the problem of historical consistency: Computer-driven investment models can be very effective when the market behaves as it has in the past. But models are blind when faced with the equivalent of the "hundred-year flood" (sometimes called *black swans*); events so extreme and unusual that they never showed up in the data used to build the model.

We saw this in the late 1990s with the collapse of the investment firm Long-Term Capital Management. LTCM was started by Nobel Prize–winning economists, but when an unexpected Russian debt crisis caused the markets to move in ways not anticipated by its models, the firm lost 90 percent of its value in less than two months. The problem was so bad that the Fed had to step in to supervise the firm's multibillion-dollar bailout. Fast forward a decade to the banking collapse of 2008, and we again see computer-driven trading funds plummet in the face of another unexpected event—the burst of the housing bubble.[74]

over-engineer

Build a model with so many variables that the solution arrived at might only work on the subset of data you've used to create it.

Data mining presents a host of other perils, as well. It's possible to **over-engineer** a model, building it with so many variables that the solution arrived at might only work on the subset of data you've used to create it. You might also be looking at a random but meaningless statistical fluke. In demonstrating how flukes occur, Tyler Vigen, a geospatial intelligence analyst for the US Army, has put together a hilarious website demonstrating high correlations among impossibly linked data, most trending in near lockstep over a ten-year period. One graph shows a ten-year trend in per-capita US sour cream consumption and motorcycle riders killed in noncollision transport accidents. An unskilled person drawing inferences from what appears to be a very consistent trend between the two might erroneously conclude that sour cream kills bikers. The number of people who drowned by falling into a swimming pool is also highly correlated with the number of films Nicolas Cage has appeared in. Someone stop the actor before his reign of swimming pool tragedy continues![75]

One way to test to see if you're looking at a random occurrence in the numbers is to divide your data, building your model with one portion of the data, and using another portion to verify your results. This is the approach Netflix has used to test results achieved by teams in the Netflix Prize, the firm's million-dollar contest for improving the predictive accuracy of its movie recommendation engine (see Chapter 4).

Analyst beware, it's also important to understand the source and consistency of data over time. Just because data may be expressed in a consistent format doesn't mean it was collected consistently or without distortive outside influence. Consider Google's initial success, then failure in identifying influenza trends from search data. Initial press trumpted the fact that Google queries

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could identify the spread of the flu more quickly and at least as accurately as the Centers for Disease Control. Two years later, Google was making more bad predictions than accurate ones. Researchers hunting for the breakdown point to the fact that Google regularly changes its search engine. For example, one update began recommending related search terms. Another began suggesting diagnoses. Suddenly Google was vastly overestimating CDC predictions, likely because its own tools accelerated the number of queries using flu-related terms.[76]

Finally, sometimes a pattern is uncovered, but determining the best choice for a response is less clear. Data-mining wizards at European retailer Tesco uncovered that product sales data showed several money-losing products, including a type of bread known as "milk loaf." Drop those products, right? Not so fast. Further analysis showed milk loaf was a "destination product" for a loyal group of high-value customers, and that these customers would shop elsewhere if milk loaf disappeared from Tesco shelves. The firm kept the bread as a loss-leader and retained those valuable milk loaf fans.[77] Data miner, beware—first findings don't always reveal an optimal course of action.

This last example underscores the importance of recruiting a data mining and business analytics team that possesses three critical skills: information technology (for understanding how to pull together data, and for selecting analysis tools), statistics (for building models and interpreting the strength and validity of results), and business knowledge (for helping set system goals and requirements, and offering deeper insight into what the data really says about the firm's operating environment). Miss one of these key functions and your team could make some major mistakes.

While we've focused on tools in our discussion above, many experts suggest that business intelligence is really an organizational process as much as it is a set of technologies. Having the right team is critical in moving the firm from goal setting through execution and results.

Key Takeaways

- Canned and ad hoc reports, digital dashboards, and OLAP are all used to transform data into information.
- OLAP reporting leverages data cubes, which take data from standard relational databases, calculating and summarizing data for superfast reporting access. OLAP tools can present results through multidimensional graphs, or via spreadsheet-style cross-tab reports.
- Modern datasets can be so large that it might be impossible for humans to spot underlying trends without the use of data mining tools.
- Businesses are using data mining to address issues in several key areas including customer segmentation, marketing and promotion targeting, collaborative filtering, and so on.
- Models influenced by bad data, missing or incomplete historical data, and over-engineering are prone to yield bad results.
- One way to test to see if you're looking at a random occurrence in your data is to divide your data, building your model with one portion of the data, and using another portion to verify your results.
- Analytics may not always provide the total solution for a problem. Sometimes a pattern is uncovered, but determining the best choice for a response is less clear.
- A competent business analytics team should possess three critical skills: information technology, statistics, and business knowledge.

Questions and Exercises

1. What are some of the tools used to convert data into information?
2. What is the difference between a canned report and ad hoc reporting?
3. How do reports created by OLAP differ from most conventional reports?
4. List the key areas where businesses are leveraging data mining.

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5. What is market basket analysis?
6. What is customer churn?
7. For data mining to work, what two critical data-related conditions must be present?
8. Discuss occurrences of model failure caused by missing or incomplete historical data.
9. Why do researchers think Google's flu predictions became less accurate over time? How does this inform managerial caution on business intelligence projects? How can one avoid making similar errors?
10. Discuss Tesco's response to their discovery that "milk loaf" was a money-losing product.
11. List the three critical skills a competent business analytics team should possess.
12. One of the most popular analytics tools is a product called Tableau. Fortunately, the folks at Tableau allow college students to download a free version. A small exercise has been prepared for any students with access to a Mac or PC that they can install software on. Visit http://gallaugher.com/tableau to find this exercise and instruction video.

15.7 Artificial Intelligence, Big Data and Machine Learning: It's Now Everywhere!

Learning Objectives

1. Understand terms such as artificial intelligence, machine learning, and deep learning.
2. Name, recognize, and give examples of popular types of AI used in modern organizations.
3. Understand the rise of AI and machine learning, as well as the challenges associated with leveraging this technology in an organization, and its broader social implications.

artificial intelligence

Computer software that can mimic or improve upon functions that would otherwise require human intelligence.

The Data Mining topics discussed in the prior section have roots in a branch of computer science known as **artificial intelligence** (or AI). The goal of AI is to create computer programs that are able to mimic or improve upon functions that would otherwise require human intelligence. An explosion of tools is fueling the current spread of AI. These include a new generation of hardware chips that fuel AI through designs tailored to find patterns faster, cloud resources that any developer with a credit card can tap into, open source algorithms that can be applied to creating custom insights, software development kits that create standards for building AI into apps and other products, and data-capture tools that include sensors, cameras, and microphones.

Google CEO Sundar Pichai says that AI will have a "more profound" impact than electricity or fire.[78] With AI becoming more accessible and ubiquitous, the market is exploding. *The Economist* reports that the total market size for AI hardware and software was $12 billion in 2017 and will grow to $58 billion by 2021.[79] Public companies mentioned AI and machine learning in their earnings reports more than 700 times in Q4 2017—that's seven times more than the period just two years earlier. Mergers and acquisitions activity related to AI increased 26-fold in the same period.[80] Part of the acquisition frenzy in AI is a so-called aqui-hire play to bring in hard-to-lure talent. Startups without revenue are being priced at $5 million to $10 million for each AI expert that comes along with the deal. Yet despite interest, firms are struggling to capitalize on trends and technologies. As a report by MIT's *Sloan Management Review* and the Boston Consulting Group points out: some 85 percent of companies think AI will offer a competitive advantage, but only one in 20 is extensively employing it today.[81]

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Understanding Popular Types of AI

The Data Mining topics discussed in the prior section have roots in a branch of computer science known as artificial intelligence (or AI). The goal of AI is to create computer programs that are able to mimic or improve upon functions that would otherwise require human intelligence. The definition of AI and some of its associated technologies don't have hard parameters, and the interpretation is often muddied by marketers trying to catch a trend, or hype-infused media reports. But the discussion below should provide a managerial understanding of key terms and how they are influencing organizations, decision-making, and products.

Machine learning is a type of AI often broadly defined as software with the ability to learn or improve without being explicitly programmed.[82] Many of the data mining techniques described in the prior section use machine learning.

Deep learning is a subcategory of machine learning. The "deep" in deep learning typically refers to the layers of interconnections and analysis that are examined to arrive at results. Some technologists refer to "deep" as having more than one "hidden" layer between input and output. That might not mean much to most managers, but just as "Big Data" is "a lot," "Deep Learning" has more analytical complexity.

There are also many subcategories of machine learning and other types of AI training, including *supervised learning* (where algorithms are trained by providing explicit examples of results sought, like defective vs. error-free, or stock price), *unsupervised learning* (where data are not explicitly labeled and don't have a predetermined result. Clustering customers into previously unknown groupings machine be one example), and semi-supervised learning (where data used to build models that determine an end result may contain data that has outputs explicitly labeled as well as unlabeled, e.g., "hey software, take a look at my categorizations and see if they are valid or you can come up with better or missing ones").

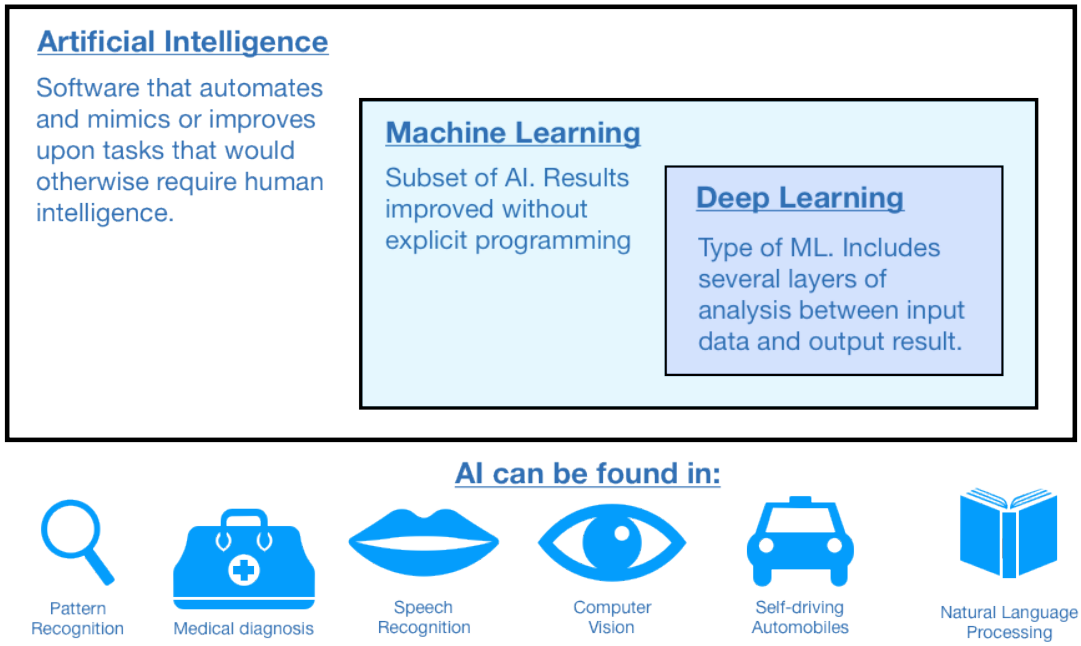
machine learning

A type of artificial intelligence that leverages massive amounts of data so that computers can improve the accuracy of actions and predictions on their own without additional programming.

deep learning

A type of machine learning that uses multiple layers of interconnections among data to identify patterns and improve predicted results. Deep learning most often uses a set of techniques known as neural networks and is popularly applied in tasks like speech recognition, image recognition, and computer vision.

FIGURE 15.8 Artificial Intelligence, Machine Learning, and deep learning
Deep learning is a subset of machine learning, which is a subset of artificial intelligence. These techniques involve some form of pattern recognition and are used in many applications, including those depicted above. ML automates discovery, which can improve as more data is added, while Deep Learning provides several layers of analysis and comparison to uncover results.



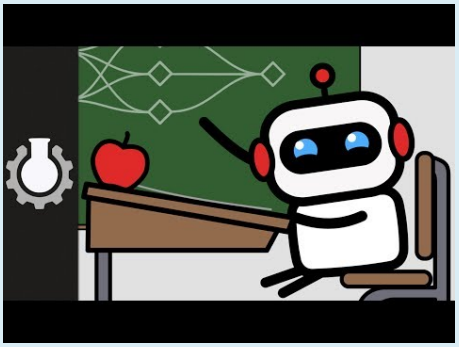
Source: John Gallaugher.

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How Smart Is Today's AI

This video provides an animated, lay-person's explanation of how machine learning works from CGP Grey.



View the video online at: http://www.youtube.com/embed/R9OHn5ZF4Uo?rel=0

Own an Apple Product? You're Already Using a Whole Lot of AI

Here are just a few examples of how AI permeates Apple products: Data collected and constantly analyzed by Siri helps the voice assistant continually improve with better understanding of voices and accents worldwide, develop a greater understanding of context, and parse how devices are used so it can better service requests. Use ApplePay? AI fights fraud by improving analysis with each transaction. Maps? AI helps plot the best route by analyzing all sorts of traffic input. HealthKit? Machine learning can help keep cheats from climbing the leaderboard by identifying legitimate activity and filtering out bogus movement. Like your photos? AI recognizes faces and builds photo collages on what are determined to be your "best" pictures. Used FaceID or chatted with friends as a talking poop animoji? AI identifies the contours of your face to know you are you, and how to turn you into a cartoon. AI is behind extending device battery life, auto-switching between cellular and Wi-Fi networks, choosing news stories, apps, music, and video content you might enjoy. The iPad relies on AI to tell the difference between movements from the Apple Pencil and accidental swipes and taps from the pencil holder's hand. And the HomePod speaker combines sensor data with AI to optimize sound to suit the acoustics of the room.[83]

Expect even more since third parties have access to many of these tools, too. Apple's custom processors and the firm's Core ML software developer framework allow coders to tap into Apple and third-party machine learning algorithms so that apps can take advantage of image recognition, natural language processing, computer vision, and more.[84] Tools like these create standards and prevent developers from having to create things from scratch, enabling even small-time programmers to cheaply, easily, and quickly incorporate AI in their products.

Some of the more popular categories of software used in AI include:

neural networks

A statistical techniques used in AI, and particularly in machine learning. Neural networks hunt down and expose patterns, building multilayered relationships that humans can't detect on their own.

Neural networks, which are statistical techniques used to hunt down and expose patterns. Neural networks identify patterns by testing multilayered relationships that humans can't detect on their own. Many refer to the multilayered interconnections among data as mimicking the neurons of the brain (hence the name). If a set of interrelationships is strong, they go into the pattern-matching scheme. If a better set of relationships is found, old ones are tweaked or discarded. Neural networks are often referred to as a "black box," meaning that the weights and relationships of data that identify patterns approximate a mathematical function, but are difficult to break out as you would in a traditional mathematical formula. Massive amounts of data play a role here. Google leverages data it collects when users talk to and type into its search engine to improve its speech recognition algorithms, cutting errors by 25 percent in a single rollout.[85]

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Expert systems are AI systems that leverage rules or examples to perform a task in a way that mimics applied human expertise. Expert systems are used in tasks ranging from medical diagnoses to product configuration. They may be programmed with explicit rules (think a big "if this, then do that" decision tree), or rules may be automatically built by analyzing specific cases against outcomes (e.g., make less product if the weather is below 40 degrees and rainy, since there will be less foot traffic).

Genetic algorithms are model-building techniques where computers examine many potential solutions to a problem, iteratively modifying (mutating) various mathematical models, and comparing the mutated models to search for a best alternative function. Many computer scientists would say that neural networks approximate functions, while genetic algorithms refine functions to optimize solutions. For most managers it's useful just to know the term as a type of automated model development that's another arrow in the AI quiver. Genetic algorithms have been used for everything from building financial trading models to handling complex airport scheduling to designing parts for the international space station.[86]

While AI is not a single technology—terms and categorizations may overlap or have debated definitions—various forms of AI can show up as part of analytics products, CRM tools, transaction processing systems, and other information systems. Many of these techniques that crunch massive amounts of data leverage the special AI-powering graphics chips and FPGAs mentioned in the Moore's Law and More chapter.

Examples of AI in Action

While the current uses of artificial intelligence and machine learning are varied, and the reach of technologies is expanding, it may be useful to look at some current examples to gain an appreciation of AI's expanding reach, and to help you brainstorm about how AI might be used in organizations where you work, or in products that you use.

Computer vision is everywhere: Uber uses Microsoft-provided computer vision to scan driver faces and confirm their identity when they are starting a shift. The congressional television network C-SPAN uses Amazon's image recognition tools to identify on-screen lawmakers so they can quickly place a name below their image.[87]

Helping delivery drivers optimize pickup and dropoff schedules is a particularly thorny problem helped by AI. United Parcel Service estimates that for every mile that its drivers reduce their daily route, the firm saves $50 million a year.[88]

AI is giving us better customer service and delivering many from "phone tree hell." China Merchants Bank, uses an AI-based messaging bot in WeChat, China's most popular mobile platform, to handle 1.5 million to 2 million queries a day, a volume that would otherwise require a staff of 7,000 human staff. Casino giant Caesars uses its Ivy virtual concierge to answer questions received via text, reducing calls to the human concierge desk by 30%. Airliner KLM has used customer service text bots to double the number of weekly customer inquiries to 120,000 while increasing the number of agents by only 6%. Insurers Humana and MetLife are using voice analysis software from the firm Cogito to identify if customer service reps have experienced "compassion fatigue." Identify an agent who shows signs an interaction may not be going well (speech speed, keywords, voice level), and the system can prompt service people with strategies to improve. This sort of advising-when-needed is especially useful in phone support, where employee turnover can easily exceed 40 percent a year.[89] And British grocer Ocado uses AI to scan 10,000 customer e-mails a day to escalate and prioritize response as well as identify sentiment (good vs. bad experiences) around keywords.[90] Applications like this don't get rid of humans, but they make existing staff more efficient and productive.

AI is increasingly embedding itself into the soft-skills discipline of human resources. Software from the SaaS vendor Workday provides software to improve employee retention by uncovering

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patterns of those most likely to leave. The firm's software examines some 60 factors, including salary, time between holidays taken, and turnover of the employee's manager. Another firm, Arena, provides technology to hospitals and home-care companies to use application and third-party data to screen job applicants for traits that indicate they may stay at their job longer. The firm claims median turnover has been reduced by nearly 40 percent in firms using their software.[91]

AI might also help make the workplace fairer, analyzing employee promotion and pay data for anomalies that suggest managers have hired staff that looks "more like them" rather than those who exhibit the characteristics and track record for success. For a look at AI for better hiring decisions, consider systems from the startup Pymetrics, used by firms as wide ranging as Unilever in packaged goods and Nielsen in ratings research. Pymetrics tests candidates on roughly 80 traits, including memory and attitude to risk, using machine learning to measure applicant scores against a firm's top performers and predict suitability and success.[92]

There's also a good chance you've been reading news items and other copy written by robo-journalists. The Associated Press uses software called Wordsmith by the firm Automated Insights to craft more than 3,000 financial reports per quarter, posting summaries online within minutes of their release. The *Los Angeles Times* uses "Quakebot" to analyze geological data, in one case breaking the story of a 4.7 magnitude earthquake in Southern California.[93] The Big Ten Network uses software from Narrative Science for updates of football and basketball games and for short recaps of collegiate baseball and softball. Box scores and other play-by-play data are all the inputs these systems need.[94]

A system developed by IBM and the Baylor College of Medicine "read" 100,000 research papers in two hours and "found completely new biology hidden in the data"—undiscovered, needle-like insights buried in the existing massive haystacks of human-generated knowledge, which no single researcher could digest and map. These specific insights "could provide routes to new cancer drugs."[95] Some hear about machine learning and have nightmares of Skynet from the *Terminator* movies (Elon Musk, Bill Gates, and Stephen Hawking are among well-known tech-forward crowds who have cautioned about AI's future),[96] but big brain insights from AI just might save your life one day.

Many sites have ranked AI skills as among the most sought-after in today's job market. Want to geek up with machine learning? Google is one of many firms that offers several free online course in how to use its AI technologies, including a free 15-hour crash course in machine learning.

It's Not as Easy as the Press Might State: Technical, Organizational, Legal, and Societal Challenges of AI and Machine Learning

AI starts with what are sometimes referred to as "naked algorithms" that need to be trained. These are starting point algorithms, and many are in the public domain or accessible from cloud provider services (e.g., Google TensorFlow) or through vendor APIs and inside software development kits (e.g., Apple Core ML). However, training implies access to a large quantity of consistent, reliable historical data. Since most data mining is a subset of AI, many of the challenges mentioned in the prior section also apply to machine learning. Issues that managers, as well as concerned citizens, might want to be aware of include:

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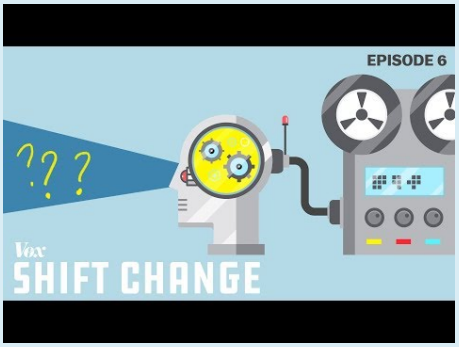
- Data quality, inconsistent data, or the inability to integrate data sources into a single dataset capable of input into machine learning systems can all stifle efforts.[97]
- Not enough data. A firm might want to get into machine learning, but may lack underlying databases to begin this effort. It might, for example, be impossible to use machine learning to develop a system to predict failure when there are very few cases of failure that occur, and hence not enough examples to learn from.[98] This also applies to the inability to predict rare "black swan" events since, by definition, they are either exceedingly rare or have never previously occurred.
- Technical staff may require training in developing and maintaining such systems, and such skills are rare. In situations where AI makes a recommendation, but a human makes the final call, managers using such systems may need coaching on when to accept and when to question results (see the Tesco "milk loaf" example in the prior section).
- AI systems also involve a discipline known as "change management" that goes hand-in-hand with many IS projects. Change management seeks to identify how workflows and processes are to be altered, and how to manage the worker and organizational transition from one system to another. This can be key because many users of corporate AI will see their jobs significantly altered. They might have to do more, take on more responsibility, or remove instinct from some decisions and rely on recommendations made by a machine.[99]
- Some types of machine learning may be legally prohibited because of the data used or the inability to identify how a model works and whether or not it might be discriminatory. For example, while gender and religion could be used to predict some risks, they are unacceptable to regulators in some applications and jurisdictions. Redlining laws in the lending industry prevent geography from being used in calculating credit worthiness, since geography is often tightly correlated with race. In other industries, regulators won't accept the "black box" solutions offered by neural networks. And some areas such as the EU may have higher privacy protection that prohibits the gathering or use of certain data or techniques.[100]
- The negative unintended consequences of data misuse might also lead to regulation that limits techniques currently used. Some believe this helps give China an edge in some systems, since the government keeps a vast database of faces that can help train facial-recognition algorithms, and privacy is less of a concern than in the West. Jaywalkers in Shanghai can already be fined (or shamed) from facial recognition that identifies scofflaw citizens.[101] In another example, The Chinese financial firm Ping An uses app-based video interviews to spot shifty behavior worthy of further screening. Prospective borrowers answer a series of questions related to income and ability to replay a loan, while machine learning systems monitor and identify some fifty distinct facial expressions related to truthfulness.[102] The camera and the cloud are becoming a sort of real-time lie detector.
- Many workers are startled to find that in the United States, just about anything done on organizational networks or using a firm's computer hardware can be monitored.[103] While examining worker communications can help ensure employees don't break the law or commit crimes against the firm, and can offer help on how to do one's job better, the acceleration of these practices will undoubtedly raise additional privacy issues and have the potential to alienate workers, especially in a tight labor market.
- And as we think of how data relates to competitive advantage, firms that gain an early lead and benefit from scale may be in a position to collect more data than competitors, fueling a virtuous cycle where early winners generate more data, have stronger predictive capabilities, and can have an edge in entering new markets, offering new services, attracting customers, and cutting prices. Good for the winners and possibly good for consumers in the short run, but this may also fuel the kind of winner-take-all / winner-take-most dominance we see when network effects are present, something that might stifle innovation if it discourages competition and feeds near-monopolies. Indeed, many have referred to data as "the new oil," in that it is has the ability to create cash-gushing opportunities.[104]

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How Smart Is Today's Artificial Intelligence?

A brief intro to AI and machine learning, with examples, expert commentary, promise, and current limitations.



View the video online at: http://www.youtube.com/embed/lJKjMlU55pE?rel=0

Catching the Golden State Killer: The Promise and Peril of Big Data's Reach

The fugitive known as the Golden State Killer is one of the most heinous criminals in US history. Police linked him to at least twelve murders, fifty rapes, and over 100 burglaries from 1976 to 1986. The criminal's sadism included extended torture of victims and family members, stealing victim's personal items and taunting them with messages following attacks. Yet despite pouring more resources into the investigation than any other in California history, the killer had eluded capture for four decades.[105] Despite the many attacks and the killer's grisly rituals, all leads reached a dead-end. That is, until, a community of online genealogists unwittingly led detectives to identify the alleged killer: one Joseph James DeAngelo, age 72 at the time of his 2018 apprehension.[106]

Using a well-preserved piece of biological evidence collected before the era of DNA testing, officers sequenced the killer's DNA, then uploaded it to the GEDmatch website. GEDmatch isn't one of the big consumer-oriented DNA analysis products, such as 23andMe or AncestryDNA. It's a modest side-project created by two volunteers in 2011, but it does act as a sort of open-source clearinghouse, providing matching among anyone interested in publicly sharing their DNA data. To be clear, the big names in consumer DNA analysis do not, under any circumstances, share identifying DNA information with others. A 23andMe spokesperson states that despite requests: no data has ever been "given out in any circumstance."[107] However, consumers can download their own DNA data from these sites to use as they'd like. Users who upload data to GEDmatch can be linked to and connect with genetic relatives, and the site has been used by hundreds of thousands of users, including amateur genealogists and those looking for clues regarding family diseases. While the suspect's DNA failed to match anything in criminal databases and he left no fingerprints, GEDmatch linked the police sample to several distant relatives—the equivalent of third cousins. Investigators then scoured census data, obituaries, death records, and modern databases to painstakingly piece together some 25 different family trees (the trees were built using a tool from Ancestry.com). The result was a lineage trail leading up to the killer's great-great-great grandparents, and eventually back down to DeAngelo—evidence gathered without a warrant and with no court order required.

Fast/cheap computing has enabled modern genetic analysis. The first human genome took nearly fifteen years to sequence and cost $2.5 billion to complete,[108] but genotyping services like 23andMe and AncestryDNA provide services for less than $100. True, consumer firms provide only a fraction of the analysis of full genome sequencing (one expert says it's like getting access to select words on a page instead of the entire page),[109] but the ability to use sub-$100 tests to identify one's link to gene-related traits, disease susceptibility, and lineage, demonstrates the

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astonishing advances in data gathering and analysis. The suspect was employed as a police officer at the time of many of the crimes, a reason that may have offered him the training and access to a police radio that helped him hide any record of his crimes. But he couldn't predict a future with genetic profiling nor the roughly one million sharing their data in the GEDmatch database.

Catching a murder suspect is clearly a net benefit to society. No one would dispute that bringing the killer to justice would be a good thing. However, the case brought to light additional issues of privacy and ethical data use. Revealing one's own DNA on a site like GEDmatch is not a decision impacting only the poster. It potentially exposes all existing and future relatives to anyone who can match the posted DNA to their family tree. While Facebook users were shocked that friends could unwittingly reveal their personal data to Cambridge Analytica without their consent, the implications of having a genetic relative share DNA data could be far more severe. Would employers, insurance companies, or the unscrupulous be able to use a link to family member DNA? Is it possible that a person could be denied coverage or a job based on a link to a kin's genes? Could merged databases influence dating decisions if someone's relative had a genetic flaw? What are the implications if one distant family member's sharing suggests others are susceptible to addiction, mental illness, violence, or some characteristic seen as negative? And even if laws are passed in one country, this doesn't protect relatives around the globe who may live under more oppressive governments. At the time that the Golden State Killer suspect was caught, 23andMe had more than five million customers, and Ancestry.com had ten million.[110] Loose attitudes by one relative could potentially compromise a family for generations. Managers, consumers, and lawmakers will have to think with breadth and depth regarding unintended consequences. We are in the midst of navigating a world where big data and machine learning can keep us safe and deliver social good as well as expose others to discrimination, extortion, or the public release of sensitive information that they had not sought or even been aware of.[111]

Key Takeaways

- **Artificial intelligence** refers to software that can mimic or improve upon functions that would otherwise require human intelligence.
- **Machine learning** is a type of AI often broadly defined as software with the ability to learn or improve without being explicitly programmed.
- **Deep learning** is a subcategory of machine learning. The "deep" in deep learning refers to the layers of interconnections and analysis that are examined to arrive at results.
- **Neural networks** are a category of AI used to identify patterns by testing multilayered relationships that humans can't detect on their own. Neural network techniques are often used in machine learning and are popular in data mining.
- **Expert systems** are AI systems that leverage rules or examples to perform a task in a way that mimics applied human expertise.
- **Genetic algorithms** are model-building techniques where computers examine many potential solutions to a problem, iteratively modifying (mutating) various mathematical models, and comparing the mutated models to search for a best alternative function.
- The explosion of machine learning is due to several factors, including open source tools; cloud computing for low-cost, high-volume data crunching; tools accessible via API or as part of software development kits; and new chips specifically designed for the simultaneous pattern hunting and relationship testing used in neural networks and other types of AI. AI can now be found in all sorts of consumer products—it is enabling the first generation of autonomous vehicles; it's influencing soft-skill disciplines like human resources; it improves the efficiency of modern, complex operations; it's is a key component in many customer service initiatives; and it's even being used in medical diagnosis and research.
- Incorporating AI and machine learning remains challenging. Organizations require technical skills and must reeducate the workforce impacted by AI decision-making tools. Firms need a clean, deep, and accurate dataset. Predictions require a tight relationship between historical data and new data used for prediction. Legal issues may prohibit the use of machine learning and "black box" algorithms in industries requiring exposure of the decision-making process.

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Varying international laws may allow techniques in one region of the globe that are prohibited in others.

- AI and machine learning have exposed the possibility of unintended consequences, including the possibility of introducing unintended bias, discrimination, and violations of privacy.

Questions and Exercises

1. How are the terms artificial intelligence, machine learning, and deep learning related?
2. What factors are leading to the new explosion in machine learning now used by organizations and making its way into consumer products? Research firms that provide low-cost access to machine learning tools and give examples of products and services developed using these technologies.
3. Do any of the products that you use leverage artificial intelligence? What kinds of AI might be used in Netflix's movie recommendation system, Apple's iTunes Genius playlist builder, or Amazon's website personalization? What kind of AI might help a physician make a diagnosis or help an engineer configure a complicated product in the field?
4. Research business applications of machine learning and come to class prepared to discuss new developments, organizations using this technology, and their current plus potential long-term impact.
5. Are you excited about the future of machine learning? Frightened? Why? How might these technologies create social change and spawn new business opportunities?
6. What ethical issues are created through public data-sharing sites like GEDmatch? List the positives and negatives. Do you feel sharing your personal data should be regulated? Why or why not? Could loopholes be plugged by preventing this data from being used in hiring, insurance, or other contexts? Why or why not?

15.8 Data Asset in Action: Technology and the Rise of Walmart

Learning Objectives

1. Understand how Walmart has leveraged information technology to become the world's largest retailer.
2. Be aware of the challenges that face Walmart in the years ahead.

Walmart demonstrates how a physical product retailer can create and leverage a data asset to achieve world-class supply chain efficiencies targeted primarily at driving down costs.

Walmart isn't just the largest retailer in the world; over the past several years it has popped in and out of the top spot on the *Fortune* 500 list—meaning that the firm has had revenues greater than *any* firm in the United States. Walmart is so big that in three months it sells more than a whole year's worth of sales at number two US retailer Home Depot.[112]

At that size, it's clear that Walmart's key source of competitive advantage is scale. But firms don't turn into giants overnight. Walmart grew in large part by leveraging information systems to an extent never before seen in the retail industry. Technology tightly coordinates the Walmart value chain from tip to tail, while these systems also deliver a minable data asset that's unmatched

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in US retail. To get a sense of the firm's overall efficiencies, at the end of the prior decade a McKinsey study found that Walmart was responsible for some 12 percent of the productivity gains in the *entire* US economy.[113] The firm's capacity as a systems innovator is so respected that many senior Walmart IT executives have been snatched up for top roles at Dell, HP, Amazon, and Microsoft. And lest one think that innovation is the province of only those located in the technology hubs of Silicon Valley, Boston, and Seattle, remember that Walmart is headquartered in Bentonville, Arkansas.

A Data-Driven Value Chain

inventory turnover ratio

The ratio of a company's annual sales to its inventory.

The Walmart efficiency dance starts with a proprietary system called Retail Link, a system originally developed in 1991 and continually refined ever since. Each time an item is scanned by a Walmart cash register, Retail Link not only records the sale, it automatically triggers inventory reordering, scheduling, and delivery. This process keeps shelves stocked while keeping inventories at a minimum. An AMR report ranked Walmart as having the seventh best supply chain in the country.[114] The firm's annual **inventory turnover ratio** of 11.11 means that Walmart sells the equivalent of its entire inventory roughly every four to five weeks (by comparison, Target's turnover ratio is 5.7, Sears' is 3.6, and the average for US retail is less than 2).[115]

Back-office scanners keep track of inventory as supplier shipments come in. Suppliers are rated based on timeliness of deliveries, and you've got to be quick to work with Walmart. In order to avoid a tractor-trailer traffic jam in store parking lots, deliveries are choreographed to arrive at intervals less than ten minutes apart. When Levi's joined Walmart, the firm had to guarantee it could replenish shelves every two days—no prior retailer had required a shorter-than-five-day window from Levi's.[116]

Walmart has been a catalyst for technology adoption among its suppliers. The firm is currently leading an adoption effort that requires partners to leverage RFID technology to track and coordinate inventories. While the rollout has been slow, a recent P&G trial showed RFID boosted sales nearly 20 percent by ensuring that inventory was on shelves and located where it should be.[117]

Keeping product stocked is one part of the streamlined value chain equation; prompting customers to return often and buy efficiently is another key element. The firm's Scan & Go app lets customers use their smartphones to scan bar codes of items they put in their cart. At checkout time, customers flash a total purchase barcode at a cash register kiosk screen and pay. Customers can keep an on-app shopping list that's checked off with each item scanned, and the app offers a shopping budget feature, too. App-delivered coupons and specials will help entice buyers to stick with Walmart instead of rivals.[118] If Walmart can cut the number of cashiers, labor savings could be significant, too. Walmart spends about $12 million every second on cashier wages across its US stores.[119] As for paying by app, Walmart's ready to play nice with competitors, too. Not every effort is a success. The firm partnered with over a dozen firms, including BestBuy, Target, Sears, and 7-Eleven, to plot a new pay-with-your-phone standard called MCX that also offered coupons, and loyalty programs.[120] Despite big name retail backing, the effort foundered and the technology was eventually purchased by JP Morgan Chase. While that was a grim outcome, the firm doubled down with its own Walmart Pay app, announcing that it was neck-and-neck with Apple Pay in terms of its acceptance by store shoppers.[121]

Data Mining Prowess

Walmart also mines its mother lode of data to get its product mix right under all sorts of varying environmental conditions, protecting the firm from "a retailer's twin nightmares: too much inventory, or not enough."[122] For example, the firm's data mining efforts informed buyers that customers

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stock up on certain products in the days leading up to predicted hurricanes. Bumping up prestorm supplies of batteries and bottled water was a no-brainer, but the firm also learned that Pop-Tarts sales spike sevenfold before storms hit, and that beer is the top prestorm seller. This insight has led to truckloads full of six packs and toaster pastries streaming into gulf states whenever word of a big storm surfaces.[123]

Data mining also helps the firm tighten operational forecasts, helping to predict things like how many cashiers are needed at a given store at various times of day throughout the year. Data drives the organization, with mined reports forming the basis of weekly sales meetings, as well as executive strategy sessions. The firm has developed what it calls its Data Café, a state-of-the-art analytics center at headquarters that leverages an industry-leading data trove that tops 40 petabytes. The system provides managers with a central clearinghouse where they can seek help on data-driven problem solving, and the system provides managers with alerts, prompting them to reach out to the Data Café for help in identifying and solving the problem.[124]

Walmart leverages its huge Hadoop-based data trove to support some of its data mining efforts, sifting through massive amounts of social media—Twitter posts, Facebook updates, and other so-called unstructured data—to gain insights on product offerings, sales leads, pricing, and more. The firm purchased social startup Kosmix for $300 million to deepen social and big data expertise in the company's @WalmartLabs.[125] Says Kosmix founder Anand Rajaraman (who previously sold a firm to Amazon and was an early investor in Facebook), "The first generation of e-commerce was about bringing the store to the Web. The next generation will be about building integrated experiences that leverage the store, the Web and mobile, with social identity being the glue that binds the experience."[126] The firm continues to hone tech chops and has aggressively established outposts in Silicon Valley. The firm's Global eCommerce unit is a 1,500-person operation headquartered across the street from Google's YouTube offices,[127] and Valley-based @WalmartLabs has grown from a slew of acquisitions, including social ad firm OneRiot, social commerce firm Tasty Labs, predictive analytics firm Inkiru, and the cloud startup OneOps.[128] The Arkansas giant's Valley offices host "hack days" in the best tradition of Facebook and other tech leaders, allowing developers to blue-sky new ideas that may eventually be put into practice.

Sharing Data, Keeping Secrets

While Walmart is demanding of its suppliers, it also shares data with them. Data can help firms become more efficient so that Walmart can keep dropping prices, and data can help firms uncover patterns that help suppliers sell more. P&G's Gillette unit, for example, claims to have mined Walmart data to develop promotions that increased sales as much as 19 percent. More than seventeen thousand suppliers are given access to their products' Walmart performance across metrics that include daily sales, shipments, returns, purchase orders, invoices, claims, and forecasts. And these suppliers collectively interrogate Walmart data warehouses to the tune of twenty-one million queries a year.[129]

While Walmart shares sales data with relevant suppliers, the firm otherwise fiercely guards this asset. Many retailers pool their data by sharing it with information brokers like Information Resources and ACNielsen. This sharing allows smaller firms to pool their data to provide more comprehensive insight on market behavior. But Walmart stopped sharing data with these agencies years ago. The firm's scale is so big, the additional data provided by brokers wasn't adding much value, and it no longer made sense to allow competitors access to what was happening in its own huge chunk of retail sales.

Other aspects of the firm's technology remain under wraps, too. Walmart custom builds large portions of its information systems to keep competitors off its trail. As for infrastructure secrets, the Walmart Data Center in McDonald County, Missouri, was considered so off limits that the county assessor was required to sign a nondisclosure statement before being allowed on-site to estimate property value.[130]

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Betting Big on e-Commerce: Acquiring Jet.com, Bonobos, Flipkart and More

Amazon has also opened its wallet in eyebrow-raising ways to gain e-commerce expertise. The firm's 2016 purchase of Jet.com carried a $3.3 billion price tag for a relatively new, still unprofitable Amazon competitor. The founders of Jet.com had previously founded Quidsi, the firm behind Diapers.com and other brands, which Walmart sought and lost when outbid by Amazon. In the year after acquiring Jet.com, Walmart US e-commerce sales increased 63 percent year over year. In the same period, Walmart pumped up the number of products sold on its website, from 10 million to over 67 million items. The firm also slashed its free shipping threshold and offered additional discounts for customers who pick up products in its stores, even installing pickup towers in some locations to streamline this process. And the firm's acquisition of trendier brands, including Bonobos, ModCloth, ShoeBuy, and Moosejaw, are helping Walmart fight its dowdy, low-budget image when compared to rival Target.[131]

Walmart Flipkart Deal

Walmart also outbid Amazon, paying $16 billion for a 77 percent stake in India's e-commerce and payments leader, Flipkart. This was the largest foreign direct investment in an Indian firm, involves prior investors Softbank (Japan) and Tencent (China) among others, and gives Walmart a strong presence in a market where it has previously struggled, plus a leadership role for challenging Amazon, which has also invested heavily in India.



View the video online at: //www.youtube.com/embed/_Z5ch8aHJrE?rel=0

Challenges Abound

But despite success, challenges continue. While Walmart grew dramatically throughout the 1990s, the firm's US business has largely matured. And as a mature business, it faces a problem not unlike the example of Microsoft discussed at the end of Chapter 18; Walmart needs to find huge markets or dramatic cost savings in order to boost profits and continue to move its stock price higher.

The firm's aggressiveness and sheer size also increasingly make Walmart a target for criticism. Those low prices come at a price, and the firm has faced accusations of subpar wages and remains a magnet for union activists. Others have identified poor labor conditions at some of the firm's contract manufacturers. Suppliers that compete for Walmart's business are often faced with a catch-22. If they bypass Walmart they miss out on the largest single chunk of world retail sales. But if they

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sell to Walmart, the firm may demand prices so aggressively low that suppliers end up cannibalizing their own sales at other retailers. Still more criticism comes from local citizen groups that have accused Walmart of ruining the market for mom-and-pop stores.[132]

While some might see Walmart as invincibly standing at the summit of world retail, it's important to note that other megaretailers have fallen from grace. In the 1920s and 1930s, the A&P grocery chain controlled 80 percent of US grocery sales, at its peak operating five times the number of stores that Walmart has today. But market conditions changed, and the government stepped in to draft antipredatory pricing laws when it felt A&P's parent was too aggressive.

For all of Walmart's data brilliance, historical data offers little insight on how to adapt to more radical changes in the retail landscape. The firm's data warehouse wasn't able to foretell the rise of Target and other up-market discounters. Savvy managers recognize that data use is a vital tool, but not the only tool in management's strategic arsenal.

Key Takeaways

- Walmart demonstrates how a physical product retailer can create and leverage a data asset to achieve world-class value chain efficiencies.
- Walmart uses data mining in numerous ways, from demand forecasting to predicting the number of cashiers needed at a store at a particular time.
- To help suppliers become more efficient, and as a result lower prices, Walmart shares data with them.
- Despite its success, Walmart is a mature business that needs to find huge markets or dramatic cost savings in order to boost profits and continue to move its stock price higher. The firm's success also makes it a high-impact target for criticism and activism. And the firm's data assets could not predict impactful industry trends such as the rise of Target and other upscale discounters.

Questions and Exercises

1. List the functions performed by Retail Link. What is its benefit to Walmart?
2. Which supplier metrics does Retail Link gather and report? How is this valuable to Walmart and suppliers?
3. Name the technology that Walmart requires partners to use to track and coordinate inventory. Do you know of other uses for this technology?
4. What steps has Walmart taken to protect its data from competitors?
5. Research Walmart's current e-commerce efforts as compared to Amazon and other rivals. Do you think Walmart will catch Amazon? Does it need to? What advantages does Walmart enjoy by blending retail stores with e-commerce efforts?
6. List the criticisms leveled at Walmart. Do you think these critiques are valid or not? What can Walmart do to counteract this criticism? Should it take these steps? Why or why not?

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CHAPTER 16

A Manager's Guide to the Internet and Telecommunications

16.1 Introduction

There's all sorts of hidden magic happening whenever you connect to the Internet. But what really makes it possible for you to reach servers halfway around the world in just a fraction of a second? Knowing this is not only flat-out fascinating stuff; it's also critically important for today's manager to have at least a working knowledge of how the Internet functions.

That's because the Internet is a platform of possibilities and a business enabler. Understanding how the Internet and networking works can help you brainstorm new products and services and understand roadblocks that might limit turning your ideas into reality. Marketing professionals who know how the Internet reaches consumers have a better understanding of how technologies can be used to find and target customers. Finance firms that rely on trading speed to move billions in the blink of an eye need to master Internet infrastructure to avoid being swept aside by more nimble market movers. And knowing how the Internet works helps all managers understand where their firms are vulnerable. In most industries today, if your network goes down then you might as well shut your doors and go home; it's nearly impossible to get anything done if you can't get online. Managers who know the Net are prepared to take the appropriate steps to secure their firms and keep their organization constantly connected.

16.2 Internet 101: Understanding How the Internet Works

Learning Objectives

1. Describe how the technologies of the Internet combine to answer these questions: What are you looking for? Where is it? And how do we get there?
2. Interpret a URL, understand what hosts and domains are, describe how domain registration works, describe cybersquatting, and give examples of conditions that constitute a valid and invalid domain-related trademark dispute.

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3. Describe certain aspects of the Internet infrastructure that are fault-tolerant and support load balancing.
4. Discuss the role of hosts, domains, IP addresses, and the DNS in making the Internet work.

Internet service provider (ISP)

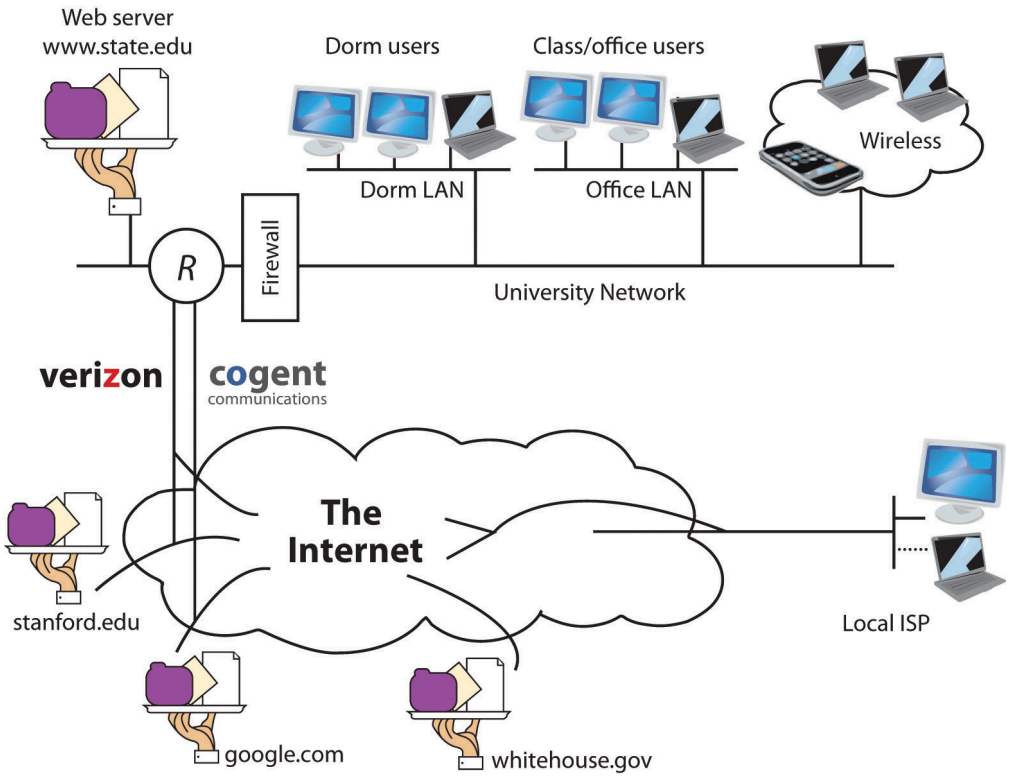
An organization or firm that provides access to the Internet.

The Internet is a network of networks—millions of them, actually. If the network at your university, your employer, or in your home has Internet access, it connects to an **Internet service provider (ISP)**. Many (but not all) ISPs are big telecommunications companies like Verizon, Comcast, and AT&T. These providers connect to one another, exchanging traffic, and ensuring your messages can get to any other computer that's online and willing to communicate with you.

The Internet has no center and no one owns it. That's a good thing. The Internet was designed to be redundant and fault-tolerant—meaning that if one network, connecting wire, or server stops working, everything else should keep on running. Rising from military research and work at educational institutions dating as far back as the 1960s, the Internet really took off in the 1990s, when graphical Web browsing was invented, and much of the Internet's operating infrastructure was transitioned to be supported by private firms rather than government grants.

FIGURE 16.1 The Internet Is a Network of Networks

The Internet is a network of networks, and these networks are connected. In the diagram above, the "state.edu" campus network is connected to other networks of the Internet via two ISPs: Cogent and Verizon.



Enough history—let's see how it all works! If you want to communicate with another computer on the Internet, your computer needs to know the answer to three questions: What are you looking for? Where is it? And how do we get there? The computers and software that make up Internet infrastructure can help provide the answers.

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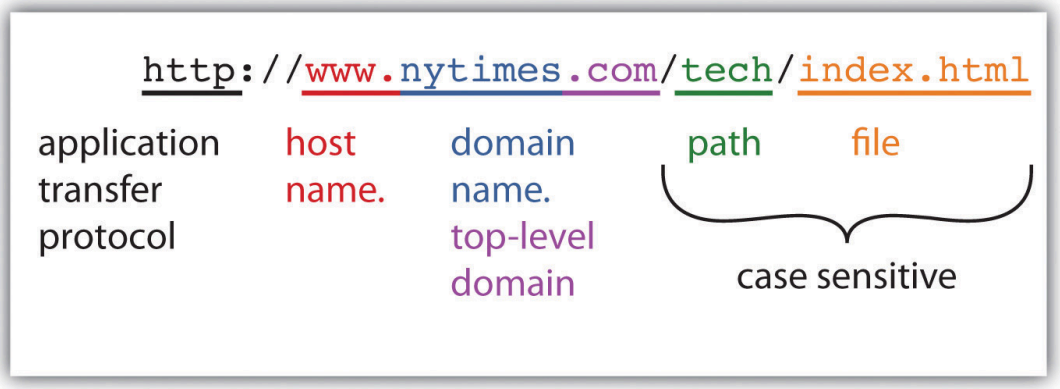
The URL: "What Are You Looking For?"

When you type an address into a Web browser (sometimes called a **URL** for *uniform resource locator*), you're telling your browser what you're looking for. Figure 16.2 describes how to read a typical URL.

URL

Often used interchangeably with "Web address," URLs identify resources on the Internet along with the application protocol needed to retrieve it.

FIGURE 16.2 Anatomy of a Web Address
The URL displayed really says, "Use the Web (http://) to find a host server named 'www' in the 'nytimes.com' network, look in the 'tech' directory, and access the 'index.html' file."



The http:// you see at the start of most Web addresses stands for **hypertext transfer protocol**. A **protocol** is a set of rules for communication—sort of like grammar and vocabulary in a language like English. The http protocol defines how Web browser and Web servers communicate and is designed to be independent from the computer's hardware and operating system. It doesn't matter if messages come from a PC, a Mac, a huge mainframe, or a pocket-sized smartphone; if a device speaks to another using a common protocol, then it will be heard and understood.

hypertext transfer protocol (http)

Application transfer protocol that allows Web browsers and Web servers to communicate with each other.

protocol

Enables communication by defining the format of data and rules for exchange.

The Internet supports lots of different applications, and many of these applications use their own application transfer protocol to communicate with each other. The server that holds your e-mail uses something called *SMTP*, or simple mail transfer protocol, to exchange mail with other e-mail servers throughout the world. **FTP**, or file transfer protocol, is used for—you guessed it—file transfer. FTP is how most Web developers upload the Web pages, graphics, and other files for their websites. Even the Web uses different protocols. When you surf to an online bank or when you're ready to enter your payment information at the Web site of an Internet retailer, the http at the beginning of your URL will probably change to https (the "s" is for secure). That means that communications between your browser and server will be encrypted for safe transmission. Many sites have switched to https for increased security this is becoming the default standard, Apple requires https for accessing web services inside of iOS apps, and Google provides a ranking boost to https vs. http sites. The beauty of the Internet infrastructure is that any savvy entrepreneur can create a new application that rides on top of the Internet.

FTP

Application transfer protocol that is used to copy files from one computer to another.

Hosts and Domain Names

The next part of the URL in our diagram holds the host and domain name. Think of the domain name as the name of the network you're trying to connect to, and think of the host as the computer you're looking for on that network.

Many domains have lots of different hosts. For example, Google's main website is served from the host named "www" (at the address https://www.google.com), but Google also runs other hosts

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including those named "finance" (finance.google.com), "calendar" (calendar.google.com), and "drive" (drive.google.com), among many others.

load balancing

Distributing a computing or networking workload across multiple systems to avoid congestion and slow performance.

fault tolerance

The ability of a system to continue operation even if a component fails.

Host and Domain Names: A Bit More Complex Than That

While it's useful to think of a host as a single computer, popular websites often have several computers that work together to share the load for incoming requests. Assigning several computers to a host name offers **load balancing** and **fault tolerance**, helping ensure that all visits to a popular site like https://www.google.com won't overload a single computer, or that Google doesn't go down if one computer fails.

It's also possible for a single computer to have several host names. This might be the case if a firm were hosting several websites on a single piece of computing hardware.

Some domains are also further broken down into subdomains—many times to represent smaller networks or subgroups within a larger organization. For example, the address https://www.rhsmith.umd.edu is a University of Maryland address with a host "www" located in the subdomain "rhsmith" for the Robert H. Smith School of Business. International URLs might also include a second-level domain classification scheme. British URLs use this scheme, for example, with the BBC carrying the commercial (.co) designation—https://www.bbc.co.uk—and the University of Oxford carrying the academic (.ac) designation—http://www.ox.ac.uk. You can actually go 127 levels deep in assigning subdomains, but that wouldn't make it easy on those who have to type in a URL that long.

Most websites are configured to load a default host, so you can often eliminate the host name if you want to go to the most popular host on a site (the default host is almost always named "www"). Another tip: most browsers will automatically add the "http://" or "https://" for you, too.

Host and domain names are not case sensitive, so you can use a combination of upper and lower case letters and you'll still get to your destination.

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I Want My Own Domain

You can stake your domain name claim in cyberspace by going through a firm called a *domain name registrar*. You don't really buy a domain name; you simply pay a registrar for the right to use that name, with the right renewable over time. While some registrars simply register domain names, others act as **Web hosting services** that are able to run your website on their Internet-connected servers for a fee.

Registrars throughout the world are accredited by **ICANN (Internet Corporation for Assigning Names and Numbers)**, a nonprofit governance and standards-setting body. Each registrar may be granted the ability to register domain names in one or more of the Net's generic top-level domains (gTLDs[1]), such as ".com," ".net," or ".org." There are dozens of registrars that can register ".com" domain names, the most popular gTLD. Available names within gTLDs can often be secured for less than $15 a year.

Some generic top-level domain names, like ".com," have no restrictions on use, while others limit registration. For example, ".edu" is restricted to US-accredited, postsecondary institutions, ".mil" is used for the US military, and .aero is approved only for those associated with aerospace industries. These restricted TLDs are sometimes referred to as **sTLDs**, for sponsored top-level domains.

ICANN has also begun to allow organizations to propose, bid on, and secure new top-level domains (e.g., gTLDs like ".berlin," or ".guru").[2] While for many, securing new gTLDs are intended to run domain registrars (so shop owners in Berlin can register their names with a ".berlin" suffix), some of the most active firms bidding on new gTLDs are large corporations. Amazon has paid $5 million for .buy, while Google paid $25 million for .app.[3] Firms looking to secure gTLDs for their own trademarks (sometimes referred to as brand gTLDs or brand TLDs) wouldn't have to bid, but the cost is a steep $185,000.[4] Google has applied to secure gTLDs on Google, YouTube, Gmail, Chrome, and Android.[5]

There are also separate agencies that handle over 250 different two-character country code top-level domains, or **ccTLDs** (e.g., ".uk" for the United Kingdom, ".ca" for Canada, and ".jp" for Japan). Servers or organizations generally don't need to be housed within a country to use a country code as part of their domain names, leading to a number of creatively named websites. The URL-shortening site "bit.ly" uses Libya's ".ly" top-level domain; many physicians are partial to Moldova's code (".md"); and the tiny Pacific island nation of Tuvalu might not have a single broadcast television station, but that doesn't stop it from licensing its country code to firms that want a ".tv" domain name.[6] Standards also allow domain names in languages that use non-Latin alphabets such as Arabic, Chinese, and Russian. There is also another category known as **geographic TLDs** (sometimes called GeoTLDs), which are associated with a geographical, geopolitical, ethnic, linguistic or cultural community. Geographic TLDs don't have the same two-character restriction as country codes, and include .cat for the Catalan language, .asia, .scot, and .paris, among hundreds of others.

Domain name registration is handled on a first-come, first-served basis, and all registrars share registration data to ensure that no two firms gain rights to the same name. Startups often sport wacky names, partly because so many domains with common words and phrases are already registered to others. While some domain names are held by legitimate businesses, others are registered by investors hoping to resell a name's rights.

Trade in domain names can be lucrative. For example, the "Insure.com" domain was sold to QuinStreet for $16 million.[7] But knowingly registering a domain name to profit from someone else's firm name or trademark is known as **cybersquatting** and that's illegal. The United States has passed the Anticybersquatting Consumer Protection Act (ACPA), and ICANN has the Domain Name Dispute Resolution Policy that can reach across borders. Try to extort money by holding a domain name that's identical to (or in some cases, even similar to) a well-known trademark holder, and you could be stripped of your domain name and even fined.

Courts and dispute resolution authorities will sometimes allow a domain that uses the trademark of another organization if it is perceived to have legitimate, nonexploitive reasons for doing so. For example, the now defunct site Verizonreallysucks.com was registered as a protest against the networking giant and was considered fair use since owners didn't try to extort money from the telecom giant.[8] However, the courts allowed the owner of the PETA trademark (the organization People for the Ethical Treatment of Animals) to claim the domain name peta.org from original registrant, who had been using that domain to host a site called "People Eating Tasty

Web hosting services

A firm that provides hardware and services to run the websites of others.

ICANN (Internet Corporation for Assigned Names and Numbers)

Nonprofit organization responsible for managing the Internet's domain and numbering systems.

sTLDs

sponsored Top Level Domains run by private agencies or organizations with established rules restricting the eligibility of registrants (e.g., only those in the aerospace industry can use .aero, only education institutions have access to .edu).

ccTLDs

Two-character country code top-level domains.

geographic TLDs

Top-level domains that are not two-level country codes, but that are associated with a geographical, geopolitical, ethnic, linguistic or cultural community. Examples include .cat (for Catalan), .paris, and .asia.

cybersquatting

Acquiring a domain name that refers to a firm, individual, product, or trademark, with the goal of exploiting it for financial gain. The practice is illegal in many nations, and ICANN has a dispute resolution mechanism that in some circumstances can strip cybersquatters of registered domains.

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Animals."[9] Amazon's application to obtain the ".amazon" gTLD was rejected by ICANN. Several South American countries objected, claiming the word amazon was one of the region's important geographic names.[10]

Trying to predict how authorities will rule can be difficult. The musician Sting's name was thought to be too generic to deserve the rights to Sting.com, but Madonna was able to take back her domain name (for the record, Sting now owns Sting.com).[11] Apple executive Jonathan Ive was denied the right to reclaim domain names incorporating his own name, but that had been registered by another party and without his consent. The publicity-shy design guru wasn't considered enough of a public figure to warrant protection.[12] And sometimes disputing parties can come to an agreement outside of court or ICANN's dispute resolution mechanisms. When Canadian teenager Michael Rowe registered a site for his part-time Web design business, a firm south of the border took notice of his domain name—Mikerowesoft.com. The two parties eventually settled in a deal that swapped the domain for an Xbox and a trip to the Microsoft Research Tech Fest.[13] The issue of cybersquatting has caused many to be critical of new gTLDs, worrying that more suffixes will prompt organizations to spend big to secure scores of domain names simply to stop them from being abused. To help mitigate some cybersquatting on the new gTLDs, ICANN requires operators of new gTLDs to offer a thirty-day "sunrise period" during which trademark holders could register trademark names in a new gTLD before they are offered for public sale.[14]

Path Name and File Name

Look to the right of the top-level domain and you might see a slash followed by either a path name, a file name, or both. If a Web address has a path and file name, the path maps to a folder location where the file is stored on the server; the file is the name of the file you're looking for.

hypertext markup language (HTML)
Language used to compose Web pages.

Most Web pages end in ".html," indicating they are in **hypertext markup language**. While http helps browsers and servers communicate, html is the language used to create and format (render) Web pages. A file, however, doesn't need to be .html; Web servers can deliver just about any type of file: Acrobat documents (.pdf), PowerPoint documents (.ppt or .pptx), Word docs (.doc or .docx), JPEG graphic images (.jpg), and—as we'll see in Chapter 17—even malware programs that attack your PC. At some Web addresses, the file displays content for every visitor, and at others (like amazon.com), a file will contain programs that run on the Web server to generate custom content just for you.

You don't always type a path or file name as part of a Web address, but there's always a file lurking behind the scenes. A Web address without a file name will load content from a default page. For example, when you visit "google.com," Google automatically pulls up a page called "index.html," a file that contains the Web page that displays the Google logo, the text entry field, the "Google Search" button, and so on. You might not see it, but it's there.

Butterfingers, beware! Path and file names are case sensitive—amazon.com/books is considered to be different from amazon.com/BOOKS. Mistype your capital letters after the domain name and you might get a 404 error (the very unfriendly Web server error code that means the document was not found).

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IP Addresses and the Domain Name System: "Where Is It? And How Do We Get There?"

The IP Address

If you want to communicate, then you need to have a way for people to find and reach you. Houses and businesses have street addresses, and telephones have phone numbers. Every device connected to the Internet has an identifying address, too—it's called an *IP (Internet protocol) address*.

A device gets its **IP address** from whichever organization is currently connecting it to the Internet. Connect using a laptop at your university and your school will assign the laptop's IP address. Connect at a hotel, and the hotel's Internet service provider lends your laptop an IP address. Laptops and other end-user machines might get a different IP address each time they connect, but the IP addresses of servers rarely change. It's OK if you use different IP addresses during different online sessions because services like e-mail and Facebook identify you by your username and password. The IP address simply tells the computers that you're communicating with where they can find you right now. IP addresses can also be used to identify a user's physical location, to tailor search results, and to customize advertising. See Chapter 18 to learn more.

IP address

A value used to identify a device that is connected to the Internet. IP addresses are usually expressed as four numbers (from 0 to 255), separated by periods.

The original and still widely used format for IP addresses is known as IPv4. Under IPv4, IP addresses are expressed as a string of four numbers between 0 and 255, separated by three periods. Want to know which IP address your smartphone or computer is using? Simply Google the phrase "what is my ip."

The Internet Is Full—We've Run Out of IP Addresses

If you do the math, four combinations of 0 to 255 gives you a little over four billion possible IP addresses. Four billion sounds like a lot, but the number of devices connecting to the Internet is exploding! Internet access is now baked into smartphones, tablets, speakers, automobiles, televisions, DVD players, video game consoles, utility meters, thermostats, appliances, picture frames, toys, light bulbs, and more. Another problem is a big chunk of existing addresses weren't allocated efficiently, and these can't be easily reclaimed from the corporations, universities, and other organizations that initially received them. All of this means that we've run out of IP addresses. In February 2011 the last batches were made available to regional Internet registries, and the last IPv4 addresses were handed out in September 2015.[15] Small pools are available, but firms in some regions, such as China, are reporting they can only bring new systems online with IPv6.[16] For a look at the current state of IPv4 address exhaustion, see: https://ipv4.potaroo.net/. Some firms are buying IP addresses from firms with excess capacity. Microsoft alone has spent millions buying addresses from firms that include Xerox, Eli Lilly, and the bankrupt firm Nortel.[17]

There are some schemes to help delay the impact of this IP address drought. For example, a technique known as **NAT (network address translation)** uses a gateway that allows multiple devices to share a single IP address. But NAT slows down Internet access and is complex, cumbersome, and expensive to administer.[18]

NAT (network address translation)

A technique often used to conserve IP addresses by maps devices on a private network to single Internet-connected device that acts on their behalf.

The only long-term solution is to shift to a new IP scheme. Fortunately, one was developed more than a decade ago. IPv6 increases the possible address space from the 2^{32} (4,294,967,296) addresses used in the current system (called IPv4) to a new theoretical limit of 2^{128} addresses, which is a really big number—bigger than thirty-four with thirty-seven zeros after it. That's enough for every gram of matter on the Earth to have its own IPv6 address.[19]

But not all the news is good. Unfortunately, IPv6 isn't backward compatible with IPv4, and the transition to the new standard has been painfully slow (for a look at the current rate of IPv6 adoption, see the country by country figures at http://www.stateoftheinternet.com/trends-visualizations-ipv6-adoption-ipv4-exhaustion-global-heat-map-network-country-growth-data.

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html). This gives us the equivalent of many islands of IPv6 in a sea of IPv4, with translation between the two schemes happening when these networks come together. Others consider it the equivalent of two Internets with a translation bridge between IPv4 and IPv6 (and that bridge introduces a delay).[20] While most modern hardware and operating systems providers now support IPv6, converting a network to IPv6 currently involves a lot of cost with little short-term benefit.[21] Upgrading may take years.[22]

Some organizations have stepped up to try to hasten the transition. Facebook, Google, Microsoft, Yahoo!, and some of the Internet's largest networks have made most of its services IPv6 accessible; the US government has mandated IPv6 support for most agencies; China has spurred conversion within its borders; and Comcast and Verizon have major IPv6 rollouts under way. While the transition will be slow, when wide-scale deployment does arrive, IPv6 will offer other benefits, including potentially improving the speed, reliability, and security of the Internet.

The DNS: The Internet's Phonebook

You can actually type an IP address of a website into a Web browser, and that page will show up. But that doesn't help users much because four sets of numbers are really hard to remember.

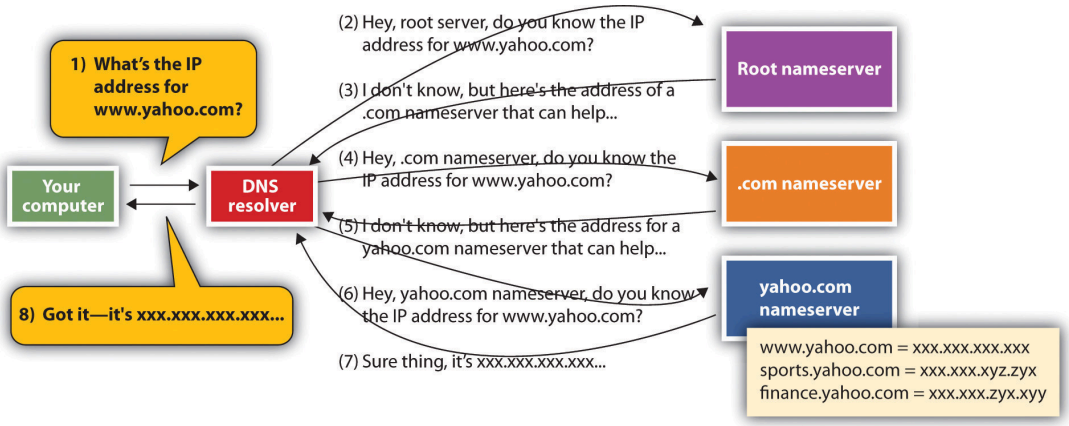
domain name service (DNS)

Internet directory service that allows devices and services to be named and discoverable. The DNS, for example, helps your browser locate the appropriate computers when entering an address like http://finance.google.com.

This is where the **domain name service (DNS)** comes in. The domain name service is a distributed database that looks up the host and domain names that you enter and returns the actual IP address for the computer that you want to communicate with. It's like a big, hierarchical set of phone books capable of finding Web servers, e-mail servers, and more. These "phone books" are called *nameservers*—and when they work together to create the DNS, they can get you anywhere you need to go online.

FIGURE 16.3 Finding an IP Address

When your computer needs to find the IP address for a host or domain name, it sends a message to a DNS resolver, which looks up the IP address starting at the root nameserver. Once the lookup has taken place, that IP address can be saved in a holding space called a cache, to speed future lookups.



To get a sense of how the DNS works, let's imagine that you type www.yahoo.com into a Web browser. Your computer doesn't know where to find that address, but when your computer connected to the network, it learned where to find a service on the network called a DNS resolver. The DNS resolver can look up host/domain name combinations to find the matching IP address using the "phone book" that is the DNS. The resolver doesn't know everything, but it does know where to start a lookup that will eventually give you the address you're looking for. If this is the first time anyone on that network has tried to find "www.yahoo.com," the resolver will contact one of thirteen identical root nameservers. The root acts as a lookup starting place. It doesn't have one big list, but it can point you to a nameserver for the next level, which would be one of the ".com" nameservers in our example. The ".com" nameserver can then find one of the yahoo.com nameservers.

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The yahoo.com nameserver can respond to the resolver with the IP address for www.yahoo.com, and the resolver passes that information back to your computer. Once your computer knows Yahoo!'s IP address, it's then ready to communicate directly with www.yahoo.com. The yahoo.com nameserver includes IP addresses for all Yahoo!'s public sites: www.yahoo.com, sports.yahoo.com, finance.yahoo.com, and so on.

The system also remembers what it's done, so the next time you need the IP address of a host you've already looked up, your computer can pull this out of a storage space called a **cache**, avoiding all those nameserver visits. Caches are periodically cleared and refreshed to ensure that data referenced via the DNS stays accurate.

cache
A temporary storage space used to speed computing tasks.

Distributing IP address lookups this way makes sense. It avoids having one huge, hard-to-maintain, and ever-changing list. Firms add and remove hosts on their own networks just by updating entries in their nameserver. And it allows host IP addresses to change easily, too. Moving your Web server off-site to a hosting provider? Just update your nameserver with the new IP address at the hosting provider, and the world will invisibly find that new IP address on the new network by using the same old, familiar host/domain name combination. The DNS is also fault-tolerant—meaning that if one nameserver goes down, the rest of the service can function. There are exact copies at each level, and the system is smart enough to move on to another nameserver if its first choice isn't responding.

But What If the DNS Gets Hacked?

A hacked DNS would be a disaster! Think about it. If bad guys could change which websites load when you type in a host and domain name, they could redirect you to impostor websites that look like a bank or e-commerce retailer but are really set up to harvest passwords and credit card data.

This exact scenario played out when the DNS of NET Virtua, a Brazilian Internet service provider, was hacked via a technique called *DNS cache poisoning*. Cache poisoning exploits a hole in DNS software, redirecting users to sites they didn't request. The Brazilian DNS hack redirected NET Virtua users wishing to visit the Brazilian bank Bradesco to fraudulent websites that attempted to steal passwords and install malware. The hack impacted about 1 percent of the bank's customers before the attack was discovered.[23]

The exploit showed the importance of paying attention to security updates. A few months earlier, a group that *Wired* magazine referred to as "A Secret Geek A-Team"[24] had developed a software update that would have prevented the DNS poisoning exploit used against NET Virtua, but administrators at the Brazilian Internet service provider failed to update their software, so the hackers got in. An additional upgrade to a DNS system, known as DNSSEC (domain name service security extensions), promises to further limit the likelihood of cache poisoning, but it may take years for the new standards to be rolled out everywhere.[25]

Key Takeaways

- The Internet is a network of networks. Internet service providers connect with one another to share traffic, enabling any Internet-connected device to communicate with any other.
- URLs may list the application protocol, host name, domain name, path name, and file name, in that order. Path and file names are case sensitive.
- A domain name represents an organization. Hosts are public services offered by that organization. Hosts are often thought of as a single computer, although many computers can operate under a single host name and many hosts can also be run off a single computer.
- You don't buy a domain name, but can register it, paying for a renewable right to use that domain name. Domains need to be registered within a generic top-level domain such as ".com" or ".org" or within a two-character country code top-level domain such as ".uk," ".ly,"

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or ".md." ICANN (Internet Corporation for Assigned Names and Numbers) has allowed the expansion of gTLDs to new names and even trademarks.

- Registering a domain that uses someone else's trademark in an attempt to extract financial gain is considered cybersquatting. The United States and other nations have anticybersquatting laws, and ICANN has a dispute resolution system that can overturn domain name claims if a registrant is considered to be cybersquatting.
- Every device connected to the Internet has an IP address. These addresses are assigned by the organization that connects the user to the Internet. An IP address may be assigned temporarily, for use only during that online session.
- We're running out of IP addresses. The current scheme (IPv4) is being replaced by IPv6, a scheme that will give us many more addresses and additional feature benefits but is not backward compatible with the IPv4 standard. Transitioning to IPv6 will be costly, take time, and introduce delay when traffic transfers between IPv4 and IPv6 networks.
- The domain name system is a distributed, fault-tolerant system that uses nameservers to map host/domain name combinations to IP addresses.

Questions and Exercises

1. Find the Web page for your school's information systems department. What is the URL that gets you to this page? Label the host name, domain name, path, and file for this URL. Are there additional subdomains? If so, indicate them, as well.
2. Go to a registrar and see if someone has registered your first or last name as a domain name. If so, what's hosted at that domain? If not, would you consider registering your name as a domain name? Why or why not?
3. Investigate cases of domain name disputes. Examine a case that you find especially interesting. Who were the parties involved? How was the issue resolved? Do you agree with the decision?
4. Describe how the DNS is fault-tolerant and promotes load balancing. Give examples of other types of information systems that might need to be fault-tolerant and offer load balancing. Why?
5. Research DNS poisoning online. List a case, other than the one mentioned in this chapter, where DNS poisoning took place. Which network was poisoned, who were the victims, and how did hackers exploit the poisoned system? Could this exploit have been stopped? How? Whose responsibility is it to stop these kinds of attacks?
6. Why is the switch from IPv4 to IPv6 so difficult? What key principles, discussed in prior chapters, are slowing migration to the new standard?
7. Test to see if networks that you frequently use (home, school, work, mobile) are ready for IPv6 by visiting http://test-ipv6.com/ (or a similar site). Search online to see if your service provider has posted details outlining their IPv6 transition strategy and be prepared to share your results with the class. Do you use other products not tested by the website mentioned previously (e.g., network-enabled video games or other software)? Search online to see if your favorite products and services are IPv6 ready.

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16.3 Getting Where You're Going

Learning Objectives

1. Understand the layers that make up the Internet—application protocol, transmission control protocol, and Internet protocol—and describe why each is important.
2. Discuss the benefits of Internet architecture in general and TCP/IP in particular.
3. Name applications that should use TCP and others that might use UDP.
4. Understand what a router does and the role these devices play in networking.
5. Conduct a traceroute and discuss the output, demonstrating how Internet interconnections work in getting messages from point to point.
6. Understand why mastery of Internet infrastructure is critical to modern finance and be able to discuss the risks in automated trading systems.
7. Describe VoIP, and contrast circuit versus packet switching, along with organizational benefits and limitations of each.

TCP/IP: The Internet's Secret Sauce

OK, we know how to read a Web address, we know that every device connected to the Net needs an IP address, and we know that the DNS can look at a Web address and find the IP address of the machine that you want to communicate with. But how does a Web page, an e-mail, or an app download actually get from a remote computer to your device?

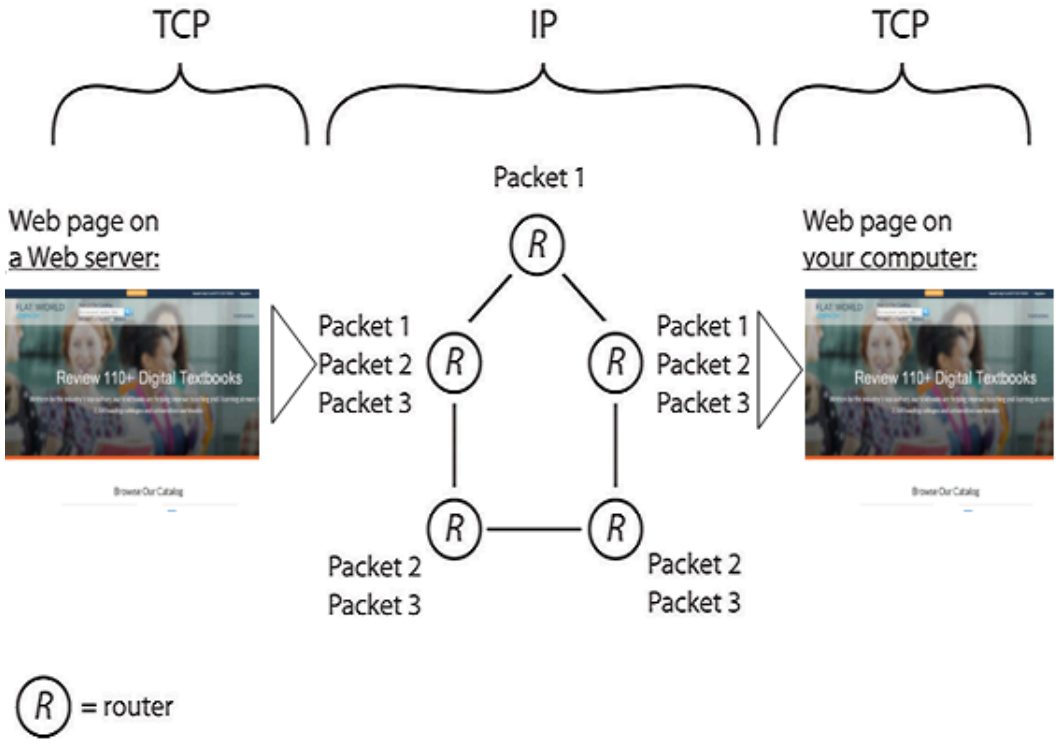
For our next part of the Internet journey, we'll learn about two additional protocols: TCP and IP. These protocols are often written as TCP/IP and pronounced by reading all five letters in a row, "T-C-P-I-P" (sometimes they're also referred to as the *Internet protocol suite*). TCP and IP are built into any device that a user would use to connect to the Internet—from handhelds to desktops to supercomputers—and together TCP/IP make Internet networking happen.

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FIGURE 16.4 TCP/IP in Action

In this example, a server on the left sends a Web page to the user on the right. The application (the Web server) passes the contents of the page to TCP (which is built into the server's operating system). TCP slices the Web page into packets. Then IP takes over, forwarding packets from router to router across the Internet until it arrives at the user's PC. Packets sometimes take different routes, and occasionally arrive out of order. TCP running on the receiving system on the right checks that all packets have arrived, requests that damaged or lost packets be re-sent, puts them in the right order, and sends a perfect, exact copy of the Web page to your browser.



TCP (transmission control protocol)

Works at both ends of most Internet communication to ensure a perfect copy of a message is sent.

packet (or datagram)

A unit of data forwarded by a network. All Internet transmissions—URLs, Web pages, e-mails—are divided into one or more packets.

IP (Internet protocol)

Routing protocol that is in charge of forwarding packets on the Internet.

router

A computing device that connects networks and exchanges data between them.

TCP and IP operate below http and the other application transfer protocols mentioned earlier. **TCP (transmission control protocol)** works its magic at the start and endpoint of the trip—on both your computer and on the destination computer you're communicating with. Let's say a Web server wants to send you a large Web page. The Web server application hands the Web page it wants to send to its own version of TCP. TCP then slices up the Web page into smaller chunks of data called **packets (or datagrams)**. The packets are like little envelopes containing part of the entire transmission—they're labeled with a destination address (where it's going) and a source address (where it came from). Now we'll leave TCP for a second, because TCP on the Web server then hands those packets off to the second half of our dynamic duo, IP.

It's the job of **IP (Internet protocol)** to route the packets to their final destination, and those packets might have to travel over several networks to get to where they're going. The relay work is done via special computers called **routers**, and these routers speak to each other and to other computers using IP (since routers are connected to the Internet, they have IP addresses, too. Some are even named). Every computer on the Internet is connected to a router, and all routers are connected to at least one (and usually more than one) other router, linking up the networks that make up the Internet.

Routers don't have perfect, end-to-end information on all points in the Internet, but they do talk to each other all the time, so a router has a pretty good idea of where to send a packet to get it closer to where it needs to end up. This chatter between the routers also keeps the Internet decentralized and fault-tolerant. Even if one path out of a router goes down (a networking cable gets cut, a router breaks, the power to a router goes out), as long as there's another connection out of that router, then your packet will get forwarded. Networks fail, so good, fault-tolerant network design involves having alternate paths into and out of a network.

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Once packets are received by the destination computer (your computer in our example), that machine's version of TCP kicks in. TCP checks that it has all the packets, makes sure that no packets were damaged or corrupted, requests replacement packets (if needed), and then puts the packets in the correct order, passing a perfect copy of your transmission to the program you're communicating with (an e-mail server, Web server, etc.).

This progression—application at the source to TCP at the source (slice up the data being sent), to IP (for forwarding among routers), to TCP at the destination (put the transmission back together and make sure it's perfect), to application at the destination—takes place in both directions, starting at the server for messages coming to you, and starting on your computer when you're sending messages to another computer.

UDP: TCP's Faster, Less Reliable Sibling

TCP is a perfectionist and that's what you want for Web transmissions, e-mail, and application downloads. But sometimes we're willing to sacrifice perfection for speed. You'd make this sacrifice for live streaming media applications like Skype, Google Hangouts, Apple AirPlay, certain video games, or other voice or video conferencing. Having to wait to make sure each packet is perfectly sent would otherwise lead to awkward pauses that interrupt real-time listening. It'd be better to just grab the packets as they come and play them, even if they have minor errors. Packets are small enough that if one packet doesn't arrive, you can ignore it and move on to the next without too much quality disruption. A protocol called **UDP (user datagram protocol)** does exactly this, working as a TCP stand-in when you've got the need for speed, and are willing to sacrifice quality. If you've ever watched a Web video or had a Web-based phone call and the quality got sketchy, it's probably because there were packet problems, but UDP kept on chugging, making the "get it fast" instead of "get it perfect" trade-off.

UDP (user datagram protocol)

Protocol that operates instead of TCP in applications where delivery speed is important and quality can be sacrificed.

VoIP: When Phone Calls Are Just Another Internet Application

The increasing speed and reliability of the Internet means that applications such as Internet phone calls (referred to as *VoIP*, or **voice over Internet protocol**) are becoming more reliable. That doesn't just mean that Skype becomes a more viable alternative for consumer landline and mobile phone calls; it's also good news for many businesses, governments, and nonprofits.

Many large organizations maintain two networks—one for data and another for *POTS* (plain old telephone service). Maintaining two networks is expensive, and while conventional phone calls are usually of a higher quality than their Internet counterparts, POTS equipment is also inefficient. Old phone systems use a technology called *circuit switching*. A "circuit" is a dedicated connection between two entities. When you have a POTS phone call, a circuit is open, dedicating a specific amount of capacity between you and the party on the other end. You're using that "circuit" regardless of whether you're talking. Pause between words or put someone on hold, and the circuit is still in use. Anyone who has ever tried to make a phone call at a busy time (say, early morning on Mother's Day or at midnight on New Year's Eve) and received an "all circuits are busy" recording has experienced congestion on an inefficient circuit-switched phone network.

But unlike circuit-switched counterparts, Internet networks are packet-switched networks, which can be more efficient. Since we can slice conversations up into packets, we can squeeze them into smaller spaces. If there are pauses in a conversation or someone's on hold, applications don't hold up the network. And that creates an opportunity to use the network's available capacity for other users. The trade-off is one that swaps circuit switching's quality of service (QoS) with packet switching's efficiency and cost savings. Try to have a VoIP call when there's too much traffic on a portion of the network, and your call quality will drop. But packet switching quality is getting much better. Networking standards are now offering special features, such as "packet prioritization," that can allow voice packets to gain delivery priority over packets for applications like e-mail, where a slight delay is OK.

voice over Internet protocol (VoIP)

Transmission technologies that enable voice communications (phone calls) to take place over the Internet as well as private packet-switched networks.

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When voice is digitized, "telephone service" simply becomes another application that sits on top of the Internet, like the Web, e-mail, or FTP. VoIP calls between remote offices can save long distance charges. And when the phone system becomes a computer application, you can do a lot more. Well-implemented VoIP systems allow users' browsers access to their voice mail inbox, one-click video conferencing and call forwarding, point-and-click conference call setup, and other features, but you'll still have a phone number, just like with POTS.

What Connects the Routers and Computers?

Routers are connected together, either via cables or wirelessly. A cable connecting a computer in a home or office is probably copper (likely what's usually called an Ethernet cable), with transmissions sent through the copper via electricity. Long-haul cables, those that carry lots of data over long distances, are usually fiber-optic lines—glass lined cables that transmit light (light is faster and travels farther distances than electricity, but fiber-optic networking equipment is more expensive than the copper-electricity kind). Wireless transmission can happen via Wi-Fi (for shorter distances), or cell phone tower or satellite over longer distances. But the beauty of the Internet protocol suite (TCP/IP) is that it doesn't matter what the actual transmission media are. As long as your routing equipment can connect any two networks, and as long as that equipment "speaks" IP, then you can be part of the Internet.

In reality, your messages likely transfer via lots of different transmission media to get to their final destination. If you use a laptop connected via Wi-Fi, then that wireless connection finds a base station, usually within about three hundred feet. That base station is probably connected to a local area network (LAN) via a copper cable. And your firm or college may connect to fast, long-haul portions of the Internet via fiber-optic cables provided by that firm's Internet service provider (ISP).

Most big organizations have multiple ISPs for redundancy, providing multiple paths in and out of a network. This is so that if a network connection provided by one firm goes down, say an errant backhoe cuts a cable, other connections can route around the problem (see Figure 16.1).

peering

When separate ISPs link their networks to swap traffic on the Internet.

In the United States (and in most deregulated telecommunications markets), ISPs come in all sizes, from smaller regional players to sprawling international firms. When different ISPs connect their networking equipment to share traffic, it's called **peering**. Peering usually takes place at neutral sites called *Internet exchange points* (IXPs), although some firms also have private peering points. Carriers usually don't charge one another for peering, although if traffic exchange is lopsided (e.g., Netflix sending lots of video inbound to Comcast's network), then the ISP left carrying more inbound content may seek payment for a faster, private-peering direct connection to its network (such relationships are often referred to as *paid peering*).[26] Instead, "the money is made" in the ISP business by charging the endpoints in a network—the customer organizations and end users that an ISP connects to the Internet. Competition among carriers helps keep prices down, quality high, and innovation moving forward.

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Finance Has a Need for Speed

When many folks think of Wall Street trading, they think of the open outcry pit at the New York Stock Exchange (NYSE). But human traders are just too slow for many of the most active trading firms. Automated trading accounts for about 75 percent of all financial market volume, meaning three in four trades are made without any human intervention.[27] There are many names for this automated, data-driven frontier of finance—algorithmic trading, black-box trading, or high-frequency trading (HFT). And while firms specializing in automated, high-frequency trading represent only about 2 percent of the trading firms operating in the United States, they account for the vast majority of all US equity trading volume.[28]

Programmers lie at the heart of modern finance. "A geek who writes code—those guys are now the valuable guys" says the former head of markets systems at Fidelity Investments, and that rare breed of top programmer can make "tens of millions of dollars" developing these systems.[29] Such systems leverage data mining and other model-building techniques to crunch massive volumes of data and discover exploitable market patterns. Models are then run against real-time data and executed the instant a trading opportunity is detected. (For more details on how data is gathered and models are built, see Chapter 15.)

Winning with these systems means being quick—very quick. Suffer delay (what techies call *latency*) and you may have missed your opportunity to pounce on a signal or market imperfection. To cut latency, many trading firms are moving their servers out of their own data centers and into a **colocation facility**. These facilities act as storage places where a firm's servers get superfast connections as close to the action as possible. And by renting space in a "*colo*," a firm gets someone else to manage the electrical and cooling issues, often providing more robust power backup and lower energy costs than a firm might get on its own.

Equinix, a major IXP and colocation firm with facilities worldwide, has added a growing number of high-frequency trading firms to a roster of customers that includes e-commerce, Internet, software, and telecom companies. In northern New Jersey alone (the location of many of the servers where "Wall Street" trading takes place), Equinix hosts nine data centers. In just one of its data centers, NY4, some forty-nine exchanges and trading platforms, as well as the NYSE Secure Financial Transaction Infrastructure (SFTI) access node.[30] Interestingly, Equinix was able to reclassify itself as a REIT or Real Estate Investment Trust, given that most of its business was related to providing physical space for the technology of its clients (firms classified as REITs enjoy certain tax advantages for the firm, and dividend advantages to shareholders, over conventional stocks).

Less than a decade ago, eighty milliseconds was acceptably low latency, but now trading firms are pushing below one millisecond into microseconds.[31] So it's pretty clear that understanding how the Internet works, and how to best exploit it, is of fundamental and strategic importance to those in finance. But also recognize that this kind of automated trading comes with risks. Systems that run on their own can move many billions in the blink of an eye, and the actions of one system may cascade, triggering actions by others.

Computer-automated high frequency trading was at least partially to blame in early 2018's nearly 1,600-point drop in the Dow Jones Industrial Average.[32] These rapid point drops have a catchy name—"flash crash", but demonstrate the way signals can dramatically set off a cascade of trades reacting from speed-of-light signals instead of human smarts. Says one former vice chair of the NASDAQ Stock Exchange, "We've created a stock market that moves too darn fast for human beings, ...[and] we see shocking results."[33] The "black boxes" of HFT systems can be mysterious—months after the first so-called flash crash event in 2010, experts were still parsing through trading records, trying to unearth how the flash crash happened.[34] The 2014 publication of the book *Flash Boys* raised additional questions about high-frequency trading (HFT) when author Michael Lewis accused certain HFT trading firms of creating a system that allowed a small and privileged group of traders to get an advance peek at trading orders of other investors. Lewis said this allows them to buy shares ahead of buyers and then sell them to these buyers at a higher price, making a tiny arbitrage premium on billions of transactions.[35] Traders have also been convicted of market manipulation by entering large volumes of trades, taking advantage of market moves by programmed systems, then canceling trades—in effect, creating a fraudulent perception of market behavior.[36] Regulators and lawmakers recognize they now need to understand technology, telecommunications, and the broader impact on society so that they can create plat-

colocation facility

Sometimes called a "colo," or carrier hotel; provides a place where the gear from multiple firms can come together and where the peering of Internet traffic can take place. Equipment connecting in colos could be high-speed lines from ISPs, telecom lines from large private data centers, or even servers hosted in a colo to be closer to high-speed Internet connections.

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forms that fuel growth without putting the economy at risk, while managers need to understand the inner workings of telecommunications to ensure their firms are positioned for opportunity and not taken advantage of.

Watching the Packet Path via Traceroute

Want to see how packets bounce from router to router as they travel around the Internet? Check out a tool called *traceroute*. Traceroute repeatedly sends a cluster of three packets starting at the first router connected to a computer, then the next, and so on, building out the path that packets take to their destination.

Traceroute is built into all major desktop operating systems (Windows, Macs, Linux), and several websites will run traceroute between locations (traceroute.org and visualroute.visualware.com are great places to explore).

The message below shows a traceroute performed between Irish firm Vistatec and Boston College. At first, it looks like a bunch of gibberish, but if we look closely, we can decipher what's going on.

FIGURE 16.5 Traceroute Between Irish Firm Vistatec and Boston College

```
Traceroute to www.bc.edu (136.167.2.220), 30 hops max, 38 byte packets
 1  vlan120.switch.deg.vistatec.ie (85.159.16.65)  0.758 ms  1.141 ms  2.189 ms
 2  ge0-1.router.deg.vistatec.ie (85.159.16.25)  4.109 ms  0.561 ms  0.485 ms
 3  xe-0-1-0-119.dub20.ip4.tinet.net (77.67.66.213)  0.698 ms  0.734 ms  0.691 ms
 4  xe-10-1-0.lon11.ip4.tinet.net (89.149.186.197)  11.290 ms  11.335 ms  11.300 ms
 5  te7-6.mpd02.lon01.atlas.cogentco.com (130.117.15.49)  11.496 ms  11.197 ms  11.454 ms
 6  te0-2-0-1.mpd21.jfk02.atlas.cogentco.com (66.28.4.189)  85.687 ms  85.627 ms  85.685 ms
 7  te2-2.mpd01.bos01.atlas.cogentco.com (154.54.6.1)  233.730 ms  91.406 ms  91.368 ms
 8  te4-2.ccr01.orh01.atlas.cogentco.com (66.28.4.222)  92.498 ms  92.615 ms  92.457 ms
 9  38.104.218.10 (38.104.218.10)  94.491 ms  94.458 ms  94.253 ms
10  136.167.9.226 (136.167.9.226)  94.816 ms  94.475 ms  94.586 ms
```

The table above shows ten hops, starting at a domain in vistatec.ie and ending in 136.167.9.226 (the table doesn't say this, but all IP addresses starting with 136.167 are Boston College addresses). The three groups of numbers at the end of three lines shows the time (in milliseconds) of three packets sent out to test that hop of our journey. These numbers might be interesting for network administrators trying to diagnose speed issues, but we'll ignore them and focus on how packets get from point to point.

At the start of each line is the name of the computer or router that is relaying packets for that leg of the journey. Sometimes routers are named, and sometimes they're just IP addresses. When routers are named, we can tell what network a packet is on by looking at the domain name. By looking at the router names to the left of each line in the traceroute above, we see that the first two hops are within the vistatec.ie network. Hop 3 shows the first router outside the vistatec.ie network. It's at a domain named tinet.net, so this must be the name of Vistatec's Internet service provider since it's the first connection outside the vistatec.ie network.

Sometimes router names suggest their locations (oftentimes they use the same three-character abbreviations you'd see in airports). Look closely at the hosts in hops 3 through 7. The subdomains dub20, lon11, lon01, jfk02, and bos01 suggest the packets are going from Dublin, then east to London, then west to New York City (John F. Kennedy International Airport), then north to Boston. That's a long way to travel in a fraction of a second!

Hop 4 is at tinet.net, but hop 5 is at cogentco.com (look them up online and you'll find out that cogentco.com, like tinet.net, is also an ISP). That suggests that between those hops peering is taking place and traffic is handed off from carrier to carrier.

Hop 8 is still cogentco.com, but it's not clear who the unnamed router in hop 9, 38.104.218.10, belongs to. We can use the Internet to sleuth that out, too. Search the Internet for the phrase "IP address lookup" and you'll find a bunch of tools to track down the organization that "owns" an IP address. Using the tool at whatismyip.com, I found that this number is registered to PSI Net, which is now part of cogentco.com.

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Routing paths, ISPs, and peering all revealed via traceroute. You've just performed a sort of network "CAT scan" and looked into the veins and arteries that make up a portion of the Internet. Pretty cool!

If you try out traceroute on your own, be aware that not all routers and networks are traceroute friendly. It's possible that as your trace hits some hops along the way (particularly at the start or end of your journey), three "*" characters will show up at the end of each line instead of the numbers indicating packet speed. This indicates that traceroute has timed out on that hop. Some networks block traceroute because hackers have used the tool to probe a network to figure out how to attack an organization. Most of the time, though, the hops between the source and destination of the traceroute (the steps involving all the ISPs and their routers) are visible.

Traceroute can be a neat way to explore how the Internet works and reinforce the topics we've just learned. Search for traceroute tools online or browse the Internet for details on how to use the traceroute command built into your computer.

There's Another Internet?

If you're a student at a large research university, there's a good chance that your school is part of Internet2. Internet2 is a research network created by a consortium of research, academic, industry, and government firms. These organizations have collectively set up a high-performance network running at speeds of up to one hundred gigabits per second to support and experiment with demanding applications. Examples include high-quality video conferencing; high-reliability, high-bandwidth imaging for the medical field; and applications that share huge datasets among researchers.

If your university is an Internet2 member, and you're communicating with another computer that's part of the Internet2 consortium, then your organization's routers are smart enough to route traffic through the superfast Internet2 backbone. If that's the case, you're likely already using Internet2 without even knowing it!

Key Takeaways

- TCP/IP, or the Internet protocol suite, helps get perfect copies of Internet transmissions from one location to another. TCP works on the ends of transmissions, breaking transmissions up into manageable packets at the start and putting them back together while checking quality at the end. IP works in the middle, routing packets to their destination.
- Routers are special computing devices that forward packets from one location to the next. Routers are typically connected with more than one outbound path, so in case one path becomes unavailable, an alternate path can be used.
- UDP is a replacement for TCP, used when it makes sense to sacrifice packet quality for delivery speed. It's often used for media streaming.
- TCP/IP doesn't care about the transition media. This allows networks of different types—copper, fiber, and wireless—to connect to and participate in the Internet.
- The ability to swap in new applications, protocols, and media files gives the network tremendous flexibility.
- Decentralization, fault tolerance, and redundancy help keep the network open and reliable.
- VoIP allows voice and phone systems to become an application traveling over the Internet. This is allowing many firms to save money on phone calls and through the elimination of old, inefficient circuit-switched networks. As Internet applications, VoIP phone systems can also have additional features that circuit-switched networks lack. The primary limitation of many VoIP systems is quality of service.
- Many firms in the finance industry have developed automated trading models that analyze data and execute trades without human intervention. Speeds substantially less than one second may be vital to capitalizing on market opportunities, so firms are increasingly moving

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equipment into colocation facilities that provide high-speed connectivity to other trading systems.

- The Internet is a network of networks, and these networks swap traffic by peering—that is, connecting their networks together. Most peering between commercial networks (e.g., between firms like AT&T and Verizon) is done without exchanging fees. However, some ISPs are demanding payment (paid peering) for access to faster, private peering points.

Questions and Exercises

1. How can the Internet consist of networks of such physically different transmission media—cable, fiber, and wireless?
2. What is the difference between TCP and UDP? Why would you use one over the other?
3. Would you recommend a VoIP phone system to your firm or university? Why or why not? What are the advantages? What are the disadvantages? Can you think of possible concerns or benefits not mentioned in this section? Research these concerns online and share your finding with your instructor.
4. What are the risks in the kinds of automated trading systems described in this section? Conduct research and find an example of where these systems have caused problems for firms and/or the broader market. What can be done to prevent such problems? Whose responsibility is this?
5. Search the Internet for a traceroute tool, or look online to figure out how to use the traceroute command built into your PC. Run three or more traceroutes to different firms at different locations around the world. List the number of ISPs that show up in the trace. Circle the areas where peering occurs. Do some of the "hops" time out with "*" values returned? If so, why do you think that happened?
6. Find out if your school or employer is an Internet2 member. If it is, run traceroutes to schools that are and are not members of Internet2. What differences do you see in the results?
7. Research high-frequency trading and flash crash incidents. Are there any recent developments that managers should be aware of? Do you feel there is enough being done to curtail risks associated with HFT? Why or why not? Come to class prepared to discuss pros and cons, as well as any interesting incidents that you may have uncovered.

16.4 Last Mile: Faster Speed, Broader Access

Learning Objectives

1. Understand the last-mile problem and be able to discuss the pros and cons of various broadband technologies, including DSL, cable, fiber, and various wireless offerings.
2. Describe mobile technologies known as 4G and the emerging 5G.
3. Understand the issue of Net neutrality and put forth arguments supporting or criticizing the concept.

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The **Internet backbone** is made of fiber-optic lines that carry data traffic over long distances. Those lines are pretty speedy. 100 Gbps (gigabits per second) backbone transmission speeds are now commonplace in many nations (that's enough to transmit a two-hour high-definition [HD] movie in about eight seconds) with speeds headed higher worldwide.[37] And even more speed is on the way. Several firms and research organizations have broken the 1 terabit per second barrier—demonstrated speeds so fast that it would take only a single second to download the *entire* Game of Thrones series in high definition.[38] But when considering overall network speed, remember **Amdahl's Law**: a system's speed is determined by its slowest component.[39] More often than not, the bottleneck isn't the backbone but the so-called **last mile**, or the connections that customers use to get online.

Internet backbone

High-speed data lines provided by many firms all across the world that interconnect and collectively form the core of the Internet.

Amdahl's Law

A system's speed is determined by its slowest component.

last mile

Technologies that connect end users to the Internet. The last-mile problem refers to the fact that these connections are usually the slowest part of the network.

High-speed last-mile technologies are often referred to as *broadband Internet access* (or just **broadband**). What qualifies as broadband is updated every few years. In 2018 the FCC kept a definition set at 25 Mbps download and upload speeds of 3 Mbps.[40] Other agencies worldwide may have different definitions, but one thing is clear: a new generation of bandwidth-demanding services requires more capacity. As we increasingly consume Internet services like HD streaming, real-time gaming, video conferencing, voice assistants, and music downloads, we are in fact becoming a bunch of voracious, bit-craving gluttons.

broadband

Broadly refers to high-speed Internet connections and is often applied to "last-mile" technologies.

With the pivotal role the United States has played in the creation of the Internet, and in pioneering software, hardware, and telecommunications industries, you might expect the US to lead the world in last-mile broadband access. Not quite. While recent large-scale investments in residential US Internet infrastructure have moved the US up in worldwide speed rankings (one study has the US ranking 10th in speed, worldwide), American broadband is among the world's costliest, with the FCC claiming that when considering speeds as well as pricing, the US ranks "among the worst in the developed world" (a ranking of only 21st worldwide).[41]

Sounds grim, but help is on the way. A range of technologies and firms are upgrading infrastructure and developing new systems that will increase capacity not just in the United States but also worldwide. Here's an overview of some of the major technologies that can be used to speed the Internet's last mile.

bandwidth

Network transmission speeds, typically expressed in some form of bits per second (bps).

Understanding Bandwidth

When folks talk about **bandwidth**, they're referring to data transmission speeds. Bandwidth is often expressed in bits per second, or bps. Prefix letters associated with multiples of bps are the same as the prefixes we mentioned in Chapter 5 when discussing storage capacity in bytes: Kbps = thousand bits (or kilobits) per second, Mbps = million bits (or megabits) per second, Gbps = billion bits (or gigabits) per second, and Tbps = trillion bits (or terabits) per second.

Remember, there are eight bits in a byte, and one byte is a single character. One megabyte is roughly equivalent to one digital book, forty-five seconds of music, or twenty seconds of medium-quality video.[42] But you can't just divide the amount of bytes by eight to estimate how many bits you'll need to transfer. When a file or other transmission is sliced into packets (usually of no more than about 1,500 bytes), there's some overhead added. Those packets "wrap" data chunks in an envelope surrounded by source and destination addressing and other important information.

Here are some rough demand requirements for streaming media. For streaming audio like Pandora, you'd need at least 150 Kbps for acceptable regular quality, and at least 300 Kbps for high quality.[43] For streaming video (via Netflix), at a minimum you'd need 1 Mbps for standard quality, 8 Mbps for HD streaming, and 16 Mbps for 4k video.[44]

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Cable Broadband

coaxial cable
Insulated copper cable commonly used by cable television providers.

Roughly 90 percent of US homes are serviced by a cable provider, each capable of using a thick copper wire to offer broadband access. That wire (called a **coaxial cable** or *coax*) has shielding that reduces electrical interference, allowing cable signals to travel longer distances without degrading and with less chance of interference than conventional telephone equipment.

One potential weakness of cable technology lies in the fact that most residential providers use a system that requires customers to share bandwidth with neighbors. If the guy next door is a BitTorrent-using bandwidth hog, your traffic could suffer.[45]

Cable is fast and it's getting faster. Many cable firms are rolling out a new technology called DOCSIS 3.1 that can support multigigabit download speeds.[46] Cable firms are also creating so-called *fiber-copper hybrids* that run higher-speed fiber-optic lines into neighborhoods, then use lower-cost, but still relatively high-speed, copper infrastructure over short distances to homes.[47] Technologies are often asymmetric, offering download speeds far greater than upload speeds. Those are fast networks, but they are also very expensive to build, since cable firms are laying entirely new lines into neighborhoods instead of leveraging the infrastructure that they've already got in place.

DSL: Phone Company Copper

digital subscriber line (DSL)
Broadband technology that uses the wires of a local telephone network.

Digital subscriber line (DSL) technology uses the copper wire the phone company has already run into most homes. Even as customers worldwide are dropping their landline phone numbers, the wires used to provide this infrastructure can still be used for broadband.

DSL speeds vary depending on the technology deployed. Worldwide speeds may range from 7 Mbps to as much as 100 Mbps or more (albeit over very short distances).[48] The Achilles heel of the technology lies in the fact that DSL uses standard copper telephone wiring. These lines lack the shielding used by cable, so signals begin to degrade the further you are from the connecting equipment in telephone company offices. Speeds drop off significantly at less than two miles from a central office or DSL hub. If you go four miles out, the technology becomes unusable. Some DSL providers are also using a hybrid fiber-copper system, but as with cable's copper hybrids, this is expensive to build.

The superspeedy DSL implementations that are popular in Europe and Asia work because foreign cities are densely populated, and so many high-value customers can be accessed over short distances. In South Korea, for example, half the population lives in apartments, and most of those customers live in and around Seoul. This density also impacts costs—since so many people live in apartments, foreign carriers run fewer lines to reach customers, digging up less ground or stringing wires across fewer telephone poles. Their US counterparts, by contrast, need to reach a customer base sprawled across the suburbs, so US firms have much higher infrastructure costs. [49]

There's another company with copper, electricity-carrying cables coming into your home—the electrical utility. BPL, or broadband over power line, technology has been available for years. However, there are few deployments because it is considered to be pricier and less practical than alternatives.[50]

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Fiber: A Light-Filled Glass Pipe to Your Doorstep

fiber to the home (FTTH)

Broadband service provided via light-transmitting fiber-optic cables.

Fiber to the home (FTTH) is the fastest last-mile technology around. It also works over long distances. Verizon Fios, CenturyLink, AT&T, and even Google are all firms offering US residential fiber service that can scale up to so-called Gig-speed. Unlike many cable alternatives, fiber upload and download speeds are roughly the same, which may be important for users who are uploading lots of video or real-time streaming on services like Twitch.[51] The problem with fiber is that unlike cable or DSL copper, fiber to the home networks weren't already in place. That means firms had to build their own fiber networks from scratch.

The cost of this buildout can be enormous. Verizon, for example, has spent over $23 billion on its FTTH infrastructure, allowing the firm to offer some of the fastest home broadband services anywhere. Google has also brought 1 Gbps high-speed fiber to the home in several US communities, including both Kansas City, Kansas, and Kansas City, Missouri; Provo, Utah; and Austin, Texas. Google initially deemed its effort an experiment, claiming it was more interested in learning how developers and users take advantage of ultrahigh-speed fiber to the home (e.g., what kinds of apps are created and used, how do usage and time spent online change), rather than becoming a nationwide ISP itself. However, Google has engaged dozens of additional US communities in exploring further rollout of fast and cheap fiber.[52] Google Fiber appears to be favorable to consumers with its competitive pricing; in communities where Google is present, rivals have dropped prices and increased speeds.[53]

Wireless

wireless spectrum

Frequencies used for wireless communication. Most mobile cell phone services have to license spectrum. Some technologies (such as Wi-Fi) use unlicensed public spectrum.

Mobile wireless service from cell phone access providers is delivered via cell towers. While these providers don't need to build a residential wired infrastructure, they still need to secure space for cell towers, build the towers, connect the towers to a backbone network, and license the **wireless spectrum** (or airwave frequency space) for transmission. As T-Mobile's CEO describes it, "Spectrum is the invisible wireless airwaves that transport information through the ether and into that device into your hand. There's only so much of it" and most mobile firms have exclusive access to the spectrum that they license.[54] [55]This leads to high-stakes regional bidding wars whenever governments put new spectrum up for license. Firms that acquire spectrum rights can gain tremendous market advantages. High-stakes auctions can also inflate operating costs, which eventually are passed down to consumers in the form of higher rates. Perhaps unsurprisingly, T-Mobile has lobbied the US government to set aside more spectrum for smaller carriers, arguing it's in the public interest to offer more carrier competition and keep costs low.

We need more bandwidth for mobile devices, too. AT&T now finds that the top 3 percent of its mobile network users gulp up 40 percent of the network's capacity, and network strain will only increase as more people adopt smartphones. These users are streaming Major League Baseball games, exploring the planet with Google Earth, watching YouTube and Netflix, streaming music on Spotify, streaming high-res virtual reality experiences, and more. Get a bunch of smartphone users in a crowded space, like in a college football stadium on game day, and the result is a network-choking data traffic jam. AT&T estimates that it's not uncommon for 80 percent of game-day iPhone users to take out their phones and surf the Web for stats, snap and upload photos, and more. But cell towers often can't handle the load.[56] If you've ever lost coverage in a crowd, you've witnessed mobile network congestion firsthand. Trying to have enough capacity to avoid congestion traffic jams will cost some serious coin. In the midst of customer complaints, AT&T committed to spending $18 billion on network upgrades to address its wireless capacity problem.[57]

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TABLE 16.1 Average Demand Usage by Function

Usage	Demand
Voice Calls	4 MB/hr.
iPhone Browsing	40–60 MB/hr.
Net Radio	60 MB/hr.
YouTube	200–400 MB/hr.
Conventional mobile phones use an estimated 100 MB/month, iPhones 560 MB/month, and iPads almost 1 GB/month.	

Source: Based on information from R. Farzad, "The Truth about Bandwidth," *BusinessWeek*, February 3, 2010.

Mobile phone services are often characterized by some number, followed by a G (for generation). As you'd expect, the bigger the "G," the faster and more reliable the network. An alphabet soup of often incompatible worldwide 3G or third-generation technologies has been largely replaced by higher-bandwidth 4G (fourth-generation) mobile networks. The winner in 4G technologies is LTE (long-term evolution). In the United States, the only firm to bet on a rival technology was Sprint, with WiMAX, a technology the firm has since abandoned.[58] Bandwidth for the service rivals what we'd consider fast cable a few years back. Average download speeds above 40 Mbps and upload speeds near 20 Mbps are now common in the United States.[59]

Carriers worldwide have also begun rolling out 5G services that are faster and more reliable, and that have a higher overall capacity than existing 4G networks. Some firms report that downloading a high-definition movie over 5G will take less than a second, whereas current speeds might take 10 or more minutes.[60] At those speeds, wireless carriers will be able to offer home television and data packages as legitimate alternatives to cable.[61] Speed of 5G service will depend on the carrier, how much spectrum they have available, and how quickly they've upgraded or deployed new transmission technology. Also important—5G will have much greater capacity, so clogged systems from simultaneous use should become rare. Latency will also shrink, and this faster, more reliable Internet may be a catalyst for all sorts of applications, including self-driving automobiles, emergency response communication, telemedicine, and smart city sensors for things like traffic routing, air and water monitoring, and community safety.[62]

Satellite Wireless and Schemes to Reach the Remote

Wireless systems provided by earth-bound base stations like cell phone towers are referred to as *terrestrial wireless*, but it is possible to provide telecommunications services via satellite. Early services struggled due to a number of problems. For example, the first residential satellite services were only used for downloads, which still needed a modem or some other connection to send any messages from the computer to the Internet. Many early systems also required large antennas and were quite expensive. Some services were based on satellites in geosynchronous earth orbit (GEO). GEO satellites circle the earth in a fixed, or stationary, orbit above a given spot on the globe, but to do so they must be positioned at a distance that is roughly equivalent to the planet's circumference. That means signals travel the equivalent of an around-the-world trip to reach the satellite and then the same distance to get to the user. The "last mile" became the last 44,000 miles at best. And if you used a service that also provided satellite upload as well as download, double that to about 88,000 miles. All that distance means higher latency (more delay).[63] Many satellite systems require a line-of-site dish, meaning nothing can obscure the path between the two. Some systems can be crippled when harsh, signal-obscuring weather is overhead. Some contend that the weaknesses of satellite service mean satellite shouldn't be considered when evaluating if broadband is available to a community.[64]

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Among a new generation of satellite providers trying to overcome the weaknesses of past efforts is O3b. The name stands for the "Other 3 Billion," of the world's population who lack broadband Internet access, and the firm has already begun to provide "fiber-quality" wireless service to underserved portions of the developing world, as well as others needing connectivity outside traditional cell networks, such as cruise ships and the US Navy.[65] These "middle earth orbit" (MEO) satellites will circle closer to the earth to reduce latency (only about 5,000 miles up, less than one-fourth the distance of GEO systems). To maintain the lower orbit, O3b's satellites orbit faster than the planet spins, but with a network of 20 satellites, the system will constantly blanket regions served. If one satellite circles to the other side of the globe, another one will circle around to take its place, ensuring there's always an O3b "bird" overhead.

Internet penetration in sub-Saharan Africa lags significantly from the rest of the world, and data rates in the few places served can cost as much as one hundred times the rates of comparable systems in nations with high Internet penetration.[66] O3b hopes to change that equation and significantly lower access rates. O3b customers will be local telecommunication firms, not end users. The plan is for local firms to buy O3b's services wholesale and then resell it to customers alongside rivals who can do the same thing, collectively providing more consumer access, higher quality, and lower prices through competition.

O3b is a big, bold, and admittedly risky plan. Many earlier satellite telecom firms hit bankruptcy before ideas were fully realized, and O3b has had its challenges. The firm has had five CEOs in three years, and initial backers, which included Google and HSBC, have taken a back seat to majority owner SES.[67] However, the firm has signed contracts with African telecom providers, and by 2018 sixteen of its twenty MEO satellites were deployed and operational. And while O3b is a leader in this space, it's certainly not alone. Virgin's Richard Branson is backing OneWeb, a company that hopes to launch hundreds of low-orbit satellites to blanket the planet with Internet access, and has pledged to connect "every unconnected school" by 2022, and to "bridging the digital divide" by 2027.[68] And then there's SpaceX, which launched founder Elon Musk's personal Tesla into space in 2018, and which has announced plans to put over 12,000 broadband satellites in orbit. To put that in perspective, as of mid-2017 there were only 1,738 satellites total in orbit across all firms and nations.[69]

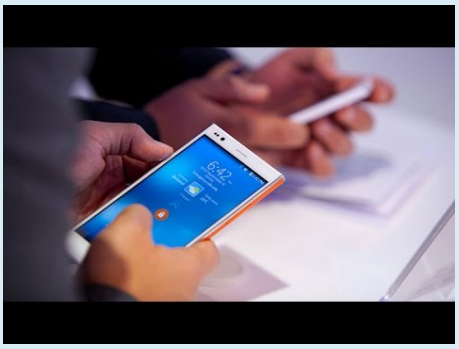
Many firms are also exploring offering the Internet closer to the planet. Google's Project Loon is working on delivering the Internet to rural areas uncovered by the Internet using a network of highly resilient balloons floating in the stratosphere above planes and below space. Facebook's Project Aquila swaps balloons for solar-powered drones that can circle an area for three or more months at a time (for more on Facebook's efforts, including Internet.org, see this book's Facebook chapter). While working to reach rural areas is admirable and can have a huge impact on those who live in hinterlands, the problem for many is not access, but cost.[70] Throughout the world, Internet, phone, and text services are sold using scratch cards, with consumers buying bandwidth and entering a code, rather than paying a still-too-expensive monthly plan. Roughly 85 percent of the world's mobile users are on these restrictive pay-as-you-go mobile plans.[71] Telecom firms in emerging markets are often caught between investing heavily to build out infrastructure and being challenged by a large portion of potential customers who just aren't that lucrative. To help, Google (through a little-known initiative called Project Link now operating as a separate entity known as CSquared) has begun laying its own high-speed fiber in several cities in Ghana and Uganda, licensing the infrastructure to third parties in the hopes that local telcos will share Google's high-quality infrastructure and lower their prices.[72] Yet another effort by Jana doesn't own a telecom network, but offers data, text, and call time in exchange for things such as participation in surveys, visiting a website, or redeeming product coupons. The firm's most promising effort, the mCent app, offers free data to users who perform actions such as installing and trying an app, performing an in-app action, or referring friends. The firm has partnerships with over 300 mobile operators worldwide, is profitable, and estimates that it is ten times the size of Facebook-backed free-Internet provider Internet.org.[73]

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Jana Founder and CEO Nathan Eagle on the Firm's Offering, Growth, Profitability, and Potential

Jana has reached tens of millions of people worldwide by offering Internet service in exchange for installing apps, performing actions online, completing services, and redeeming coupons.



View the video online at: http://www.youtube.com/embed/_5vlJzD121s?rel=0

Wi-Fi and Other Hotspots

Wi-Fi

A term used to brand wireless local-area networking devices. Devices typically connect to an antenna-equipped base station or hotspot, which is then connected to the Internet. Wi-Fi devices use standards known as IEEE 802.11, and various versions of this standard (e.g., b, g, n) may operate in different frequency bands and have access ranges.

Bluetooth

A standard for short-range (around 30 feet or less) wireless connectivity, typically meant to eliminate cabling used for things like speakers, printers, cameras, and other devices.

Many users access the Internet via **Wi-Fi** (which stands for *wireless fidelity*). Computer and mobile devices have Wi-Fi antennas built into their chipsets, but to connect to the Internet, a device needs to be within range of a *base station* or *hotspot*. The base station range is usually around three hundred feet (you might get a longer range outdoors and with special equipment; and less range indoors when signals need to pass through solid objects like walls, ceilings, and floors). Wi-Fi base stations used in the home are usually bought by end users, then connected to a cable, DSL, or fiber provider. Many Wi-Fi–equipped mobile devices also offer an opportunity to act as a personal hotspot. These devices connect to the Internet over the traditional cell network, but will allow nearby devices (e.g., laptops and tablets) to use mobile Internet access by connecting device-to-device via either Wi-Fi (without needing a base station) or **Bluetooth** (a local wireless technology meant primarily as a replacement for things like printer and speaker cabling, usually requiring devices to be thirty feet or less from each other). Remember, the technologies known as Wi-Fi are constantly being upgraded. It's quite possible that an old hotspot or older devices are slower than the broadband into a home or other location. And given Amdahl's law, the benefits of speedy broadband could be eliminated by an outdated Wi-Fi hotspot or device that doesn't support faster standards.

And now a sort of mobile phone hotspot is being used to overcome limitations in those services, as well. Mobile providers can also be susceptible to poor coverage indoors. That's because the spectrum used by most mobile phone firms doesn't travel well through solid objects. Cell coverage is also often limited in the United States because of a lack of towers, which is a result of the *NIMBY problem* (not in my backyard). People don't want an eighty-foot to four-hundred-foot unsightly tower clouding their local landscape, even if it will give their neighborhood better cell phone coverage.[74] To overcome reception and availability problems, mobile telecom services firms have begun offering femtocells. These devices are usually smaller than a box of cereal and can sell for $150 or less (some are free with specific service contracts). Plug a femtocell into a high-speed Internet connection like an in-home cable or fiber service and you can get "five-bar" coverage in a roughly 5,000-square-foot footprint.[75] That can be a great solution for someone who has an in-home, high-speed Internet connection, but wants to get phone and mobile data service indoors, too.

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Net Neutrality: What's Fair?

Across the world, battle lines are being drawn regarding the topic of Net neutrality. Net neutrality is the principle that all Internet traffic should be treated equally, and ISPs should not discriminate, slow down access, or charge differentially by user, content, site, platform, application, type of attached equipment, or modes of communication.[76] Sometimes access providers have wanted to offer varying (some say "discriminatory") coverage, depending on the service used and bandwidth consumed.

On one side of the debate are Internet service firms, with Google being one of the strongest Net neutrality supporters. In an advocacy paper, Google stated, "Just as telephone companies are not permitted to tell consumers who they can call or what they can say, broadband carriers should not be allowed to use their market power to control activity online."[77] Google and other Internet content providers worry that without strong net neutrality rules, ISPs may block content or favor their own offerings above rivals. AT&T has previously blocked Apple FaceTime and Google Hangouts, while Verizon and AT&T have blocked Google Wallet.[78] Comcast, the nation's largest cable provider, owns NBCUniversal and has a streaming service that can be considered a competitor to Netflix. Should Comcast, which operates as the only cable company in many of the communities it services, be allowed to use this power as an advantage over competitors? Many Internet firms also worry that if network providers move away from flat-rate pricing toward usage-based (or metered) schemes, this may limit innovation. Metered billing may limit the use of everything from iTunes to Netflix. After all, if you have to pay for per-bit bandwidth consumption and for the download service, then it's as if you're paying twice. Another concern is that if paid peering is the norm, big players like Netflix are likely the only ones with the scale to afford to pay the broadband gatekeepers. If startups need to raise capital for "pay to play" on an infrastructure based on government-funded research (that's what the Net is, after all), could this smother the plans of would-be entrepreneurs?

In a scathing critique of US policy in *The Verge*, author Nilay Patel writes, "In the UK, where incumbent provider BT is required to allow competitors to use its wired broadband network, home internet service prices are as low as £2.50 a month, or just over $4. In South Korea, where wireless giants SK Telecom and LG Uplus are locked in a fierce technology battle, customers have access to the fastest mobile networks in the world—up to 300 Mbps, compared to a theoretical max of 80 Mbps on Verizon [in the US]" that's actually more like 15 or 20 Mbps in the real world. As for wireless, in "Germany...T-Mobile customers pay just $1.18 per Mbps of speed. In the US...mostly incompatible wireless networks lock customers in with expensive handsets they can't take elsewhere, allowing AT&T and Verizon to charge around $4 per Mbps each and Sprint to clock in at an insane $7.50." Patel boils the problem down to "four simple ideas: the internet is a utility, there is zero meaningful competition to provide that utility to Americans, all internet providers should be treated equally, and the FCC is doing a miserably ineffective job."[79]

The counterargument is that if firms are restricted from charging more for their investment in infrastructure and services, then they'll have little incentive to continue to make the kinds of multibillion-dollar investments that innovations like 5G and fiber networks require, and that these innovations are precisely what is required to power the innovations provided by the next generation of entrepreneurs. Telecom industry executives have railed against Google, Netflix, and others, calling them free riders who earn huge profits by piggybacking off ISP networks, all while funneling no profits back to the firms that provide the infrastructure. One Verizon vice president said, "The network builders are spending a fortune constructing and maintaining the networks that Google intends to ride on with nothing but cheap servers.... It is enjoying a free lunch that should, by any rational account, be the lunch of the facilities providers."[80] AT&T's previous CEO has suggested that Google, Netflix, and other services firms should pay for "preferred access" to the firm's customers.

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ISPs also lament the relentlessly increasing bandwidth demands placed on their networks. YouTube streams as much data in three months as the world's radio, cable, and broadcast television channels combined stream in one year,[81] and Netflix sucks up more than twice the home broadband capacity of YouTube, accounting for over one-third of all US downstream traffic during primetime hours.[82] Should ISPs be required to support the strain of this kind of bandwidth hog? And what if this one application clogs network use for other traffic, such as e-mail or Web surfing? Similarly, shouldn't firms have the right to prioritize some services to better serve customers? Some network providers argue that services like video chat and streaming audio should get priority over, say, e-mail, which can afford slight delay without major impact. In that case, there's a pretty good argument that providers should be able to discriminate against services. But improving efficiency and throttling usage are two different things.

Internet service firms say they create demand for broadband business, while broadband firms say Google and allies are ungrateful parasites that aren't sharing the wealth. The battle lines on the Net neutrality frontier continue to be drawn, and the eventual outcome will impact consumers and investors, and will likely influence the continued expansion and innovation of the Internet. Net neutrality laws vary worldwide, and they continue to evolve in the United States. The Obama administration had largely supported Net neutrality, but the Trump administration removed most of these regulations. As a result, several states have attempted to enact their own rules favoring Net neutrality.[83] Expect flux and court battles for years to come.

Summing Up

Hopefully, this chapter helped reveal the mysteries of the Internet. It's interesting to know how "the cloud" works, but it can also be vital. As we've seen, the executive office in financial services firms considers mastery of the Internet infrastructure to be critically important to their competitive advantage. Media firms find the Internet both threatening and empowering. The advancement of last-mile technologies and issues of Net neutrality will expose threats and create opportunity. And a manager who knows how the Internet works will be in a better position to make decisions about how to keep the firm and its customers safe and secure, and be better prepared to brainstorm ideas for winning in a world where access is faster and cheaper, and firms, rivals, partners, and customers are more connected.

Key Takeaways

- The slowest part of the Internet is typically the last mile, not the backbone. While several technologies can offer broadband service over the last mile, the United States continues to rank below many other nations in terms of access speed, availability, and price.
- Cable firms and phone companies can leverage existing wiring for cable broadband and DSL service, respectively. Cable services are often criticized for shared bandwidth. DSL's primary limitation is that it only works within a short distance of telephone office equipment.
- Fiber to the home can be very fast but very expensive to build.
- An explosion of high-bandwidth mobile applications has strained wireless networks. The transition from 3G to 4G is increasing bandwidth and capacity, but usage continues to skyrocket as smartphone and tablet users stream increasing amounts of video and audio.
- Femtocells are a technology that can improve wireless service by providing a personal mobile phone hotspot that can plug into in-home broadband access.
- Emerging fifth-generation (5G) wireless technologies promise speeds that can compete with cable television providers, while lowering latency, and increasing overall network capacity. These services will be critical as advances from self-driving vehicles to connected smart homes place increasing demands on wireless networks.

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- Satellite systems show promise in providing high-speed access to underserved parts of the world, but few satellite broadband providers have been successful so far.
- Net neutrality is the principle that all Internet traffic should be treated equally. Google, Netflix, and other firms say it is vital to maintain the openness of the Internet. Telecommunications firms say they should be able to limit access to services that overtax their networks, and some have suggested charging content providers for providing access to their customers.

Questions and Exercises

1. Research online for the latest country rankings for broadband service. Where does the United States currently rank? Why?
2. Which broadband providers can service your home? Which would you choose? Why?
3. Research the status of Google Fiber. Report updated findings to your class. Why do you suppose Google decided to become an ISP? What other Internet access experiments has the firm been involved in?
4. Show your understanding of the economics and competitive forces of the telecom industry. Discuss why Verizon chose to go with fiber. Do you think this was a wise decision or not? Why? Feel free to do additional research to back up your argument.
5. Why have other nations enjoyed faster broadband speeds, greater availability, and lower prices?
6. The iPhone and other smartphones have been called both a blessing and a curse for AT&T. Why do you suppose this is so?
7. Investigate the status of mobile wireless offerings available in your area. Which firm would you choose? Why? Which factors are most important in your decision?
8. Have you ever lost communication access—wirelessly or via wired connection? What caused the loss or outage?
9. What factors shape the profitability of the mobile wireless provider industry? How do these economics compare with the cable and wire line industry? Who are the major players, and which would you invest in? Why?
10. Last-mile providers often advertise very fast speeds, but users rarely see speeds as high as advertised rates. Search online to find a network speed test and try it from your home, office, mobile device, or dorm. How fast is the network? If you're able to test from home, what bandwidth rates does your ISP advertise? Does this differ from what you experienced? What could account for this discrepancy?
11. What's the difference between LEO satellite systems and the type of system used by O3b and SpaceX? What are the pros and cons of these efforts? Conduct some additional research. What is the status of O3b and other satellite broadband efforts?
12. What advantages could broadband offer to underserved areas of the world? Is Internet access important for economic development? Why or why not?
13. Does your carrier offer a femtocell? Would you use one? Why or why not?
14. Be prepared to debate the issue of Net neutrality in class. Prepare positions both supporting and opposing Net neutrality. Which do you support and why?
15. Investigate the current status of Net neutrality regulations in your state and nation and report your findings to your instructor. Do you agree with the stance currently taken by your government? Why or why not?

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Endnotes

1. generic Top Level Domains refer to the right-side of an Internet domain address. Historic gTLDs include .com, .info, and .net. The term gTLD is often used for all TLDs that are not restricted by country or geography, including the subclass known as sTLDs (specialty Top Level Domains) that are are also restricted to a given category of registrants (e.g., .edu for educational institutions, .aero for aerospace firms).
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CHAPTER 17

Information Security: Barbarians at the Gateway (and Just About Everywhere Else)

17.1 Introduction

Learning Objectives

1. Recognize that information security breaches are on the rise.
2. Understand the potentially damaging impact of security breaches.
3. Recognize that information security must be made a top organizational priority.

"There are two kinds of companies: those who have been breached and those who don't know they've been breached"—former Cisco CEO John Chambers

Let's set the stage for our discussion of security issues, vulnerabilities, and organizational failure by examining two of the best known and most widely impactful breaches in US business history—the hack at Equifax, and the hack at Target.

Got a Bank Account or Credit Card? You've Been Hacked!

You've been hacked; or rather, an organization that has your personal data has almost certainly been hacked. One of the largest breaches ever occurred in Summer 2017 against Equifax, one of three leading firms whose business it is to monitor the creditworthiness of adults in the US and abroad. Hackers exploiting a known vulnerability grabbed data on 143 million consumers. Pretty much everyone in the US with a bank account or credit card was compromised. The stolen information included addresses, Social Security numbers, tax IDs, driver's license numbers, hundreds of

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thousands of credit card numbers, and more. The hack impacted those beyond US borders, with some 400,000 hit in the UK, and over 100,000 Canadians.[1] The exploit targeted a vulnerability in the widely used open source Apache Struts product. Equifax had two months to patch the vulnerability, but the firm failed at basic maintenance, leaving the door open for an easily preventable intrusion.

There was clearly something wrong with procedures and follow-through at Equifax. Even the site that Equifax set up to answer consumer questions and offer free credit monitoring was riddled with vulnerabilities.[2] Executive negligence looks even shadier considering leaders sold roughly $2 million in stock before the hack was publicly exposed.[3] The CEO promptly "retired" but was still dragged before a Congress demanding answers. The *Wall Street Journal* estimates the eventual total cost of the breach, already the most expensive in corporate history, will run into the billions.[4] Those wishing to learn more and who have a tolerance for not-suitable-for-work humor might don headphones and explore the informative, albeit curse-laden, summary of the Equifax breach and its aftermath by John Oliver on *Last Week Tonight*.

A Look at the Target Hack

After being victimized in one of the worst consumer-targeted hacking incidents in US history, the Target logo was plastered across media reports, depicted as a bull's-eye that lured cyber criminals. In the days prior to Thanksgiving 2013, a perfect time to take advantage of what would soon be a peak retail shopping season, hackers managed to install malware in Target's security and payments system. This code was designed to steal every credit card used in the company's 1,797 US stores. The bad guys' data-snarfing malware went operational on November 27. The hack shouldn't have been as damaging as it eventually became. Target had previously paid roughly $1.6 million for software from the security firm FireEye to detect breaches in real time, and the software worked. A FireEye notification went off shortly after unauthorized software began collecting data inside Target's network, but Target ignored the warning. Another alert went up within the week and Target's team ignored that warning as well. At this point, the malware hadn't begun transmitting the captured data out of Target's network, so had Target heeded the warnings, the firm could have prevented the data theft. Even worse, the firm's security software has an option to automatically delete malware as it's detected, but Target's security team had turned that function off. As a result, hackers operating out of Odessa and Moscow vacuumed up records on roughly one-third of US consumers for more than two weeks. Target's investigation didn't start until federal law enforcement contacted the firm in mid-December to report suspicious activities on cards used in its stores.[5]

The malware used to breach Target was described by one security expert as "absolutely unsophisticated and uninteresting." The code was likely snuck into Target's system using the security credentials of one of Target's partners, a heating and ventilation firm. While the area where credit card transactions are processed is supposed to be walled off from other areas of the Target network (e.g., the air conditioning guys should never be able to touch systems that read credit cards) hackers, found holes and eventually nestled their code in a sweet spot for grabbing customer data, disguising the code with the label "BladeLogic" the name of a legitimate data center management product.[6]

The damage Target suffered should lead to sleepless nights among managers in any organization that accepts sensitive customer data. Reports say 40 million cards used at Target were stolen and additional personal information on 70 million customers was exposed. The firm's CEO was booted within months. And Target isn't alone in having been caught with their guard down. Neiman Marcus Group, the crafts chain Michael's, and several other merchants were also hacked at about the same time.[7] According to one study, only 5 percent of retailers discover breaches through their own monitoring. Analysts estimate the cost of the Target breach will run into the billions: ninety lawsuits had been filed within ninety days of the attack's public disclosure; on top of that, Target's holiday quarter profits fell 46 percent from the prior year, and the retailer reported

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its biggest ever decline in transactions.[8] The massive impact of the Target breach should make it clear that security must be a top organizational priority. According to Accenture, the average cost of a data breach is up 23 percent in a single year, to $11.7 million.[9] IBM claims the average time to identify a breach in the study was 201 days, and the average time to contain a breach was 70 days.[10] Annual worldwide cybercrime costs a jaw-dropping $600 billion per year.[11] Health insurer Anthem and the US Government Office of Personnel Management are among the organizations that have since suffered high-profile and deeply damaging hacks that have released personal information on tens of millions of people.[12] While the examples and scenarios presented here are shocking, the good news is that the vast majority of security breaches can be prevented. Let's be clear from the start: no text can provide an approach that will guarantee that you'll be 100 percent secure. And that's not the goal of this chapter. The issues raised in this brief introduction can, however, help make you aware of vulnerabilities; improve your critical thinking regarding current and future security issues; and help you consider whether a firm has technologies, training, policies, and procedures in place to assess risks, lessen the likelihood of damage, and respond in the event of a breach. A constant vigilance regarding security needs to be part of your individual skill set and a key component in your organization's culture. An awareness of the threats and approaches discussed in this chapter should help reduce your chance of becoming a victim.

As we examine security issues, we'll first need to understand what's happening, who's doing it, and what their motivation is. We'll then examine how these breaches are happening, with a focus on technologies and procedures. Finally, we'll sum up with what can be done to minimize the risks of being victimized and quell potential damage of a breach for both the individual and the organization.

Key Takeaways

- Information security is everyone's business and needs to be made a top organizational priority.
- Firms suffering a security breach can experience direct financial loss, exposed proprietary information, fines, legal payouts, court costs, damaged reputations, plummeting stock prices, and more.
- Information security isn't just a technology problem; a host of personnel, operational, and procedural factors can create and amplify a firm's vulnerability.

Questions and Exercises

1. The data breaches at Equifax and Target Corporation are among the largest ever in US history. Were you impacted by this breach (or any other)? How did you find out about the breach? Did you take action as a result? Research and report the estimated costs associated with this breach. Has the theft resulted in additional security issues for the individuals who had their data stolen?
2. What factors were responsible for the Target and Equifax breaches? Who should have been responsible for these breaches? How do you think the firms could have prevented the attacks, and what should they do in the future to heighten security and win back customer trust?
3. As individuals or in groups assigned by your instructor, search online for recent reports on information security breaches. Come to class prepared to discuss a breach you've researched, its potential impact, and how it might have been avoided. What should the key takeaways be for managers studying your example?
4. Think of firms that you've done business with online. Search to see if these firms have experienced security breaches in the past. What have you found out? Does this change your attitude about dealing with the firm? Why or why not?

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17.2 Why Is This Happening? Who Is Doing It? And What's Their Motivation?

Learning Objectives

1. Understand the source and motivation of those initiating information security attacks.
2. Relate examples of various infiltrations in a way that helps raise organizational awareness of threats.

Thieves, vandals, and other bad guys have always existed, but the environment has changed. Today, nearly every organization is online, making any Internet-connected network a potential entry point for the growing worldwide community of computer criminals, state-sponsored infiltrators, corporate spies, and other malfeasants. Software and hardware solutions are also more complex than ever. Different vendors, each with its own potential weaknesses, provide technology components that may be compromised by misuse, misconfiguration, or mismanagement. With the rise of "big data," corporations have become data pack rats, hoarding information in hopes of turning bits into bucks by licensing databases, targeting advertisements, or cross-selling products. And flatter organizations also mean that lower-level employees may be able to use technology to reach deep into corporate assets—amplifying threats from operator error, a renegade employee, or one compromised by external forces.

There are a lot of bad guys out there, and motivations vary widely, including the following:

- Account theft and illegal funds transfer
- Stealing personal or financial data
- Compromising computing assets for use in other crimes
- Extortion
- Intellectual property theft
- Espionage
- Cyberwarfare
- Terrorism
- Pranksters
- Protest hacking (hacktivism)
- Revenge (disgruntled employees)

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British insurance company Lloyd's estimates that cybercrime and cyber espionage will cost the US economy $2 trillion by 2019.[13] Nearly all of this is done "without drawing a gun or passing a note to a teller."[14] While some steal cash for their own use, others resell their hacking take to others. There is a thriving cybercrime underworld market in which **data harvesters** sell to **cash-out fraudsters**: criminals who might purchase data from the harvesters in order to buy (then resell) goods using stolen credit cards or create false accounts via identity theft. These collection and resale operations are efficient and sophisticated. Law enforcement has taken down sites like DarkMarket and ShadowCrew, in which card thieves and hacking tool peddlers received eBay-style seller ratings vouching for the "quality" of their wares.[15]

Hackers might also infiltrate computer systems to enlist hardware for subsequent illegal acts. A cybercrook might deliberately hop through several systems to make his path difficult to follow, slowing cross-border legal pursuit or even thwarting prosecution if launched from nations without extradition agreements.

In fact, your computer may be up for rent by cyber thieves right now. **Botnets** (or zombie networks) of zombie computers (networks of infiltrated and compromised machines controlled by a central command) are used for all sorts of nefarious activity. This includes sending spam from thousands of difficult-to-shut-down accounts, launching tough-to-track click fraud efforts or staging what's known as **distributed denial of service (DDoS)** attacks (effectively shutting down websites by overwhelming them with a crushing load of seemingly legitimate requests sent simultaneously by thousands of machines). Botnets have been discovered that are capable of sending out 100 billion spam messages a day,[16] and botnets as large as 10 million zombies have been identified. Such systems theoretically control more computing power than the world's fastest supercomputers.[17]

Extortionists might leverage botnets or hacked data to demand payment to avoid retribution. Three eastern European gangsters used a botnet and threatened DDoS to extort $4 million from UK sports bookmakers,[18] while an extortion plot against the state of Virginia threatened to reveal names, Social Security numbers, and prescription information stolen from a medical records database.[19] Competition has also lowered the price to inflict such pain. *BusinessWeek* reports that the cost of renting out ten thousand machines, which at the time was enough to cripple a site like Twitter, had tumbled to just $200 a day.[20]

Ransomware allow, criminals to move beyond extortion to take data assets hostage. Ransomware will lock and encrypt infected computers, rendering them unusable and irrecoverable unless instructions are followed—often involving payment in untraceable bitcoin. IBM pins total losses at more than $8 billion.[21]

In Spring 2018, the city of Atlanta fell victim to a well-known, but crippling ransomware exploit known as SamSam. The attack disrupted five government departments, hobbling the city's court system, blocking the payment of residential water bills, making it impossible for the city to collect parking fines, and causing the police department to shift to inefficient paper instead of electronic reports.[22] SamSam attacks on governments, hospitals, and non-profits have extorted roughly $850,000 in bitcoin payments from victims.[23]

Corporate espionage might be performed by insiders, rivals, or even foreign governments. Gary Min, a scientist working for DuPont, was busted when he tried to sell information valued at some $400 million, including R&D documents and secret data on proprietary products.[24] Spies also breached the $300 billion US Joint Strike Fighter project, siphoning off terabytes of data on navigation and other electronics systems.[25] Hackers infiltrated security firm RSA, stealing data keys used in the firm's commercial authentication devices. The hackers then apparently leveraged the heist to enter the systems of RSA customers, US Defense contractors L3, Lockheed Martin, and Northrop Grumman.[26] Google has identified China as the nation of origin for a series of hacks

data harvesters

Cybercriminals who infiltrate systems and collect data for illegal resale.

cash-out fraudsters

Criminals who purchase assets from data harvesters to be used for illegal financial gain. Actions may include using stolen credit card numbers to purchase goods, creating fake accounts via identity fraud, and more.

botnets

Hordes of surreptitiously infiltrated computers, linked and controlled remotely, also known as zombie networks.

distributed denial of service (DDoS)

An attack where a firm's computer systems are flooded with thousands of seemingly legitimate requests, the sheer volume of which will slow or shut down the site's use. DDoS attacks are often performed via botnets.

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targeting the Google accounts of diplomats and activists.[27] The US government has indicted Chinese military officials, even printing up "Most Wanted" posters, claiming those named were behind terabytes of theft from organizations including Alcoa, US Steel, the US Steelworkers Union, electricity and nuclear energy firm Westinghouse, Allegheny Technologies Inc., and SolarWorld.[28] US federal authorities blamed the embarrassing hacking and exposure of internal documents and e-mail from Sony Entertainment on operatives for the government of North Korea, angry about the release of the Kim Jong-un–ridiculing comedy *The Interview,* while researchers suggested the Sony hack was actually perpetrated by insiders.[29] And the government of Tunisia even attempted a whole-scale hacking of local users' Facebook accounts during protests that eventually led to the ouster of the regime. The so-called man-in-the-middle style attack intercepted Facebook traffic at the state-affiliated ISP as it traveled between Tunisian Web surfers and Facebook's servers, enabling the government to steal passwords and delete posts and photos that criticized the regime (Facebook has since made these efforts more difficult to perpetrate).[30]

FIGURE 17.1 Chinese Military Officials Charged with Cyber Espionage Against the US

FBI posted images of indicted Chinese military officials charged with cyber espionage against the United States.



Source: FBI.gov website, accessed May 26, 2013, http://www.fbi.gov/news/news_blog/five-chinese-military-hackers-charged-with-cyber-espionage-against-u.s.

Cyberwarfare has also become a legitimate threat, with several attacks demonstrating how devastating technology disruptions by terrorists or a foreign power might be (see sidebar on Stuxnet). Brazil has seen hacks that cut off power to millions; attacks in Spring 2018 cut off communications of at least seven US pipeline firms;[31] and the *60 Minutes* news program showed a demonstration by "white hat" hackers that could compromise a key component in an oil refinery, force it to overheat, and cause an explosion. Taking out key components of the vulnerable US power grid may be particularly devastating, as the equipment is expensive, much of it is no longer made in the United States, and some components may take three to four months to replace.[32]

Stuxnet: A New Era of Cyberwarfare

Stuxnet may be the most notorious known act of cyberwarfare effort to date (one expert called it "the most sophisticated worm ever created").[33] Suspected to have been launched by either US or Israeli intelligence (or both), Stuxnet infiltrated Iranian nuclear facilities and reprogrammed the industrial control software operating hundreds of uranium-enriching centrifuges. The worm made the devices spin so fast that the centrifuges effectively destroyed themselves, in the process setting back any Iranian nuclear ambitions. The attack was so sophisticated that it even altered equipment readings to report normal activity so that operators didn't even know something was wrong until it was too late.

Some might fear Stuxnet in the wild—what happens if the code spread to systems operated by peaceful nations or systems controlling critical infrastructure that could threaten lives if infected? In Stuxnet's case the worm appears to have been designed to target very specific systems. If it got onto a nontarget machine, it would become inert. Propagation was also limited, with each copy designed to infect only three additional machines. And the virus was also designed to self-destruct at a future date.[34] Despite these precautions, other malicious code that appears to have a common heritage with Stuxnet has been spotted on systems outside of Iran.[35] Spy code has been leaked to the public. This includes the 2017 release by the hacker group Shadow Brokers of a suite of tools believed developed by the US National Security Agency. Related documents in Wikileaks claim one of the tools in this suite allowed the CIA to spy on users using Samsung TVs that were set in a "fake off" mode.[36]

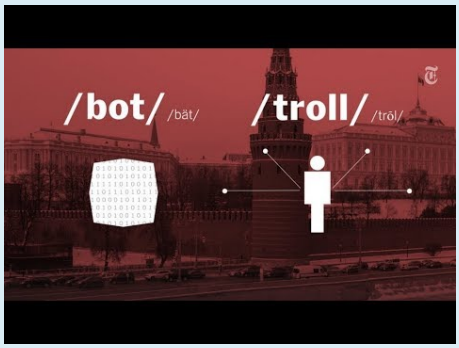
Stuxnet showed that with computers at the heart of so many systems, it's now possible to destroy critical infrastructure without firing a shot.[37] What does the rise of cyberwarfare mean for future combat and for citizen vulnerability, and what might this mean for businesses whose products, services, or organizations may become targets?

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How Bots and Trolls Targeted US Elections

This video explains how bots and trolls targeted US elections.



View the video online at: http://www.youtube.com/embed/sZmrlkRDMsU?rel=0

Espionage efforts have also expanded beyond threats against infrastructure and into attempts to influence democracy and create political chaos. A 2018 indictment filed by the US Special Counsel alleged a Russian government-linked conspiracy aimed at "*impairing, obstructing and defeating the lawful governmental functions of the United States.*" The indictment claims a multi-year effort backed by tens of millions of dollars aimed at influencing American opinion.[38] Alleged efforts were specifically designed to benefit campaigns of Bernie Sanders and underdog-turned-president Donald Trump. Russian-linked efforts allegedly included an army of false-fact-spewing fake social media personas, as well as social media groups posing as initiatives led by US citizen activists. It is believed some of these groups accrued over 100,000 followers. Similar attempts to influence European democracies were also alleged.[39] The US news program *60 Minutes* further alleges a Russian-conducted "sweeping assault" on American voting systems. While systems had been penetrated, at the time of writing there was no evidence that voting records or votes were altered (in fact, the largely aging voting systems themselves are not connected to the Internet). However, agencies worldwide have alleged the goal was not direct altering of data, but rather psychological influence fanning the flames of division and casting doubt on the integrity of leading democracies.[40]

Other threats come from malicious pranksters (sometimes called *griefers* or *trolls*), like the group that posted seizure-inducing images on websites frequented by epilepsy sufferers.[41] Others are **hacktivists**, targeting firms, websites, or even users as a protest measure. Twitter was once brought down and Facebook and LiveJournal were hobbled as Russian-sympathizing hacktivists targeted the social networking and blog accounts of the Georgian blogger known as Cyxymu. The silencing of millions of accounts was simply collateral damage in a massive DDoS attack meant to mute this single critic of the Russian government.[42]

hacktivists

A protester seeking to make a political point by leveraging technology tools, often through system infiltration, defacement, or damage.

And as power and responsibility are concentrated in the hands of a few, revenge-seeking employees can do great damage. The San Francisco city government lost control of a large portion of its own computer network over a ten-day period when a single disgruntled employee refused to divulge critical passwords.[43]

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Is Your Government Spying on You?

While sinister and invasive government espionage tools have long been a plot vehicle in Hollywood films, the extent of government surveillance came under scrutiny when a former CIA employee and NSA contractor, Edward Snowden, gathered over 1.7 million digital documents from US, British, and Australian agencies and began leaking them to the press.

FIGURE 17.2 Edward Snowden



Source: Laura Poitras / Praxis Films [CC BY 3.0 (https://creativecommons.org/licenses/by/3.0)], via Wikimedia Commons.

The Snowden disclosures revealed that several US government agencies, including the NSA and FBI, had data-monitoring efforts far more pervasive than many realized. These included mechanisms for the "direct access to audio, video, photographs, e-mails, documents and connection logs" at nine major US Internet companies, including Google, Facebook, Yahoo!, Microsoft, and Apple,[44] and *unlimited* access to phone records from Verizon's US customers.[45] Another tool, XKeyscore, has been described as allowing the collection of data on "nearly everything a user does on the Internet" and enabling "analysts to search with no prior authorization through vast databases containing emails, online chats and the browsing histories of millions of individuals."[46] A program tapping undersea cables has allowed US and British intelligence authorities to sift through some 21 million GB of data each day.[47] The British intelligence agency GCHQ, using a system code-named "Optic Nerve," allegedly collected Web cam images "from millions of Yahoo users, regardless of whether they were suspected of illegal activity," and up to 11 percent of secretly collected images were thought to have been sexually explicit.[48] Snowden also revealed monitoring programs targeting US allies, including one that eavesdropped on the private phone conversations of German Chancellor Angela Merkel.[49]

Whether Snowden was a whistle-blower or traitor is hotly debated. After the revelations, Snowden fled to Russia via Hong Kong (where he had previously been living during the document disclosure), and the Putin government has granted him temporary asylum. The US government has charged Snowden with espionage and revoked his passport, but during this time, Snowden has spoken via remote link at the South by Southwest Conference, appeared via video conference at a TED event, and has been elected rector of the University of Glasgow. Regardless of whether you feel that Edward Snowden is a hero, a villain, or something in between, the Snowden case underscores the sensitivity of data collection and the peril that governments and organizations face when technology without adequate safeguards is used along the frontier where privacy and national security meet.

The US government contends that hundreds of terrorists have been captured using techniques revealed by Snowden, implying that this surveillance makes the world more secure.[50] The US government claims that safeguards are in place to prevent widespread abuse. For example, under US law, the NSA is required to obtain a warrant from the Foreign Intelligence Surveillance Court (or FISA) when specifically targeting surveillance in the United States.[51] However, no such

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warrants are required for intercepting communication between US-based persons and "foreign targets,"[52] and FISA has rejected only eleven of the more than 33,900 requests (less than 0.03 percent) made in over three decades since the act was established.[53] Even if such surveillance programs are well intentioned, risks include having the data fall into the hands of foreign spies, rogue employees, criminals, or unscrupulous government employees. US technology firms have also complained that the actions of surveillance agencies have put them at a disadvantage, with customers looking for alternatives free of the tarnished perception of having (complicitly or unwittingly) provided private information to authorities.[54] European firms, in particular, have noticed an uptick in business, and one estimate pins projected collective losses to US firms at $35 billion through 2016.[55]

The bad guys are legion, and the good guys often seem outmatched and underresourced. Law enforcement agencies dealing with computer crime are increasingly outnumbered, outskilled, and underfunded. Many agencies are staffed with technically weak personnel who were trained in a prior era's crime-fighting techniques. Governments can rarely match the pay scale and stock bonuses offered by private industry. Organized crime networks now have their own R&D labs and are engaged in sophisticated development efforts to piece together methods to thwart current security measures.

"Hacker": Good or Bad?

The terms **hacker** and **hack** are widely used, but their meaning is often based on context. When referring to security issues, the media often refers to hackers as bad guys who try to break into (hack) computer systems. Some geezer geeks object to this use, as the term *hack* in computer circles originally referred to a clever (often technical) solution and the term *hacker* referred to a particularly skilled programmer. Expect to see the terms used both positively and negatively.

You might also encounter the terms **white hat hackers** and **black hat hackers**. The white hats are the good guys who probe for weaknesses, but don't exploit them. Instead, they share their knowledge in hopes that the holes they've found will be plugged and security will be improved. Many firms hire consultants to conduct "white hat" hacking expeditions on their own assets as part of their auditing and security process. "Black hats" are the bad guys. Some call them "crackers." There's even a well-known series of hacker conventions known as the Black Hat conference.

hacker

A term that, depending on the context, may be applied to either 1) someone who breaks into computer systems, or 2) to a particularly clever programmer.

hack

A term that may, depending on the context, refer to either 1) breaking into a computer system, or 2) a particularly clever solution.

white hat hackers

Someone who uncovers computer weaknesses without exploiting them. The goal of the white hat hacker is to improve system security.

black hat hackers

A computer criminal.

Key Takeaways

- Computer security threats have moved beyond the curious teen with a PC and are now sourced from a number of motivations, including theft, leveraging compromised computing assets, extortion, espionage, warfare, terrorism, national security, pranks, protest, and revenge.
- Threats can come from both within the firm as well as from the outside.
- Cybercriminals operate in an increasingly sophisticated ecosystem where data harvesters and tool peddlers leverage robust online markets to sell to cash-out fraudsters and other crooks.
- Technical and legal complexity make pursuit and prosecution difficult.
- Government surveillance efforts can put citizens and corporations at risk if poorly executed and ineffectively managed.
- Many law enforcement agencies are underfunded, underresourced, and underskilled to deal with the growing hacker threat.

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Questions and Exercises

1. What is a botnet? What sorts of exploits would use a botnet? Why would a botnet be useful to cybercriminals?
2. Why are threats to the power grid potentially so concerning? What are the implications of power grid failure and of property damage? Who might execute these kinds of attacks? What are the implications for firms and governments planning for the possibility of cyberwarfare and cyberterror?
3. Scan the trade press for examples of hacking that apply to the various motivations mentioned in this chapter. What happened to the hacker? Were they caught? What penalties do they face?
4. Why do cybercriminals execute attacks across national borders? What are the implications for pursuit, prosecution, and law enforcement?
5. Why do law enforcement agencies struggle to cope with computer crime?
6. A single rogue employee effectively held the city of San Francisco's network hostage for ten days. What processes or controls might the city have created that could have prevented this kind of situation from taking place?
7. Research recent revelations on the extent of government data surveillance. What concerns do government surveillance raise for the computer security of individuals and corporations? Do you believe that there are adequate safeguards to prevent abuse? As a citizen and manager, what changes (if any) would you lobby for and why?
8. The Geneva Conventions are a set of international treaties that in part set standards for protecting citizens in and around a war zone. Should we have similar rules that set the limits of cyberwarfare? Would such limits even be effective? Why or why not?
9. What does the rise of cyberwarfare suggest for businesses and organizations? What sorts of contingencies should firms consider and possibly prepare for? How might considerations also impact a firm's partners, customers, and suppliers?

17.3 Where Are Vulnerabilities? Understanding the Weaknesses

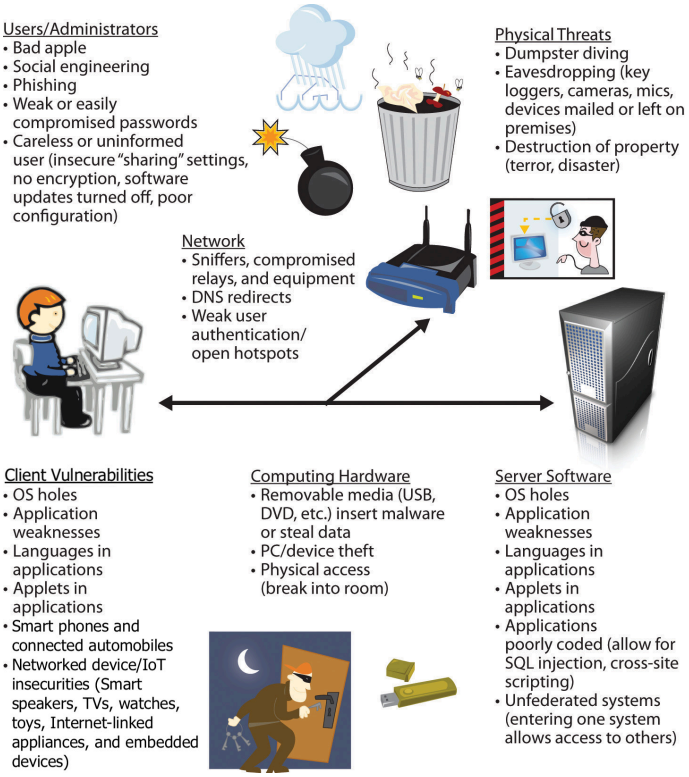
Learning Objectives

1. Recognize the potential entry points for security compromise.
2. Understand infiltration techniques such as social engineering, phishing, malware, website compromises (such as SQL injection), and more.
3. Identify various methods and techniques to thwart infiltration.

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FIGURE 17.3 Potential Information System Security Weaknesses
This diagram shows only some of the potential weaknesses that can compromise the security of an organization's information systems. Every physical or network "touch point" is a potential vulnerability. Understanding where weaknesses may exist is a vital step toward improved security.



Modern information systems have lots of interrelated components, and if one of these components fails, there might be a way in to the goodies. This creates a large attack surface for potential infiltration and compromise, as well as one that is simply vulnerable to unintentional damage and disruption.

User and Administrator Threats

Bad Apples

While some of the more sensational exploits involve criminal gangs, research firm Gartner estimates that 70 percent of loss-causing security incidents involve insiders.[56] Rogue employees can steal secrets, install malware, or hold a firm hostage. A rogue Bank of America employee nabbed names, Social Security numbers, and bank account data—a criminal gold mine—and cost the firm at least $10 million.[57]

And it's not just firm employees. Many firms hire temporary staffers or contract employees, or outsource key components of their infrastructure (Edward Snowden was an NSA contractor). Other firms have been compromised by members of their cleaning or security staff. A contract employee working at Sentry Insurance stole information on 110,000 of the firm's clients.[58] Verizon claims that 85 percent of "insider" data theft cases were carried out "while in the office and right under the noses of their co-workers."[59]

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Social Engineering

As P. T. Barnum is reported to have said, "There's a sucker born every minute." Con games that trick employees into revealing information or performing other tasks that compromise a firm are known as *social engineering* in security circles. In some ways, crooks have never had easier access to background information that might be used to craft a scam. It's likely that a directory of a firm's employees, their titles, and other personal details is online right now via social networks like LinkedIn and Facebook. With just a few moments of searching, a skilled con artist can piece together a convincing and compelling story.

A Sampling of Methods Employed in Social Engineering

- Impersonating senior management, a current or new end user needing help with access to systems, investigators, or staff (fake uniforms, badges)
- Identifying a key individual by name or title as a supposed friend or acquaintance
- Making claims with confidence and authority ("Of course I belong at this White House dinner.")
- Baiting someone to add, deny, or clarify information that can help an attacker
- Using harassment, guilt, or intimidation
- Using an attractive individual to charm others into gaining information, favors, or access
- Setting off a series of false alarms that cause the victim to disable alarm systems
- Answering bogus surveys (e.g., "Win a free trip to Hawaii—just answer three questions about your network.")

Data aggregator ChoicePoint sold private information to criminals who posed as legitimate clients, compromising the names, addresses, and Social Security numbers of some 145,000 individuals. In this breach, not a single computer was compromised. Employees were simply duped into turning data over to crooks. Gaffes like that can be painful. ChoicePoint paid $15 million in a settlement with the Federal Trade Commission, suffered customer loss, and ended up abandoning once lucrative businesses.[60]

Phishing

phishing
A con executed using technology, typically targeted at acquiring sensitive information or tricking someone into installing malicious software.

Phishing refers to cons executed through technology. The goal of phishing is to leverage the reputation of a trusted firm or friend to trick the victim into performing an action or revealing information. The cons are crafty. Many have masqueraded as a security alert from a bank or e-commerce site ("Our website has been compromised, click to log in and reset your password."), a message from an employer, or even a notice from the government ("Click here to update needed information to receive your tax refund transfer."). Sophisticated con artists will lift logos, mimic standard layouts, and copy official language from legitimate websites or prior e-mails. Gartner estimates that these sorts phishing attacks cost consumers upward of $3.2 billion a year.[61]

Other phishing attempts might dupe a user into unwittingly downloading dangerous software (malware) that can do things like record passwords and keystrokes, copy vital data from your RAM or hard drive, provide hackers with deeper access to your corporate network, or enlist your PC as part of a botnet. One attempt masqueraded as a message from a Facebook friend, inviting the recipient to view a video. Victims clicking the link were then told they need to install an updated version of the Adobe Flash plug-in to view the clip. The plug-in was really a malware program that gave phishers control of the infected user's computer.[62] Other attempts have populated P2P networks (peer-to-peer file distribution systems such as BitTorrent) with malware-installing files masquerading as video games or other software, movies, songs, and pornography.

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So-called spear phishing attacks specifically target a given organization or group of users. In one incident, employees of a medical center received e-mails purportedly from the center itself, indicating that the recipient was being laid off and offering a link to job counseling resources. The link really offered a software payload that recorded and forwarded any keystrokes on the victim's PC.[63] And with this type of phishing, the more you know about a user, the more convincing it is to con them. Phishers using pilfered résumé information from Monster.com crafted targeted and personalized e-mails. The request, seemingly from the job site, advised users to download the "Monster Job Seeker Tool"; this "tool" installed malware that encrypted files on the victim's PC, leaving a ransom note demanding payment to liberate a victim's hard disk.[64]

Don't Take the Bait: Recognizing the "Phish Hooks"

Web browser developers, e-mail providers, search engines, and other firms are actively working to curtail phishing attempts. Many firms create blacklists that block access to harmful websites and increasingly robust tools screen for common phishing tactics. But it's still important to have your guard up. Some exploits may be so new that they haven't made it into screening systems (so-called zero-day exploits).

Never click on a link or download a suspicious, unexpected enclosure without verifying the authenticity of the sender. If something looks suspicious, don't implicitly trust the "from" link in an e-mail. It's possible that the e-mail address has been **spoofed** (faked) or that it was sent via a colleague's compromised account. If unsure, contact the sender or your security staff.

Also know how to read the complete URL to look for tricks. Some firms misspell Web address names (http://wwwyourbank.com—note the missing period), set up subdomains to trick the eye (http://yourbank.com.sneakysite.com—which is hosted at sneakysite.com even though a quick glance looks like yourbank.com), or hijack brands by registering a legitimate firm's name via foreign top-level domains (http://yourbank.cn).

A legitimate URL might also appear in a phishing message, but an HTML coding trick might make something that looks like http://yourbank.com/login actually link to http://sneakysite.com. Hovering your cursor over the URL or an image connected to a link should reveal the actual URL as a tool tip (just don't click it, or you'll go to that site).

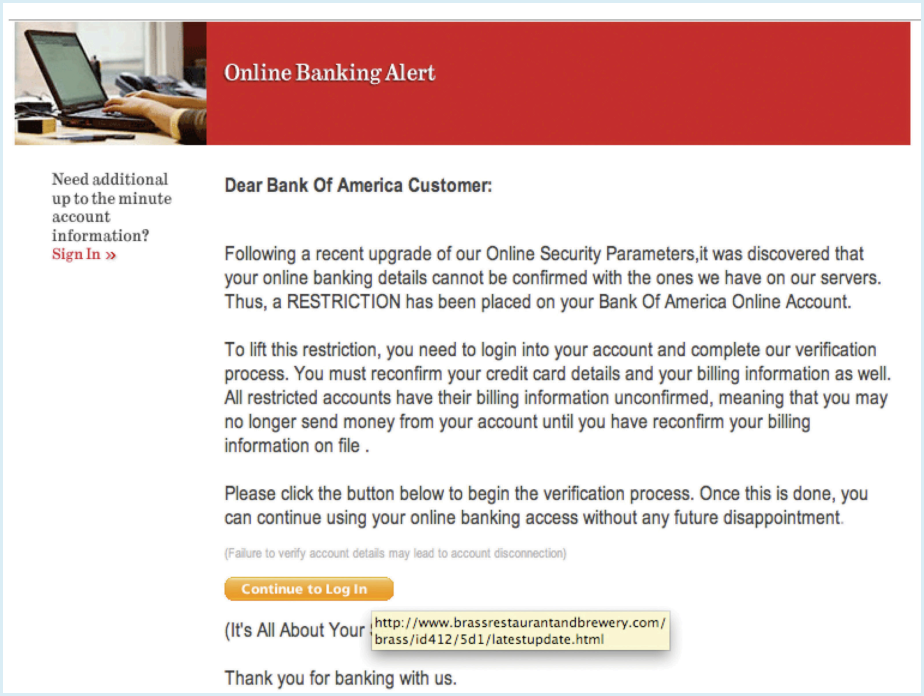
spoofed

Term used in security to refer to forging or disguising the origin or identity. E-mail transmissions and packets that have been altered to seem as if they came from another source are referred to as being "spoofed."

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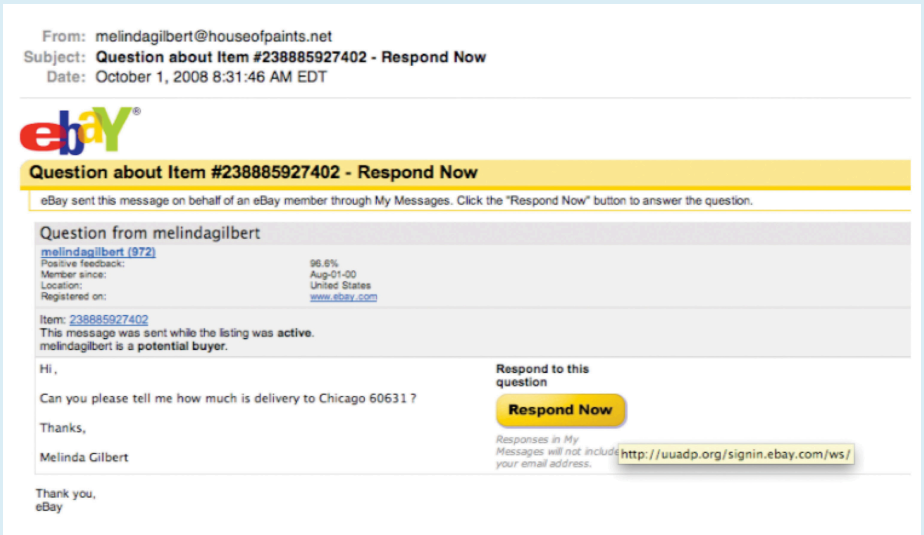
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FIGURE 17.4 Example of a Phishing E-mail
This e-mail message looks like it's from Bank of America. However, hovering the cursor above the "Continue to Log In" button reveals the URL without clicking through to the site. Note how the actual URL associated with the link is not associated with Bank of America.



Source: John Gallaugher.

FIGURE 17.5 Example of a Phishing E-mail
This image is from a phishing scheme masquerading as an eBay message. The real destination is a compromised .org domain unassociated with eBay, but the phishers have created a directory at this domain named "signin.ebay.com" in hopes that users will focus on that part of the URL and not recognize they're really headed to a non-eBay site.



Source: John Gallaugher.

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Social Media: A Rising Security Threat

Social media tools are a potential gold mine for crooks seeking to pull off phishing scams. Malware can send messages that seem to come from trusted "friends." Messages such as status updates and tweets are short, and with limited background information, there are fewer contexts to question a post's validity. Many users leverage bit.ly or other URL-shortening services that don't reveal the website they link to in their URL, making it easier to hide a malicious link. While the most popular URL-shortening services maintain a blacklist, early victims are threatened by **zero-day exploits**. Criminals have also been using a variety of techniques to spread malware across sites or otherwise make them difficult to track and catch.

zero-day exploits
Attacks that are so new that they haven't been clearly identified, and so they haven't made it into security screening systems.

The technical openness of many social media efforts can also create problems if schemes aren't implemented properly. For example, Mark Zuckerberg's Facebook page fell victim to hackers who used a hole in a Facebook API that allowed unauthorized status update posts to public Facebook fan pages.[65] APIs can allow firms to share services, collaborate, and enable mash-ups, but if code is poorly implemented it can also be an open back door where the bad guys can sneak in.

FIGURE 17.6 Example of Social Media as a Security Threat
A member of the House Intelligence Committee uses Twitter and reveals his locale on a secret trip.



Source: Twitter.

Some botnets have even used Twitter to communicate by sending out coded tweets to instruct compromised machines.[66] Social media can also be a megaphone for loose lips, enabling a careless user to broadcast proprietary information to the public domain. For example, a congressional delegation to Iraq was supposed to have been secret. But Rep. Peter Hoekstra tweeted his final arrival into Baghdad for all to see, apparently unable to contain his excitement at receiving BlackBerry service in Iraq. Hoekstra tweeted, "Just landed in Baghdad. I believe it may be first time I've had bb service in Iraq. 11th trip here." You'd think he would have known better. At the time, Hoekstra was a ranking member of the House Intelligence Committee!

Passwords

Many valuable assets are kept secure via just one thin layer of protection—the password. And if you're like most users, your password system is a mess.[67] With so many destinations asking for passwords, chances are you're using the same password (or easily guessed variants) in a way that means getting just one "key" would open many "doors." The typical Web user has 6.5 passwords, each of which is used at four sites, on average.[68] Some sites force users to change passwords regularly, but this often results in insecure compromises. Users make only minor tweaks (e.g., appending the month or year); they write passwords down (in an unlocked drawer or Post-it note attached to the monitor); or they save passwords in personal e-mail accounts or on unencrypted hard drives.

The challenge questions offered by many sites to automate password distribution and reset are often pitifully insecure. What's your mother's maiden name? What elementary school did you attend? Where were you born? All are pretty easy to guess. One IEEE study found acquaintances could correctly answer colleagues' secret questions 28 percent of the time, and those who did not know the person still guessed right at a rate of 17 percent. Plus, within three to six months, 16 percent of study participants forgot answers to *their own* security questions.[69] In many cases, answers to these questions can be easily uncovered online. Chances are, if you've got an account at a site like

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Ancestry.com or Facebook, then some of your secret answers have already been exposed—by you! A Tennessee teen hacked into Sarah Palin's personal Yahoo! account (gov.palin@yahoo.com) in part by correctly guessing where she met her husband. A similar attack hit staffers at Twitter, resulting in the theft of hundreds of internal documents, including strategy memos, e-mails, and financial forecasts, many of which ended up embarrassingly posted online.[70]

Related to the password problem are issues with system setup and configuration. Many vendors sell software with a common default password. For example, for years, leading database products came with the default account and password combination "scott/tiger." Any firm not changing default accounts and passwords risks having an open door. Other firms are left vulnerable if users set systems for open access—say turning on file sharing permission for their PC. Programmers, take note: well-designed products come with secure default settings, require users to reset passwords at setup, and also offer strong warnings when security settings are made weaker. But unfortunately, there are a lot of legacy products out there, and not all vendors have the insight to design for out-of-the-box security.

biometrics

Technologies that measure and analyze human body characteristics for identification or authentication. These might include fingerprint readers, retina scanners, voice and face recognition, and more.

multi-factor authentication

When identity is proven by presenting more than one item for proof of credentials. Multiple factors often include a password and some other identifier such as a unique code sent via e-mail or mobile phone text, a biometric reading (e.g., fingerprint or iris scan), a swipe or tap card, or other form of identification.

voice-print

Technology that identifies users via unique characteristics in speech.

Building a Better Password

There's no simple answer for the password problem. **Biometrics** are often thought of as a solution. While fingerprint readers and facial identification have begun to appear on many mainstream mobile devices, biometrics are not a panacea. Apple and Samsung[71] are among the high-profile firms that have needed to correct flaws in the biometric systems built into their products.

Other approaches leverage technology that distributes single-use passwords. These might arrive via external devices like an electronic wallet card, key chain fob, or cell phone. Enter a username and receive a phone message with a temporary password. Even if a system was compromised by keystroke capture malware, the password is only good for one session. Lost device? A central command can disable it. This may be a good solution for situations that demand a high level of security, and Wells Fargo and PayPal are among the firms offering these types of services as an option. However, for most consumer applications, slowing down users with a two-factor or **multi-factor authentication** system would be an impractical mandate. Also, as with other technologies, some systems have had weaknesses that were penetrated. Hackers have previously figured out how to bypass the two-factor authentication used by Google,[72] and a failure to upgrade one of JP Morgan's servers allowed hackers to make off with contact information on millions of depositors.[73]

We're seeing many of these schemes come together to improve credit card security and electronic payments under systems such as Apple Pay and Android Pay. These schemes encrypt credit cards on a mobile device rather than store them at retailers. A scheme called tokenization sends one-time-use representations of a credit card over the Internet. While these tokens will buy your stuff, if stolen they can't be reused by bad guys. Fingerprint readers, **voice-print**, and facial recognition add biometrics to multi-factor authentication at the point of purchase. Devices themselves also have a unique identifier so transactions can only happen from authorized devices. And banks must provide an additional verification step when cards are initially scanned in (added verification is critical; during Apple Pay's rollout, many banks initially approved cards without added customer verification, allowing Apple Pay to be a convenient avenue for fraud).[74]

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FIGURE 17.7 Apple Pay Improves Security
Efforts such as Apple Pay dramatically improve security for credit card transactions by leveraging multi-factor authentication, single-use tokenization, encryption, and biometrics.



Source: https://www.apple.com/pr/products/apple-pay/apple-pay.html.

While you await technical fixes, you can at least work to be part of the solution rather than part of the problem. It's unlikely you've got the memory or discipline to create separate unique passwords for all of your sites, but at least make it a priority to create separate, hard-to-guess passwords for each of your highest priority accounts (e.g., e-mail, financial websites, corporate network, and PC). Remember, the integrity of a password shared across websites isn't just up to you. That hot startup Web service may not have the security resources or experience to protect your special code, and if that website's account is hacked, your username and password are now in the hands of hackers who can try out those "keys" across the Web's most popular destinations. Software programs such as 1Password or LastPass can help create a secure directory of all your passwords, and it's possible to have these synced across several desktop and mobile devices. Just be sure that if you use this, you never lose your master password, or you've effectively given up the key that holds all of your other keys.

Websites are increasingly demanding more "secure" passwords, requiring users to create passwords at least eight characters in length and that include at least one number and other nonalphabet character. Beware of using seemingly clever techniques to disguise common words. Many commonly available brute-force password cracking tools run through dictionary guesses of common words or phrases, substituting symbols or numbers for common characters (e.g., "@" for "a," "+" for "t"). For stronger security, experts often advise basing passwords on a phrase, where each letter makes up a letter in an acronym. For example, the phrase "My first Cadillac was a real lemon so I bought a Toyota" becomes "M1stCwarlsIbaT."[75] Be careful to choose an original phrase that's known only by you and that's easy for you to remember. Studies have shown that acronym-based passwords using song lyrics, common quotes, or movie lines are still susceptible to dictionary-style hacks that build passwords from pop culture references (in one test, two of 144 participants made password phrases from an acronym of the Oscar Mayer wiener jingle).[76] Finding that balance between something tough for others to guess yet easy for you to remember will require some thought—but it will make you more secure. Do it now!

Technology Threats (Client and Server Software, Hardware, and Networking)

Malware

Any accessible computing device is a potential target for infiltration by malware. *Malware* (for malicious software) seeks to compromise a computing system without permission. Client PCs and a firm's servers are primary targets, but as computing has spread, malware now threatens nearly any

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connected system running software, including mobile phones, embedded devices, ATMs, point-of-sale equipment, and a firm's networking equipment.

Some hackers will try to sneak malware onto a system via techniques like phishing. In another high-profile hacking example, infected USB drives were purposely left lying around government offices. Those seemingly abandoned office supplies really contained code that attempted to infiltrate government PCs when inserted by unwitting employees.

Machines are constantly under attack. Microsoft's Internet Safety Enforcement Team claims that the mean time to infection for an unprotected PC is less than five minutes.[77] Oftentimes malware attempts to compromise weaknesses in software—either bugs, poor design, or poor configuration.

Years ago, most attacks centered on weaknesses in the operating system, but now malware exploits have expanded to other targets, including browsers, plug-ins, and scripting languages used by software. *BusinessWeek* reports that Adobe has replaced Microsoft as the primary means by which hackers try to infect or take control of PCs. Even trusted websites have become a conduit to deliver malware payloads. More than a dozen sites, including those of the *New York Times*, *USA Today*, and *Nature*, were compromised when seemingly honest advertising clients switched on fake ads that exploit Adobe software.[78] Some attacks were delivered through Flash animations that direct computers to sites that scan PCs, installing malware payloads through whatever vulnerabilities are discovered. Others circulated via e-mail through PDF-triggered payloads deployed when a file was loaded via Acrobat Reader. Adobe is a particularly tempting target, as Flash and Acrobat Reader are now installed on nearly every PC, including Mac and Linux machines.

Malware goes by many names. Here are a few of the more common terms you're likely to encounter.[79]

Methods of infection are as follows:

- *Viruses.* Programs that infect other software or files. They require an executable (a running program) to spread, attaching to other executables. Viruses can spread via operating systems, programs, or the boot sector or auto-run feature of media such as DVDs or USB drives. Some applications have executable languages (macros) that can also host viruses that run and spread when a file is open.
- *Worms.* Programs that take advantage of security vulnerability to automatically spread, but unlike viruses, worms do not require an executable. Some worms scan for and install themselves on vulnerable systems with stunning speed (in an extreme example, the SQL Slammer worm infected 90 percent of vulnerable software worldwide within just ten minutes).[80]
- *Trojans.* Exploits that, like the mythical Trojan horse, try to sneak in by masquerading as something they're not. The payload is released when the user is duped into downloading and installing the malware cargo, oftentimes via phishing exploits.

While the terms above cover methods for infection, the terms below address the goal of the malware:

- *Botnets or zombie networks.* Hordes of surreptitiously infected computers linked and controlled remotely by a central command. Botnets are used in crimes where controlling many difficult-to-identify PCs is useful, such as when perpetrating click fraud, sending spam, executing "dictionary" password cracking attempts, or launching denial-of-service attacks. Yahoo! advertisements once inadvertently distributed botnet software that may have enlisted and infected as many as 2 million computers to mine bitcoins (a technique demanding significant collection computing assets to be efficiently used, and that can grant access to new units of the cryptocurrency).[82] Other botnets have been used to try and decipher **CAPTCHAs** (those scrambled character images meant to thwart things like automated account setup or ticket buying).
- *Malicious adware.* Programs installed without full user consent or knowledge that later serve unwanted advertisements.

CAPTCHAs

An acronym for Completely Automated Public Turing Test to Tell Computers and Humans Apart. CAPTCHAs are those scrambled character images that many sites require to submit some sort of entry (account setup, ticket buying) and are meant to be a *Turing Test*—a test to distinguish if a task is being performed by a computer or a human.[81]

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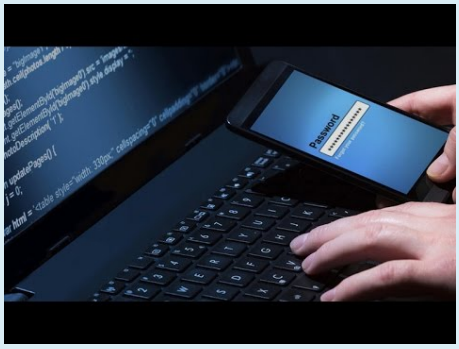
- *Spyware*. Software that surreptitiously monitors user actions or network traffic, or scans for files.
- *Keylogger*. Type of spyware that records user keystrokes. Keyloggers can be either software based or hardware based, such as a recording "dongle" that is plugged in between a keyboard and a PC.
- *Screen capture*. Variant of the keylogger approach. This category of software records the pixels that appear on a user's screen for later playback in hopes of identifying proprietary information.
- *Card skimmer*. A software program that secretly captures data from a swipe card's magnetic strip.
- *RAM scraping or storage scanning software*. Malicious code that scans computing memory (RAM, hard drives, or other storage) for sensitive data, often looking for patterns such as credit card or Social Security numbers.
- *Ransomware*. Malware that encrypts a user's files (perhaps threatening to delete them), with demands that a user pay to regain control of their data and/or device.
- *Blended threats*. Attacks combining multiple malware or hacking exploits.

The Virus in Your Pocket, The Spy in Your Kitchen

Most mobile phones are really pocket computers, so it's not surprising that these devices have become malware targets. And there are a lot of pathways to exploit. Malware might infiltrate a smartphone via e-mail, Internet surfing, MMS attachments, or even Bluetooth. The "commwarrior" mobile virus spread to at least eight countries, propagating from a combination of MMS messages and Bluetooth.[83]

60 Minutes Shows How Easily Your Phone Can Be Hacked

This video shows hackers accessing mobile devices.



View the video online at: http://www.youtube.com/embed/zGUR6kao9ys?rel=0

Most smartphones have layers of security to block the spread of malware, so hackers typically hunt for the weakest victims. Easy marks include "jail-broken" iPhones, devices with warranty-voiding modifications in which security restrictions are overridden to allow phones to be used off network, and for the installation of unsanctioned applications. Estimates suggest some 10 percent of iPhones are jail-broken, and early viruses exploiting the compromised devices ranged from a "Rickroll" that replaced the home screen image with a photo of 1980s crooner Rick Astley,[84] to the more nefarious Ikee.B, which scanned text messages and hunted out banking codes, forwarding the nabbed data to a server in Lithuania.[85] President Trump's use of an older-model Samsung phone that he has used for tweeting has been cited as a vulnerability. This is

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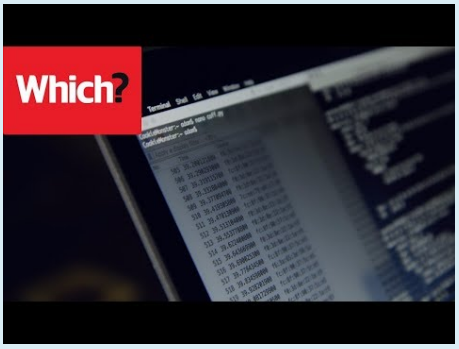
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due, not only to weaknesses of the earlier model, but the challenges in monitoring and filtering access that flows from Twitter to the president's hands, bypassing monitoring tools that could be used on existing networks.[86]

The upside? Those smart devices are sometimes crime fighters themselves. Scores of theft victims have used Apple's "Find My iPhone" service to lead cops directly to thieves' doorsteps.[87]

Could Your Smart Home Be Hacked?

Smart home devices could be vulnerable to hackers: A demonstration of hacks using toys, smart coffee makers, and other devices.



View the video online at: //www.youtube.com/embed/rM_yeh-N3RQ?rel=0

As new devices proliferate, the attack surface is only growing. A Bluetooth vulnerability potentially provided access to hackers in-range to attack any devices without pairing with it. Security professionals now need to consider any device with a microphone—which can include smart speakers, baby monitors, watches, and ear buds—as part of attack vectors. Devices that function as voice assistants are always on, regularly listening, and firms should be concerned about data collection and vulnerability. The kids' toy firm CloudPets leaked some 2.2 voice records of parents and children through a database vulnerability, and data from Amazon's Alexa has been subpoenaed for access in murder investigations. While "bug" listening devices have been a staple of espionage for years, employees dealing with highly sensitive information need to recognize that their house may already have the equivalent of compromised listening devices that they, themselves, have planted, and attendant training on what should not be discussed outside of secure locations is vital.[88]

Compromising Poorly Designed Software

Some exploits directly target poorly designed and programmed websites. Consider the SQL injection technique. It zeros in on a sloppy programming practice where software developers don't validate user input.

It works like this. Imagine that you visit a website and are asked to enter your user ID in a field on a Web page (say your user ID is smith). A website may be programmed to take the data you enter from the Web page's user ID field (smith), then add it to a database command (creating the equivalent of a command that says "find the account for 'smith'"). The database then executes that command.

But websites that don't verify user entries and instead just blindly pass along entered data are vulnerable to attack. Hackers with just a rudimentary knowledge of SQL could type actual code fragments into the user ID field, appending this code to statements executed by the site (see sidebar for a more detailed description). Such modified instructions could instruct the website's database

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software to drop (delete) tables, insert additional data, return all records in a database, or even redirect users to another website that will scan clients for weaknesses, then launch further attacks. Security expert Bruce Schneier noted a particularly ghastly SQL injection vulnerability in the publicly facing database for the Oklahoma Department of Corrections, where "anyone with basic SQL knowledge could have registered anyone he wanted as a sex offender."[89]

Not trusting user input is a cardinal rule of programming, and most well-trained programmers know to validate user input. But there's a lot of sloppy code out there, which hackers are all too eager to exploit. An IBM study claimed that over half a million SQL injection attack attempts are identified each day.[90] The bad guys are clearly probing for weaknesses. Some vulnerable systems started life as quickly developed proofs of concepts, and programmers never went back to add the needed code to validate input and block these exploits. Other websites may have been designed by poorly trained developers who have moved on to other projects, by staff that have since left the firm, or where development was outsourced to another firm. As such, many firms don't even know if they suffer from this vulnerability.

SQL injection and other application weaknesses are particularly problematic because there's not a commercial software patch or easily deployed piece of security software that can protect a firm. Instead, firms have to meticulously examine the integrity of their websites to see if they are vulnerable.[91]

How SQL Injection Works

For those who want to get into some of the geekier details of a SQL injection attack, consider a website that executes the code below to verify that an entered user ID is in a database table of usernames. The code executed by the website might look something like this:

```
"SELECT * FROM users WHERE userName = '" + userID + "';"
```

The statement above tells the database to SELECT (find and return) all columns (that's what the "*" means) from a table named users where the database's userName field equals the text you just entered in the userID field. If the website's visitor entered smith, that text is added to the statement above, and it's executed as:

```
"SELECT * FROM users WHERE userName = 'smith';"
```

No problem. But now imagine a hacker gets sneaky and instead of just typing smith, into the website's userID field, they also add some *additional* SQL code like this:

```
smith'; DROP TABLE users; DELETE * FROM users WHERE 't' = 't
```

If the programming statement above is entered into the user ID, the website adds this code to its own programming to create a statement that is executed as:

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```
SELECT * FROM users WHERE userName = 'smith'; DELETE * FROM users
WHERE 't' = 't';
```

The semicolons separate SQL statements. That second statement says delete all data in the users table for records where 't' = 't' (this last part, 't' = 't,' is always true, so all records will be deleted). Yikes! In this case, someone entering the kind of code you'd learn in the first chapter of *SQL for Dummies* could annihilate a site's entire user ID file using one of the site's own Web pages as the attack vehicle.[92]

Related programming exploits go by names such as cross-site scripting attacks, buffer overflow vulnerabilities, and HTTP header injection. We'll spare you the technical details, but what this means for both the manager and the programmer is that all systems must be designed and tested with security in mind. This includes testing new applications, existing and legacy applications, partner offerings, and SaaS (software as a service) applications—everything. Visa and MasterCard are among the firms requiring partners to rigorously apply testing standards. Firms that aren't testing their applications will find they're locked out of business; if caught with unacceptable breaches, such firms may be forced to pay big fines and absorb any costs associated with their weak practices.[93] You can find several YouTube videos demonstrating this exploit, including this one from Sam Bowne.

Push-Button Hacking

Not only are the list of technical vulnerabilities well known, hackers have created tools to make it easy for the criminally inclined to automate attacks. Chapter 18 outlines how websites can interrogate a system to find out more about the software and hardware used by visitors. Hacking toolkits can do the same thing. While you won't find this sort of software for sale on Amazon, a casual surfing of the online underworld (not recommended or advocated) will surface scores of tools that probe systems for the latest vulnerabilities then launch appropriate attacks. Writing code for criminals is not a recommended career aspiration, however it can be big business. The exploit kit *Angler* was bringing in roughly $100 million in yearly sales.[94] As an industry executive in *BusinessWeek* has stated, "The barrier of entry is becoming so low that literally anyone can carry out these attacks."[95]

Network Threats

The network itself may also be a source of compromise. The retailer TJX (parent of Marshalls, HomeGoods, and T. J. Maxx stores) was hacked when a Wi-Fi access point was left open and undetected. A hacker just drove up and performed the digital equivalent of crawling through an open window. The crooks stole at least 45.7 million credit and debit card numbers and pilfered driver's licenses and other private information from an additional 450,000 customers,[96] a breach that eventually inflicted over $1.35 billion in damages on the retailer.[97] Problems like this are made more challenging since wireless access points are so inexpensive and easy to install. For less than $100, a user (well intentioned or not) could plug in to an access point that could provide entry for anyone. If a firm doesn't regularly monitor its premises, its network, and its network traffic, it may fall victim.

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Other troubling exploits have targeted the very underpinning of the Internet itself. This is the case with so-called DNS cache poisoning. The DNS, or domain name service, is a collection of software that maps an Internet address, such as (http://www.bc.edu), to an IP address, such as 136.167.2.220 (see Chapter 16 for more detail). DNS cache poisoning exploits can redirect this mapping and the consequences are huge. Imagine thinking that you're visiting your bank's website, but instead your network's DNS server has been poisoned so that you really visit a carefully crafted replica that hackers use to steal your log-in credentials and drain your bank account. A DNS cache poisoning attack launched against one of China's largest ISPs redirected users to sites that launched malware exploits, targeting weaknesses in RealPlayer, Adobe Flash, and Microsoft's ActiveX technology, commonly used in browsers.[98]

Physical Threats

A firm doesn't just have to watch out for insiders or compromised software and hardware; a host of other physical threats can grease the skids to fraud, theft, and damage. Most large firms have disaster-recovery plans in place. These often include provisions to back up systems and data to off-site locales, to protect operations and provide a fallback in the case of disaster. Such plans increasingly take into account the potential impact of physical security threats such as terrorism or vandalism, as well.

Anything valuable that reaches the trash in a recoverable state is also a potential security breach. Hackers and spies sometimes practice **dumpster diving**, sifting through trash in an effort to uncover valuable data or insights that can be stolen or used to launch a security attack. This might include hunting for discarded passwords written on Post-it notes, recovering unshredded printed user account listings, scanning e-mails or program printouts for system clues, recovering tape backups, resurrecting files from discarded hard drives, and more.

dumpster diving
Combing through trash to identify valuable assets.

Other compromises might take place via **shoulder surfing**, simply looking over someone's shoulder to glean a password or see other proprietary information that might be displayed on a worker's screen.

shoulder surfing
Gaining compromising information through observation (as in looking over someone's shoulder).

Firms might also fall victim to various forms of eavesdropping, such as efforts to listen into or record conversations, transmissions, or keystrokes. A device hidden inside a package might sit inside a mailroom or a worker's physical inbox, scanning for open wireless connections, or recording and forwarding conversations.[99] Other forms of eavesdropping can be accomplished via compromised wireless or other network connections, malware keylogger or screen capture programs, as well as hardware devices such as replacement keyboards with keyloggers embedded inside, microphones to capture the slightly unique and identifiable sound of each key being pressed, programs that turn on built-in microphones or cameras that are now standard on many PCs, or even James Bond–style devices using Van Eck techniques that attempt to read monitors from afar by detecting their electromagnetic emissions.

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encryption

Scrambling data using a code or formula, known as a cipher, such that it is hidden from those who do not have the unlocking key.

key

Code that unlocks encryption.

brute-force attacks

An attack that exhausts all possible password combinations in order to break into an account. The larger and more complicated a password or key, the longer a brute-force attack will take.

The Encryption Prescription

During a routine physical transfer of backup media, Bank of America lost tapes containing the private information—including Social Security and credit card numbers—of hundreds of thousands of customers.[100] This was potentially devastating fodder for identity thieves. But who cares if someone steals your files if they still can't read the data? That's the goal of encryption!

Encryption scrambles data, making it essentially unreadable to any program that doesn't have the descrambling password, known as a **key**. For the most part, the larger the key, the more difficult it is for a brute-force attack to exhaust all available combinations and crack the code. When well implemented, encryption can be the equivalent of a rock solid vault. To date, the largest known **brute-force attacks**, demonstration hacks launched by grids of simultaneous code-cracking computers working in unison, haven't come close to breaking the type of encryption used to scramble transmissions that most browsers use when communicating with banks and shopping sites. The problem occurs when data is nabbed before encryption or after decrypting, or in rare cases, if the encrypting key itself is compromised.

Extremely sensitive data—trade secrets, passwords, credit card numbers, and employee and customer information—should be encrypted before being sent or stored.[101] Deploying encryption dramatically lowers the potential damage from lost or stolen laptops, or from hardware recovered from dumpster diving. It is vital for any laptops carrying sensitive information.

Encryption is also employed in virtual private network (VPN) technology, which scrambles data passed across a network. Public wireless connections pose significant security threats—they may be set up by hackers who pose as service providers while really launching attacks on or monitoring the transmissions of unwitting users. The use of VPN software can make any passed-through packets unreadable. Contact your firm or school to find out how to set up VPN software.

In the Bank of America example above, the bank was burned. It couldn't verify that the lost tapes were encrypted, so it had to notify customers and incur the cost associated with assuming data had been breached.[102]

Encryption is not without its downsides. Key management is a potentially costly procedural challenge for most firms. If your keys aren't secure, it's the equivalent of leaving the keys to a safe out in public. Encryption also requires additional processing to scramble and descramble data—drawing more power and slowing computing tasks. Moore's Law will speed things along, but it also puts more computing power in the hands of attackers. With hacking threats on the rise, expect to see laws and compliance requirements that mandate encrypted data, standardize encryption regimes, and simplify management.

public key encryption

A two-key system used for securing electronic transmissions. One key distributed publicly is used to encrypt (lock) data, but it cannot unlock data. Unlocking can only be performed with the private key. The private key also cannot be reverse engineered from the public key. By distributing public keys, but keeping the private key, Internet services can ensure transmissions to their site are secure.

certificate authority

A trusted third party that provides authentication services in public key encryption schemes.

How Do Websites Encrypt Transmissions?

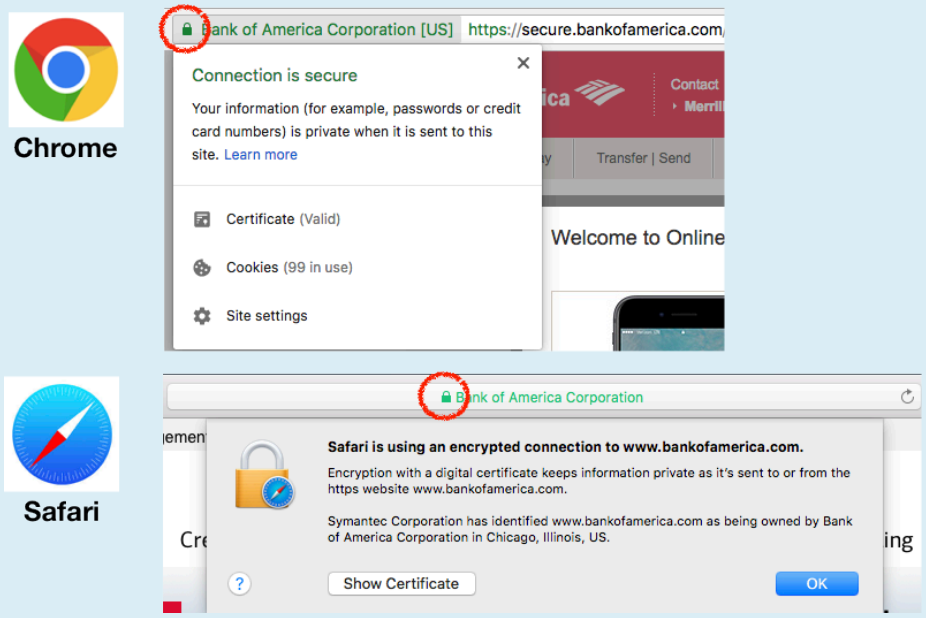
Most websites that deal with financial transactions (e.g., banks, online stores) secure transmissions using a method called **public key encryption**. The system works with two keys—a public key and a private key. The public key can "lock" or encrypt data, but it can't unlock it: that can only be performed by the private key. So a website that wants you to transmit secure information will send you a public key—you use this to lock the data, and no one who intercepts that transmission can break in unless they've got the private key. If the website does its job, it will keep the private key out of reach of all potentially prying eyes.

Wondering if a website's transmissions are encrypted? Look at the Web address. If it begins with "https" instead of "http," it should be secure. Also, look for the padlock icon in the corner of your Web browser to be closed (locked). Finally, you can double-click the padlock to bring up a verification of the website's identity (verified by a trusted third-party firm, known as a **certificate authority**). If this matches your URL and indicates the firm you're doing business with, then you can be pretty sure verified encryption is being used by the firm that you intend to do business with.

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FIGURE 17.8 Encrypted Website Transmissions
This screenshot shows the result of clicking the padlock icon (circled in red) in both Chrome and Safari. Note how each browser verifies the legitimacy of the website, with additional links where the user can get more detail.



Heartbleed: What Happens When Nearly Everyone Uses Buggy Software?

Open source software can be a huge benefit to firms, allowing them to use free, reliable software instead of having to develop code on their own or pay expensive commercial license fees. Many of the websites and services that you visit are built on open source components like the Linux operating system, Apache Web server, and MySQL database. But a vulnerability in widely used software can create a problem for anyone using this code, and while the "openness" of open source software allows geeks worldwide to search for potential weaknesses, sometimes a hole gets through and inadvertently creates a massive vulnerability.

This is exactly what happened with the Heartbleed bug, a vulnerability in the OpenSSL security software used by about two-thirds of websites and which is embedded into all sorts of Internet-connected products. Heartbleed exploited a bug in a common function that allowed servers to "handshake" or verify they exist and are open for communication. But instead of a program sending the equivalent of a message that instructs a website to "*say 'Hi' to tell me you're there*," the bug allowed malicious code to instruct in this way: "*say 'Hi' and send me a massive chunk of your memory to tell me you're there*." Why is this bad? That massive chunk of memory could contain usernames, passwords, or even the digital certificate that would allow another server to impersonate a legitimate website. The geek comic site xkcd offered a short, six-panel graphic explanation that gives a good sense of what's happening with Heartbleed (see http://xkcd.com/1354).

As of this writing, few security incidents have been directly attributed to Heartbleed. In one example, authorities bagged a nineteen-year-old who used the flaw to steal hundreds of tax IDs from a Canadian government system. But the full extent of the exploit is hard to know—crooks don't announce "I'm stealing your stuff," and tracing data theft back to a given vulnerability can be difficult. The bug had existed for two years before it was discovered and widely disclosed,[103] so widespread theft is possible. The good news? Publicity and fast-acting open source advocates helped quickly patch software and eliminate the flaw. All of the top 1,000 most popular websites, and all but fifty-three of the top 10,000 sites, were patched within days of Heart-

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bleed becoming public.[104] However, one of the problems is that OpenSSL is also baked into many hardware products, such as cable modems, routers, and so-called embedded devices (see Chapter 5). Since software in these devices is built into a shipping physical product, it often cannot be upgraded like a server, PC, or phone. As security expert Bruce Schneier points out, "fixing the vulnerability [in many hardware systems] involves a trash can, a credit card, and a trip to the computer store."[105] The Heartbleed bug underscores that managers and technologists need to think about possible software vulnerabilities in all of their smart devices and devise plans for their upgrade or replacement.

Key Takeaways

- An organization's information assets are vulnerable to attack from several points of weakness, including users and administrators, its hardware and software, its networking systems, and various physical threats.
- Social engineering attempts to trick or con individuals into providing information, while phishing techniques are cons conducted through technology.
- While dangerous, a number of tools and techniques can be used to identify phishing scams, limiting their likelihood of success.
- Social media sites may assist hackers in crafting phishing or social engineering threats, provide information to password crackers, and act as conduits for unwanted dissemination of proprietary information.
- Most users employ inefficient and insecure password systems; however, techniques were offered to improve one's individual password regime.
- Viruses, worms, and Trojans are types of infecting malware. Other types of malware might spy on users, enlist the use of computing assets for committing crimes, steal assets, destroy property, serve unwanted ads, and more.
- Examples of attacks and scams launched through advertising on legitimate Web pages highlight the need for end-user caution, as well as for firms to ensure the integrity of their participating online partners.
- SQL injection and related techniques show the perils of poor programming. Software developers must design for security from the start—considering potential security weaknesses, and methods that improve end-user security (e.g., in areas such as installation and configuration).
- Encryption can render a firm's data assets unreadable, even if copied or stolen. While potentially complex to administer and resource intensive, encryption is a critical tool for securing an organization's electronic assets.

Questions and Exercises

1. Consider your own personal password regime and correct any weaknesses. Share any additional password management tips and techniques with your class.
2. Why is it a bad idea to use variants of existing passwords when registering for new websites?
3. Relate an example of social engineering that you've experienced or heard of. How might the victim have avoided being compromised?
4. Have you ever seen phishing exploits? Have you fallen for one? Why did you take the bait, or what alerted you to the scam? How can you identify phishing scams?
5. Have you or has anyone you know fallen victim to malware? Relate the experience—how do you suppose it happened? What damage was done? What, if anything, could be done to recover from the situation?
6. Why are social media sites such a threat to information security? Give various potential scenarios where social media use might create personal or organizational security compromises.

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7. Some users regularly update their passwords by adding a number (say month or year) to their code. Why is this bad practice?
8. What kind of features should a programmer build into systems in order to design for security? Think about the products that you use. Are there products that you feel did a good job of ensuring security during setup? Are there products you use that have demonstrated bad security design? How?
9. Why are SQL injection attacks more difficult to address than the latest virus threat?
10. How should individuals and firms leverage encryption?
11. Investigate how you might use a VPN if traveling with your laptop. Be prepared to share your findings with your class and your instructor.
12. Why was the Heartbleed bug so concerning? What sorts of products and services were impacted by the bug? Do some research online. Did you use any products or services that were vulnerable because of Heartbleed? How did you find out about Heartbleed? What are you doing to ensure that you are aware of similar security threats in the future?

17.4 Taking Action

Learning Objectives

1. Identify critical steps to improve your individual and organizational information security.
2. Be a tips, tricks, and techniques advocate, helping make your friends, family, colleagues, and organization more secure.
3. Recognize the major information security issues that organizations face, as well as the resources, methods, and approaches that can help make firms more secure.

Taking Action as a User

The weakest link in security is often a careless user, so don't make yourself an easy mark. Once you get a sense of threats, you understand the kinds of precautions you need to take. Security considerations then become more common sense than high tech. Here's a brief list of major issues to consider:

- *Surf smart.* Think before you click—question links, enclosures, download requests, and the integrity of websites that you visit. Avoid suspicious e-mail attachments and Internet downloads. Be on guard for phishing and other attempts to con you into letting in malware. Verify anything that looks suspicious before acting. Avoid using public machines (libraries, coffee shops) when accessing sites that contain your financial data or other confidential information.
- *Stay vigilant.* Social engineering con artists and rogue insiders are out there. An appropriate level of questioning applies not only to computer use, but also to personal interactions, be it in person, on the phone, or electronically.
- *Stay updated.* Turn on software update features for your operating system and any application you use (browsers, applications, plug-ins, and applets), and manually check for updates when needed. Malware toolkits specifically scan for older, vulnerable systems, so working with updated programs that address prior concerns lowers your vulnerable attack surface.

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- *Stay armed.* Install a full suite of security software. Many vendors offer a combination of products that provide antivirus software that blocks infection, personal firewalls that repel unwanted intrusion, malware scanners that seek out bad code that might already be nesting on your PC, antiphishing software that identifies if you're visiting questionable websites, and more. Such tools are increasingly being built into operating systems, browsers, and are deployed at the ISP or service provider (e-mail firm, social network) level. But every consumer should make it a priority to understand the state of the art for personal protection. In the way that you regularly balance your investment portfolio to account for economic shifts, or take your car in for an oil change to keep it in top running condition, make it a priority to periodically scan the major trade press or end-user computing sites for reviews and commentary on the latest tools and techniques for protecting yourself (and your firm).
- *Be settings smart.* Don't turn on risky settings like unrestricted folder sharing that may act as an invitation for hackers to drop off malware payloads. Secure home networks with password protection and a firewall. Encrypt hard drives—especially on laptops or other devices that might be lost or stolen. Register mobile devices for location identification or remote wiping. Don't click the "Remember me" or "Save password" settings on public machines, or any device that might be shared or accessed by others. Similarly, if your machine might be used by others, turn off browser settings that auto-fill fields with prior entries—otherwise you make it easy for someone to use that machine to track your entries and impersonate you. And when using public hotspots, be sure to turn on your VPN software to encrypt transmission and hide from network eavesdroppers.
- *Be password savvy.* Change the default password on any new products that you install. Update your passwords regularly. Using guidelines outlined earlier, choose passwords that are tough to guess but easy for you (and only you) to remember. Generate your passwords so that you're not using the same access codes for your most secure sites. Never save passwords in nonsecured files, e-mail, or written down in easily accessed locations. Consider a secure password management tool such as 1Password or LastPass and be sure to use the software and manage the master password effectively.
- *Be disposal smart.* Shred personal documents. Wipe hard drives with an industrial strength software tool before recycling, donating, or throwing away—remember in many cases "deleted" files can still be recovered. Destroy media such as CDs and DVDs that may contain sensitive information. Erase USB drives when they are no longer needed.
- *Back up.* The most likely threat to your data doesn't come from hackers; it comes from hardware failure.[106] Yet most users still don't regularly back up their systems. This is another do-it-now priority. Cheap, plug-in hard drives work with most modern operating systems to provide continual backups, allowing for quick rollback to earlier versions if you've accidentally ruined some vital work. And services like Carbonite or Mozy provide regular backup over the Internet for a monthly fee that's likely less than what you spent on your last lunch (a fire, theft, or similar event could also result in the loss of any backups stored on-site, but Internet backup services can provide off-site storage and access if disaster strikes).
- *Check with your administrator.* All organizations that help you connect to the Internet—your ISP, firm, or school—should have security pages. Many provide free security software tools. Use them as resources. Remember—it's in their interest to keep you safe, too!

Taking Action as an Organization

Frameworks, Standards, and Compliance

Developing organizational security is a daunting task. You're in an arms race with adversaries that are tenacious and constantly on the lookout for new exploits. Fortunately, no firm is starting from

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scratch—others have gone before you and many have worked together to create published best practices.

There are several frameworks, but perhaps the best known of these efforts comes from the International Organization for Standards (ISO), and is broadly referred to as ISO27k or the ISO 27000 series. According to ISO.org, this evolving set of standards provides "a model for establishing, implementing, operating, monitoring, reviewing, maintaining, and improving an Information Security Management System."

Firms may also face compliance requirements—legal or professionally binding steps that must be taken. Failure to do so could result in fine, sanction, and other punitive measures. At the federal level, examples include HIPAA (the Health Insurance Portability and Accountability Act), which regulates health data; the Gramm-Leach-Bliley Act, which regulates financial data; and the Children's Online Privacy Protection Act, which regulates data collection on minors. US government agencies must also comply with FISMA (the Federal Information Security Management Act), and there are several initiatives at the other government levels. Some level of state data breach laws have been passed in most US states, while multinationals face a growing number of statues throughout the world. Your legal team and trade associations can help you understand your domestic and international obligations. Fortunately, there are often frameworks and guidelines to assist in compliance. For example, the ISO standards include subsets targeted at the telecommunications and health care industries, and major credit card firms have created the PCI (payment card industry) standards. And there are skilled consulting professionals who can help bring firms up to speed in these areas and help expand their organizational radar as new issues develop.

Here is a word of warning on frameworks and standards: compliance does not equal security. Outsourcing portions of security efforts without a complete, organizational commitment to being secure can also be dangerous. Some organizations simply approach compliance as a necessary evil, a sort of checklist that can reduce the likelihood of a lawsuit or other punitive measure.[107] While you want to make sure you're doing everything in your power not to get sued, this isn't the goal. The goal is taking all appropriate measures to ensure that your firm is secure for your customers, employees, shareholders, and others. Frameworks help shape your thinking and expose things you should do, but security doesn't stop there—this is a constant, evolving process that needs to pervade the organization from the CEO suite and board, down to front line workers and potentially out to customers and partners. And be aware of the security issues associated with any mergers and acquisitions. Bringing in new firms, employees, technologies, and procedures means reassessing the security environment for all players involved.

The Heartland Breach: Compliance ≠ Security

Credit card processor Heartland, at the time of the attack that would become one of the largest security breaches in history, was the nation's fifth largest payments processor. Its business was responsible for handling the transfer of funds and information between retailers and cardholders' financial institutions. That means infiltrating Heartland was like breaking into Fort Knox.

It's been estimated that as many as 100 million cards issued by more than 650 financial services companies may have been compromised during the Heartland breach. Said the firm's CEO, this was "the worst thing that can happen to a payments company and it happened to us."[108] Wall Street noticed. The firm's stock tanked—within a month, its market capitalization had plummeted over 75 percent, dropping over half a billion dollars in value.[109]

The Heartland case provides a cautionary warning against thinking that security ends with compliance. Heartland had in fact passed multiple audits, including one conducted the month before the infiltration began. Still, at least thirteen pieces of malware were uncovered on the firm's servers. Compliance does not equal security. Heartland was compliant, but a firm can be compliant and not be secure. Compliance is not the goal, security is.

Since the breach, the firm's executives have championed industry efforts to expand security practices, including encrypting card information at the point it is swiped and keeping it secure through settlement. Such "cradle-to-grave" encryption can help create an environment where even com-

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promised networking equipment or intercepting relay systems wouldn't be able to grab codes.[110] Recognize that security is a continual process, it is never done, and firms need to pursue security with tenacity and commitment.

Education, Audit, and Enforcement

Security is as much about people, process, and policy, as it is about technology.

From a people perspective, the security function requires multiple levels of expertise. Operations employees are involved in the day-to-day monitoring of existing systems. A group's R&D function is involved in understanding emerging threats and reviewing, selecting, and implementing updated security techniques. A team must also work on broader governance issues. These efforts should include representatives from specialized security and broader technology and infrastructure functions. It should also include representatives from general counsel, audit, public relations, and human resources. What this means is that even if you're a nontechnical staffer, you may be brought in to help a firm deal with security issues.

Processes and policies will include education and awareness—this is also everyone's business. As the vice president of product development at security firm Symantec puts it, "We do products really well, but the next step is education. We can't keep the Internet safe with antivirus software alone."[111] Companies should approach information security as a part of their "collective corporate responsibility...regardless of whether regulation requires them to do so."[112]

For a lesson in how important education is, look no further than former head of the CIA and US Director of Intelligence John Deutch. Deutch engaged in shockingly loose behavior with digital secrets, including keeping a daily journal of classified information—some 1,000+ pages—on memory cards he'd transport in his shirt pocket. He also downloaded and stored Pentagon information, including details of covert operations, at home on computers that his family used for routine Internet access.[113]

Employees need to know a firm's policies, be regularly trained, and understand that they will face strict penalties if they fail to meet their obligations. Policies without eyes (audit) and teeth (enforcement) won't be taken seriously. Audits include real-time monitoring of usage (e.g., who's accessing what, from where, how, and why; sound the alarm if an anomaly is detected), announced audits, and surprise spot-checks. This function might also stage white hat demonstration attacks—attempts to hunt for and expose weaknesses, hopefully before hackers find them. Frameworks offer guidelines on auditing, but a recent survey found most organizations don't document enforcement procedures in their information security policies, that more than one-third do not audit or monitor user compliance with security policies, and that only 48 percent annually measure and review the effectiveness of security policies.[114]

A firm's technology development and deployment processes must also integrate with the security team to ensure that from the start, applications, databases, and other systems are implemented with security in mind. The team will have specialized skills and monitor the latest threats and are able to advise on precautions necessary to be sure systems aren't compromised during installation, development, testing, and deployment.

What Needs to Be Protected and How Much Is Enough?

A worldwide study by PricewaterhouseCoopers and *Chief Security Officer* magazine revealed that most firms don't even know what they need to protect. Only 33 percent of executives responded that their organizations kept accurate inventory of the locations and jurisdictions where data was stored, and only 24 percent kept inventory of all third parties using their customer data.[115] What

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this means is that most firms don't even have an accurate read on where their valuables are kept, let alone how to protect them.

So information security should start with an inventory-style auditing and risk assessment. Technologies map back to specific business risks. What do we need to protect? What are we afraid might happen? And how do we protect it? Security is an economic problem, involving attack likelihood, costs, and prevention benefits. These are complex trade-offs that must consider losses from theft or resources, systems damage, data loss, disclosure of proprietary information, recovery, downtime, stock price declines, legal fees, government and compliance penalties, and intangibles such as damaged firm reputation, loss of customer and partner confidence, industry damage, promotion of adversary, and encouragement of future attacks.

While many firms skimp on security, firms also don't want to misspend, targeting exploits that aren't likely while underinvesting in easily prevented methods to thwart common infiltration techniques. Hacker conventions like DefCon can show some really wild exploits. But it's up to the firm to assess how vulnerable it is to these various risks. The local donut shop has far different needs than a military installation, law enforcement agency, financial institution, or firm housing other high-value electronic assets. A skilled risk assessment team will consider these vulnerabilities and what sort of countermeasure investments should take place.

Economic decisions usually drive hacker behavior, too. While in some cases attacks are based on vendetta or personal reasons, in most cases exploit economics largely boils down to:

$$\text{Adversary ROI} = \text{Asset value to adversary} - \text{Adversary cost.}$$

An adversary's costs include not only the resources, knowledge, and technology required for the exploit, but also the risk of getting caught. Make things tough to get at, and lobbying for legislation that imposes severe penalties on crooks can help raise adversary costs and lower your likelihood of becoming a victim.

Technology's Role

Technical solutions often involve industrial strength variants of the previously discussed issues individuals can employ, so your awareness is already high. Additionally, an organization's approach will often leverage multiple layers of protection and incorporate a wide variety of protective measures.

Patch. Firms must be especially vigilant to pay attention to security bulletins and install software updates that plug existing holes, (often referred to as *patches*). Firms that don't plug known problems will be vulnerable to trivial and automated attacks. Unfortunately, many firms aren't updating all components of their systems with consistent attention. With operating systems automating security update installations, hackers have moved on to application targets. But a major study recently found that organizations took at least twice as long to patch application vulnerabilities as they take to patch operating system holes.[116] And remember, software isn't limited to conventional PCs and servers. Embedded systems abound, and connected, yet unpatched devices are vulnerable. Malware has infected everything from unprotected ATM machines[117] to restaurant point-of-sale systems[118] to fighter plane navigation systems.[119]

As an example of unpatched vulnerabilities, consider the DNS cache poisoning exploit described earlier in this chapter. The discovery of this weakness was one of the biggest security stories the year it was discovered, and security experts saw this as a major threat. Teams of programmers worldwide raced to provide fixes for the most widely used versions of DNS software. Yet several months after patches were available, roughly one-quarter of all DNS servers were still unpatched and exposed.[120]

To be fair, not all firms delay patches out of negligence. Some organizations have legitimate concerns about testing whether the patch will break their system or whether the new technology contains a change that will cause problems down the road.[121] And there have been cases where

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patches themselves have caused problems. Finally, many software updates require that systems be taken down. Firms may have uptime requirements that make immediate patching difficult. But ultimately, unpatched systems are an open door for infiltration.

Lock down hardware. Firms range widely in the security regimes used to govern purchase-through-disposal system use. While some large firms such as Kraft are allowing employees to select their own hardware (Mac or PC, desktop or notebook, iPhone or BlackBerry),[122] others issue standard systems that prevent all unapproved software installation and force file saving to hardened, backed-up, scanned, and monitored servers. Firms in especially sensitive industries such as financial services may regularly re-image the hard drive of end-user PCs, completely replacing all the bits on a user's hard drive with a pristine, current version—effectively wiping out malware that might have previously sneaked onto a user's PC. Other lock-down methods might disable the boot capability of removable media (a common method for spreading viruses via inserted discs or USBs), prevent Wi-Fi use or require VPN encryption before allowing any network transmissions, and more. The cloud helps here, too (see Chapter 14). Employers can also require workers to run all of their corporate applications inside a remote desktop where the actual executing hardware and software is elsewhere (likely hosted as a virtual machine session on the organization's servers), and the user is simply served an image of what is executing remotely. This seals the virtual PC off in a way that can be thoroughly monitored, updated, backed up, and locked down by the firm.

In the case of Kraft, executives worried that the firm's previously restrictive technology policies prevented employees from staying in step with trends. Employees opting into the system must sign an agreement promising they'll follow mandated security procedures. Still, financial services firms, law offices, health care providers, and others may need to maintain stricter control, for legal and industry compliance reasons.

Lock down the network. Network monitoring is a critical part of security, and a host of technical tools can help.

Firms employ **firewalls** to examine traffic as it enters and leaves the network, potentially blocking certain types of access, while permitting approved communication. **Intrusion detection systems** specifically look for unauthorized behavior, sounding the alarm and potentially taking action if something seems amiss. Some firms deploy **honeypots**—bogus offerings meant to distract attackers. If attackers take honeypot bait, firms may gain an opportunity to recognize the hacker's exploits, identify the IP address of intrusion, and take action to block further attacks and alert authorities.

firewalls

A system that acts as a control for network traffic, blocking unauthorized traffic while permitting acceptable use.

intrusion detection systems

A system that monitors network use for potential hacking attempts. Such a system may take preventative action to block, isolate, or identify attempted infiltration, and raise further alarms to warn security personnel.

honeypots

A seemingly tempting, but bogus target meant to draw hacking attempts. By monitoring infiltration attempts against a honeypot, organizations may gain insight into the identity of hackers and their techniques, and they can share this with partners and law enforcement.

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Many firms also deploy **blacklists**—denying the entry or exit of specific IP addresses, products, Internet domains, and other communication restrictions. While blacklists block known bad guys, **whitelists** are even more restrictive—permitting communication only with approved entities or in an approved manner.

blacklists

Programs that deny the entry or exit of specific IP addresses, products, Internet domains, and other communication restrictions.

whitelists

Highly restrictive programs that permit communication only with approved entities and/or in an approved manner.

These technologies can be applied to network technology, specific applications, screening for certain kinds of apps, malware signatures, and hunting for anomalous patterns. The latter is important, as recent malware has become polymorphic, meaning different versions are created and deployed in a way that their signature, a sort of electronic fingerprint often used to recognize malicious code, is slightly altered. This also helps with zero-day exploits, and in situations where whitelisted websites themselves become compromised.

Many technical solutions, ranging from network monitoring and response to e-mail screening, are migrating to "the cloud." This can be a good thing—if network monitoring software immediately shares news of a certain type of attack, defenses might be pushed out to all clients of a firm (the more users, the "smarter" the system can potentially become—again we see the power of network effects in action).

Lock down partners. Insist that partner firms be compliant, and audit them to ensure this is the case. This includes technology providers and contract firms, as well as value chain participants such as suppliers and distributors. Anyone who touches your network is a potential point of weakness. Many firms will build security expectations and commitments into performance guarantees known as service level agreements (SLAs).

Lock down systems. Audit for SQL injection and other application exploits. The security team must constantly scan exploits and then probe its systems to see if it's susceptible, advising and enforcing action if problems are uncovered. This kind of auditing should occur with all of a firm's partners.

Access controls can also compartmentalize data access on a need-to-know basis. Such tools can not only enforce access privileges, they can help create and monitor audit trails to help verify that systems are not being accessed by the unauthorized, or in suspicious ways.

Audit trails are used for deterring, identifying, and investigating these cases. Recording, monitoring, and auditing access allows firms to hunt for patterns of abuse. Logs can detail who, when, and from where assets are accessed. Giveaways of nefarious activity may include access from unfamiliar IP addresses, from nonstandard times, accesses that occur at higher than usual volumes, and so on. Automated alerts can put an account on hold or call in a response team for further observation of the anomaly.

Single-sign-on tools can help firms offer employees one very strong password that works across applications, is changed frequently (or managed via hardware cards or mobile phone log-in), and can be altered by password management staff.

Multiple administrators should jointly control key systems. Major configuration changes might require approval of multiple staffers, as well as the automatic notification of concerned personnel. And firms should employ a recovery mechanism to regain control in the event that key administrators are incapacitated or uncooperative. This balances security needs with an ability to respond in the event of a crisis. Such a system was not in place in the earlier described case of the rogue IT staffer who held the city of San Francisco's networks hostage by refusing to give up vital passwords.

Have failure and recovery plans. While firms work to prevent infiltration attempts, they should also have provisions in place that plan for the worst. If a compromise has taken place, what needs to be done? Do stolen assets need to be devalued (e.g., accounts terminated, new accounts issued)? What should be done to notify customers and partners, educate them, and advise them through any necessary responses? Who should work with law enforcement and with the media? Do off-site backups or redundant systems need to be activated? Can systems be reliably restored without risking further damage?

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Best practices are beginning to emerge. While postevent triage is beyond the scope of our introduction, the good news is that firms are now sharing data on breaches. Given the potential negative consequences of a breach, organizations once rarely admitted they'd been compromised. But now many are obligated to do so. And the broad awareness of infiltration both reduces organizational stigma in coming forward, and allows firms and technology providers to share knowledge on the techniques used by cybercrooks.

Information security is a complex, continually changing, and vitally important domain. The exploits covered in this chapter seem daunting, and new exploits constantly emerge. But your thinking on key issues should now be broader. Hopefully you've now embedded security thinking in your managerial DNA, and you are better prepared to be a savvy system user and a proactive participant working for your firm's security. Stay safe!

Key Takeaways

- End users can engage in several steps to improve the information security of themselves and their organizations. These include surfing smart, staying vigilant, updating software and products, using a comprehensive security suite, managing settings and passwords responsibly, backing up, properly disposing of sensitive assets, and seeking education.
- Frameworks such as ISO27k can provide a road map to help organizations plan and implement an effective security regime.
- Many organizations are bound by security compliance commitments and will face fines and retribution if they fail to meet these commitments.
- The use of frameworks and being compliant is not equal to security. Security is a continued process that must be constantly addressed and deeply ingrained in an organization's culture.
- Security is about trade-offs—economic and intangible. Firms need to understand their assets and risks in order to best allocate resources and address needs.
- Information security is not simply a technical fix. Education, audit, and enforcement regarding firm policies are critical. The security team is broadly skilled and constantly working to identify and incorporate new technologies and methods into their organizations. Involvement and commitment is essential from the boardroom to frontline workers, and out to customers and partners.

Questions and Exercises

1. Visit the security page for your ISP, school, or employer. What techniques do they advocate that we've discussed here? Are there any additional techniques mentioned and discussed? What additional provisions do they offer (tools, services) to help keep you informed and secure?
2. What sorts of security regimes are in use at your university, and at firms you've worked or interned for? If you don't have experience with this, ask a friend or relative for their professional experiences. Do you consider these measures to be too restrictive, too lax, or about right?
3. While we've discussed the risks in having security that is too lax, what risk does a firm run if its security mechanisms are especially strict? What might a firm give up? What are the consequences of strict end-user security provisions?
4. What risks does a firm face by leaving software unpatched? What risks does it face if it deploys patches as soon as they emerge? How should a firm reconcile these risks?
5. What methods do firms use to ensure the integrity of their software, their hardware, their networks, and their partners?
6. An organization's password management system represents "the keys to the city." Describe personnel issues that a firm should be concerned with regarding password administration. How might it address these concerns?

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CHAPTER 18

Google in Three Parts: Search, Online Advertising, and an Alphabet of Opportunity

18.1 Introduction

Learning Objectives

1. Understand the extent of Google's rapid rise and its size and influence when compared with others in the media industry.
2. Recognize the shift away from traditional advertising media to Internet advertising.
3. Gain insight into the uniqueness and appeal of Google's corporate culture.

It's hard to match Google for societal impact. The largest division of the massive tech conglomerate now known as Alphabet has "revolutionized access to knowledge, invigorated democratic forces, boosted productivity and spawned innovation on a scale unrecognized since the dawn of civilization."[1] However, from a revenue perspective, Google has long been considered a one-trick pony.[2] Now as tricks go, this one's pretty exquisite. Google's "trick" is matchmaking—pairing Internet surfers with advertisers and taking a cut along the way. This cut is substantial, as some 86 percent of Alphabet's nearly $111 billion in 2017 revenue came from advertising.[3] As *Wired*'s Steve Levy puts it, Google's matchmaking capabilities may represent "the most successful business idea in history."[4] Google has already grown to earn more annual advertising dollars than any US media company. No television network, magazine group, or newspaper chain brings in more ad revenue than Google. And none has been more profitable. Google's stated mission is "to organize the world's information and make it universally accessible and useful"; advertising drives profits and lets the firm offer most of its services for free.

Those free services have propelled the firm, now known as Alphabet, into a wide-ranging, multifront war that includes mobile, browsers, cloud infrastructure, e-mail, office apps, social media, maps, e-commerce, payments, and more. While the firm's performance in each space varies, the success of its ad business provides a massive cash hoard, which allows the firm to fuel experimentation, constantly innovate, tolerate failure, acquire aggressively, and patiently build new markets. Android now tops the smartphone market share, and Google intends to extend the platform to PC, TV, car, home automation, and accessories such as Google Home (an Echo competitor), smart watches, virtual and augmented reality, and more. Artificial intelligence and machine learning are increasingly at the heart of these innovations—so much so that Google's CEO has said the firm has moved from "mobile first" to "AI first".[5] Google's AI tools are widely considered to be leaders, and with its massive server farm, growing data hoard (think about how much data you regularly feed Alphabet products), and algorithmic lead, it intends to keep it that way.[6] The firm also relent-

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lessly pursues "moonshot" projects (i.e., wildly ambitious and risky multiyear research efforts). The current list includes driverless cars, smart contact lenses, and world-wrapping satellite and balloon-delivered wireless networks. Google bought eleven robotics firms in a single year for, well, the firm isn't saying[7] (although it may have had second thoughts on the value of earlier purchases[8]). And that's just a fraction of the roughly 200 acquisitions that Google has made overall,[9] which is more than Apple, Microsoft, Amazon, Facebook, and Yahoo!, combined.[10] A *Time* magazine cover story on Google's Calico health and aging research initiative was titled "Can Google Solve Death?"[11] Alphabet is losing money on those moonshots—for now—but all the stuff beyond the "one trick" of advertising? It added up to over $15.5 billion in 2017 and includes devices, cloud computing and enterprise sales, and more—enough revenue that if Alphabet's non-ad revenue were considered a separate company, it'd rank 187 on the *Fortune* 500 list. The firm's activities are so broad that CEO Larry Page has acknowledged it may be time for a new motto.[12]

CEO Sundair Pichai Discusses Google as an "AI First" Company

Hear Google CEO Sundair Pichai discuss what it means to be an "AI First" company, along with examples of how this is fundamentally redesigning the firm's products and services.



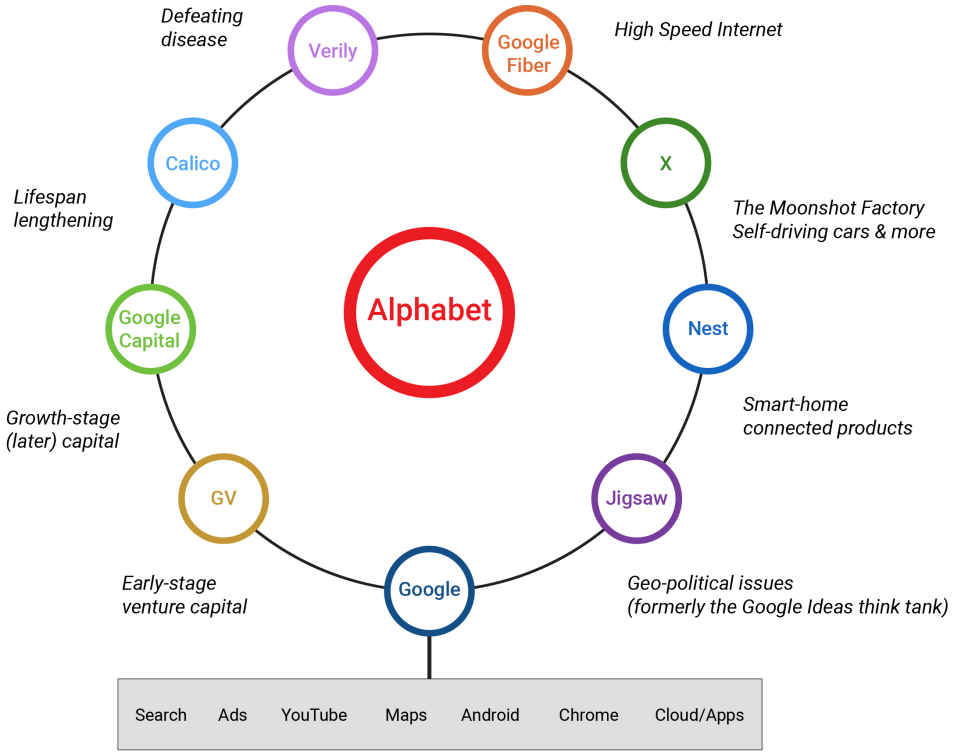
View the video online at: http://www.youtube.com/embed/5WRJYEA-mwY?rel=0

Just a few months after that statement, Page announced a reorganization under a holding company named Alphabet (same stock symbol), which will treat Google's core consumer businesses (e.g., search, mail, ads, and YouTube) as separate from other efforts, such as Nest home automation, Calico longevity initiatives, disease-tackling work of Verily, the self-driving cars and other "moonshots" of X, the firm's early-stage (GV) and later-stage growth (Capital) investment arms, and more (details were announced on the Alphabet website, http://abc.xyz). The reorganization is thought to offer more transparency for the performance of the firm's various businesses, and allow the company to structure compensation and job titles in a way that is competitive with startups taking similar risks.[13] While long-time Googler Sundar Pichai holds the title of CEO for the Google part of Alphabet, apologies if accounts in this book and chapter continue to refer to the new firm under the legacy name and leadership titles. While Google is a risk-taker, it's important to recognize that the firm isn't always a winner. Many of Google's once-hyped efforts are no more. The abandoned e-mail replacement tool Google Wave, the defunct social network Google Buzz, and the firm's flubbed acquisition of Motorola for $12.5 billion (sold for $2.91 billion two years later) are just some of Google's more high-profile busts.[14] Nobody bats 1.000, but ad profits give Google the financial stamina to keep coming to the plate and swinging for the fences.

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FIGURE 18.1 Alphabet
Google has evolved into Alphabet, a diverse holding company investing in a wide-ranging array of potentially high-impact endeavors.



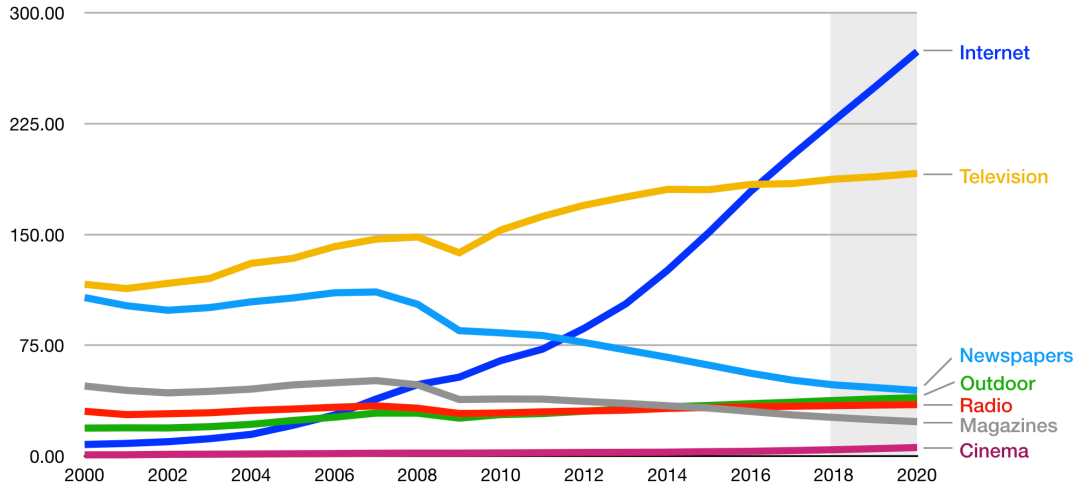
Source: John Gallaugher.

That profit graph keeps moving up and to the right. As more people spend more time online, advertisers are shifting spending away from old channels to the Internet, and Google is swallowing the lion's share of this funds transfer.[15] Add to that Google's lucrative ad network that serves ads to apps and websites ranging from small-time bloggers to the *New York Times*, plus Google ad-serving properties like YouTube, Gmail, Google Finance, and Google Maps, and the firm controls about a third of *all* online advertising dollars. Facebook, Bing, Yahoo!, AOL, Twitter—add up all their advertising revenue and combined they're *less than half of* Google's. Add in China's giants Baidu, Alibaba, and Tencent and Google's still in the lead.[16] Google has one of the world's strongest brands[17] (its name is a verb—*just Google it*). It is regularly voted among the best firms to work for in America (topping *Fortune*'s list six times in a row before "retiring" in 2018).[18] While rivals continue to innovate (see the box "Search: Google Rules, but It Ain't Over" in Section 10), Google continues to dominate the search market.

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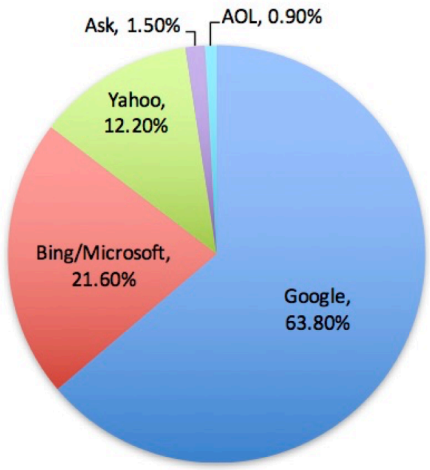
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FIGURE 18.2 Global Ad Spend by Media (in $US billions)
More is spent on Internet ads than any other form of advertising, and this is expected to rise for the foreseeable future.



Source: Data from Zenith via R. Molla, "Advertisers will spend $40 billion more on internet ads than on TV ads this year," Recode, March 26, 2018, https://www.recode.net/2018/3/26/17163852/online-internet-advertisers-outspend-tv-ads-advertisers-social-video-mobile-40-billion-2018.

FIGURE 18.3 US Search Market Share (Volume of Searches, April 2016)
While nearly 2/3 of all US search engine queries take place on Google, the firm's actual take of search ad spending is closer to 80 percent (*Search Engine Journal*, May, 2018).



Source: Data from Statista Jan. 2018

market capitalization (market cap)
The value of a firm calculated by multiplying its share price by the number of shares.

Wall Street has rewarded this success. Even before the firm's Alphabet reorg, the firm's **market capitalization (market cap)**, the value of the firm calculated by multiplying its share price by the number of shares, made Google the most valuable media company on the planet. The firm's founding duo, Sergey Brin and Larry Page, are billionaires, regularly appearing near the top of the *Forbes* 400 list of wealthiest Americans. Within five years of going public, Google's market cap was greater than that of News Corp (which includes all of the Fox networks, and the *Wall Street Journal*), Disney (including ABC, ESPN, theme parks, and Pixar), Time Warner (*Fortune*, *Time*, *Sports Illustrated*, CNN, and Warner Bros.), Viacom (MTV, VH1, and Nickelodeon), CBS, and the *New York Times*—combined! Just six years after its IPO, Google had become one of the twenty most profitable firms in the United States and was the youngest firm on the list—by far. Not bad for a business started by two twenty-something computer science graduate students.

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Genius Geeks and Plum Perks

Brin and Page have built a talent magnet. At the Googleplex, the firm's Mountain View, California, headquarters, geeks are lavished with perks that include on-site laundry, massage, car-wash, bicycle repair, free haircuts, state-of-the-art gyms, and Wi-Fi–equipped shuttles that ferry employees around Silicon Valley and the San Francisco Bay area. The Googleplex is also pretty green. The facility gets 30 percent of its energy from solar cells; at the time of its deployment it was the largest corporate installation of its kind.[19]

The firm's quirky tech-centric culture is evident everywhere. A T-Rex skeleton looms near the volleyball court. Hanging from the lobby ceiling is a replica of SpaceShipOne, the first commercial space vehicle. And visitors to the bathroom will find "testing on the toilet," coding problems or other brainteasers to keep gray matter humming while seated on one of the firm's $800 remote-controlled Japanese commodes. Staff also enjoy an A-list lecture series attracting luminaries ranging from celebrities to heads of state.

And of course there's the food—all of it free. The firm's founders felt that no employee should be more than 100 feet away from nourishment, and a tour around Google offices will find espresso bars, snack nooks, and fully stocked beverage refrigerators galore. There are eleven gourmet cafeterias on-site, the most famous being "Charlie's Place," first run by the former executive chef for the Grateful Dead.

Chairman and former CEO Eric Schmidt said the goal of all this is "to strip away everything that gets in our employees' way."[20] And the perks, culture, and sense of mission have allowed the firm to assemble one of the most impressive rosters of technical talent anywhere. The Googleplex is like a well-fed Manhattan Project, and employee ranks have included a gaggle of geniuses that helped invent critical technologies such as the Macintosh user interface, the Python programming language, the XML standard, and even the protocols that underlie the Internet itself.

Engineers find Google a particularly attractive place to work, in part due to a corporate policy of offering "20 percent time," the ability to work the equivalent of one day a week on new projects that interest them. It's a policy that has fueled innovation. Roughly half of Google products got their start in 20 percent time.[21]

Why Study Google?

Google is without a doubt one of the most influential and impactful firms of the modern era. You'd be hard-pressed to find an organization in any country where Google operates that isn't impacted by the firm's reach, be it in workforce empowerment (search, apps, software, devices); promotion (organic search and paid ads); or infrastructure (cloud). Studying Google gives us a platform for understanding online promotion and advertising, as well as a living case on how quickly technology-fueled market disruptions can happen, and how deeply these disruptions penetrate various industries. The chapter will allow us to study technical issues such as distributed computing, customer profiling, artificial intelligence, and more. We'll study the chapter within the context of learning the technologies and business issues across the online ad landscape, including search, display, and mobile. We'll also apply strategic thinking to understand current competition and illuminate the landscape for the battles ahead. The transition to the Alphabet corporate structure will be one watched for years—is this a viable model for large firms to break out and nurture new initiatives that create growth through genuine disruptive innovation? You can consider this chapter as consisting of three extended sections. The first part covers Google Search, the firm's core product, and introduces how search works. The second part ("Understanding the Increase in Online Ad Spending" through "Search Engines, Ad Networks, and Fraud") covers how the firm makes most of its money—advertising. By reading this section you'll get a solid introduction to various types of online advertising, how customer profiling works, and issues of online privacy and fraud. The last section ("The Battle Unfolds") covers the firm's evolving strategy, its competition with disparate rivals, and the opportunities and challenges the firm faces going forward.

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Key Takeaways

- Online advertising represents the only advertising category that, over the last several years, has been consistently trending with positive growth.
- Google dominates Internet search volume and controls the lion's share of the Internet search advertising business and online advertising dollars. The firm also earns more total advertising revenue than any other firm, online or off.
- Google's market cap makes it the most valuable media company in the world; it has been rated as having one of the world's strongest brands, and it ranks among the most profitable firms in the United States.

Questions and Exercises

1. List the reasons why Google has been considered a particularly attractive firm to work for. Are all of these associated with perks?
2. Market capitalization and market share change frequently. Investigate Google's current market cap and compare it with other media companies. Do patterns suggested in this case continue to hold? Why or why not?
3. Google has been dominant in the US for years. Research online to find out if Google's dominance spreads to international markets, as well. Give examples of markets where Google's share is as strong or stronger than in the US. Give examples where Google isn't a leader. Why do you think Google struggles in these global markets?
4. What other businesses is Google investing in? Is Alphabet a credible innovator in these areas? Do you think innovation across such a broad portfolio is a wise business decision? Why or why not?
5. Make a list of firms that currently compete with Google and that will likely see Google as a significant competitor in the future. Which firms and job titles will require a substantial understanding of how Google operates and competes?

18.2 Understanding Search

Learning Objectives

1. Understand the mechanics of search, including how Google indexes the Web and ranks its organic search results.
2. Examine the infrastructure that powers Google and how its scale and complexity offer key sources of competitive advantages.

Before diving into how the firm makes money, let's first understand how Google's core service, search, works.

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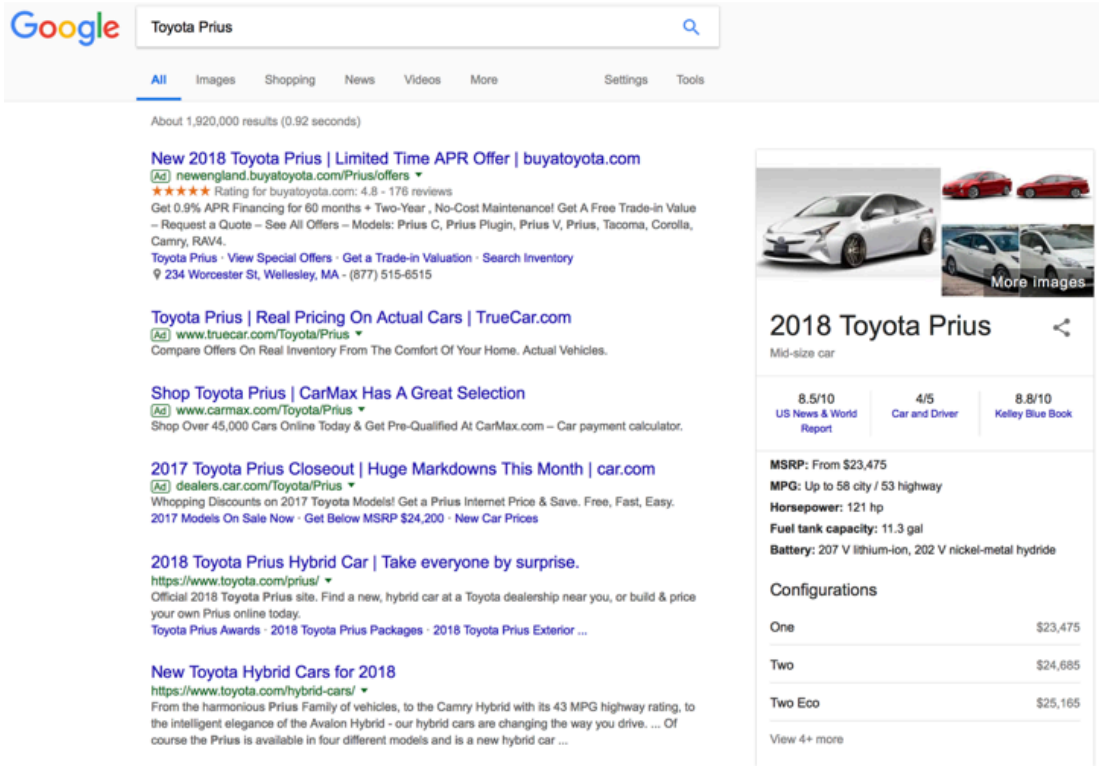
Perform a search (or **query**) on Google or another search engine, and the results you'll see are referred to by industry professionals as **organic or natural search**. Search engines use different algorithms for determining the order of organic search results, but at Google the method is called **PageRank** (a bit of a play on words, it ranks Web pages, and was initially developed by Google cofounder Larry Page). Google does not accept money for placement of links in organic search results. Instead, PageRank results are a kind of popularity contest. Web pages that have more pages *linking to them* are ranked higher (while organic search results can't be bought, firms do pay for preferred placement in some Google products, including Google Shopping, Hotels, and Flight Search).[22]

query
Search.

organic or natural search
Search engine results returned and ranked according to relevance.

PageRank
Algorithm developed by Google cofounder Larry Page to rank websites.

FIGURE 18.4 Google Query
The query for "Toyota Prius" triggers organic search results, flanked top and right by advertisements.



Source: Google.

The process of improving a page's organic search results is often referred to as **search engine optimization (SEO)**. SEO has become a critical function for many marketing organizations, since if a firm's pages aren't near the top of search results, customers may never discover its site.

search engine optimization (SEO)
The process of improving a page's organic search rankings.

Google is a bit vague about the specifics of precisely how PageRank has been refined, in part because many have tried to game the system. In addition to in-bound links, Google's organic search results also consider some two hundred other signals, and the firm's search quality team is relentlessly analyzing user behavior for clues on how to tweak the system to improve accuracy.[23] The less scrupulous have tried creating a series of bogus websites, all linking back to the pages they're trying to promote (this is called **link fraud**, and Google actively works to uncover and shut down such efforts—see the "Link Fraudsters" sidebar).

link fraud
Also called "spamdexing" or "link farming." The process of creating a series of bogus websites, all linking back to the pages one is trying to promote.

Link Fraudsters, Be Prepared to Experience Google's "Death Penalty"

JCPenney is a big retailer, for sure, but not necessarily the first firm to come to mind when you think of most retail categories. So the *New York Times* suspected that something fishy was up when the retailer's site came out tops for dozens of Google searches, including the phrases

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"skinny jeans," "dresses," "bedding," "area rugs," "home decor," "comforter sets," "furniture," and "tablecloths." The phrase "Samsonite carry-on luggage" even placed JCPenney ahead of Samsonite's own site!

The *Times* reported that "someone paid to have thousands of links placed on hundreds of sites scattered around the Web, all of which lead directly to JCPenney.com." And there was little question it was blatant link fraud. Phrases related to dresses and linking back to the retailer were coming from such nondress sites as nuclear.engineeringaddict.com, casino-focus.com, and bulgariapropertyportal.com. One SEO expert called the effort the most ambitious link farming attempt he'd ever seen.

Link fraud undercuts the credibility of Google's core search product, so when the search giant discovers a firm engaged in link farming, they drop the hammer. In this case Google both manually demoted JCPenney rankings and launched tweaks to its ranking algorithm. Within two hours JCPenney organic results plummeted, in some cases from first to seventy-first (the *Times* calls this the organic search equivalent of the "death penalty"). Getting a top spot in Google search results is a big deal. On average, 34 percent of clicks go to the top result, about twice the percentage that goes to number two. Google's punishment was administered despite the fact that JCPenney was also a large online ad customer, at times paying Google some $2.5 million a month for ads.[24]

JCPenney isn't the first firm busted. When Google discovered so-called black-hat SEO was being used to push BMW up in organic search rankings, Google made certain BMW sites virtually unfindable in its organic search results. JCPenney claims that they were the victim of rogue behavior by an SEO consultant (who was promptly fired) and that the retailer was otherwise unaware of the unethical behavior. But it is surprising that the retailer's internal team didn't see their unbelievably successful organic search results as a red flag that something was amiss, and this case highlights the types of things managers need to watch for in the digital age. JCPenney outsourced SEO, and the fraud uncovered in this story underscores the critical importance of vetting and regularly auditing the performance of partners throughout a firm's supply chain.[25]

While Google doesn't divulge specifics on the weighting of inbound links from a given website, we do know that links from some websites carry more weight than others. For example, links from websites that Google deems "influential" have greater weight in PageRank calculations than links from run-of-the-mill sites. For searches performed on mobile devices, Web pages that meet Google's criteria for being "mobile friendly" will be ranked higher than those that don't have an option for mobile devices (Google does offer testing tools to see if your pages are compliant).[26] Additionally, different users may not see identical organic search results. Google defaults to a mix of rankings that includes individual user behavior and, for those users searching while logged into Google accounts, social connections (although displaying generic results remains an option).[27]

spiders, Web crawlers, software robots

Software that traverses available websites in an attempt to perform a given task. Search engines use spiders to discover documents for indexing and retrieval.

cached

Refers to a temporary storage space used to speed computing tasks.

deep Web

Internet content that can't be indexed by Google and other search engines.

Spiders and Bots and Crawlers—Oh My!

Google handles an average of 40 million searches *per second*, resulting in 3.5 billion searches each day, or about 1.2 trillion searches a year.[28] When performing a search via Google or another search engine, you're not actually searching the Web. What really happens is that you're searching something that amounts to a *copy* of the Web that major search engines make by storing and indexing the text of online documents on their own computers. Google's index considers over 130 trillion URLs.[29] Google starts to retrieve results as soon as you begin to type, and a line above each Google query shows you just how fast a search takes, and how many pages were considered.

To create these massive indexes, search firms use software to crawl the Web and uncover as much information as they can find. This software is referred to by several different names—**spiders, Web crawlers, software robots**—but they all pretty much work the same way. The spiders ask each public computer network for a list of its public websites (for more on this see DNS in Chapter 16). Then the spiders go through this list ("crawling" a site), following every available link until all pages are uncovered.

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Google will crawl frequently updated sites, like those run by news organizations, as often as several times an hour. Rarely updated, less popular sites might only be reindexed every few days. The method used to crawl the Web also means that if a website isn't the first page on a public server, or isn't linked to from another public page, then it'll never be found.[30] In addition, each search engine also offers a page where you can submit your website for indexing.

While search engines show you what they've found on their *copy* of the Web's contents that Google has **cached** on its own servers, clicking a search result will direct you to the actual website, not the copy. Sometimes you'll click a result only to find that the website doesn't match what the search engine found. This is rare, but it happens if a website was updated before your search engine had a chance to reindex the changes.

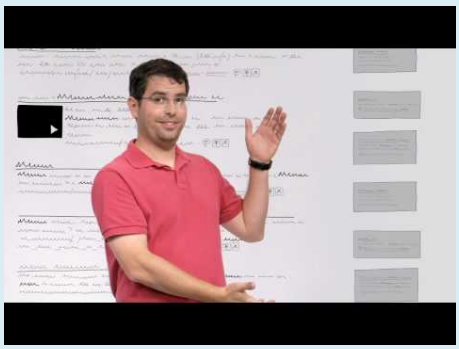
But what if you want the content on your website to remain off limits to search engine indexing and caching? Organizations have created a set of standards to stop the spider crawl, and all commercial search engines have agreed to respect these standards. One way is to put a line of *HTML code* invisibly embedded in a Web page that tells all software robots to stop indexing a page, stop following links on the page, or stop offering old page archives in a cache. Users don't see this code, but commercial Web crawlers do. For those familiar with HTML code (the language used to describe a website), the command to stop Web crawlers from indexing a page, following links, and listing archives of cached pages looks like this:

?META NAME="ROBOTS" CONTENT="NOINDEX, NOFOLLOW, NOARCHIVE"?

There are other techniques to keep the spiders out, too. Website administrators can add a special file (called robots.txt) that provides similar instructions on how indexing software should treat the website. And a lot of content lies inside the "**deep Web**," either behind corporate firewalls or inaccessible to those without a user account—think of private Facebook updates no one can see unless they're your friend—all of that is out of Google's reach.

How Google Search Works

How Search Works—a short Google video illustrating how search works and how it decides which results to show to you, and in what order.



View the video online at: http://www.youtube.com/embed/BNHR6IQJGZs?rel=0

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server farm

A massive network of computer servers running software to coordinate their collective use. Server farms provide the infrastructure backbone to SaaS and hardware cloud efforts, as well as many large-scale Internet services.

fault-tolerant

Capable of continuing operation even if a component fails.

colocation facilities

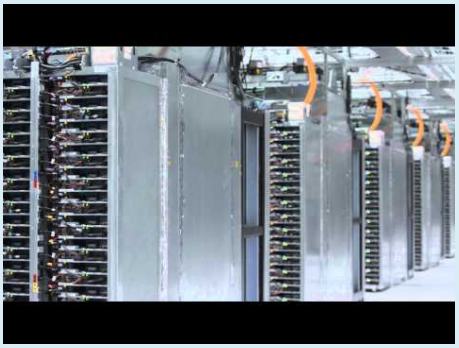
Sometimes called a "colo," or carrier hotel; provides a place where the gear from multiple firms can come together and where the peering of Internet traffic can take place. Equipment connecting in colos could be high-speed lines from ISPs, telecom lines from large private data centers, or even servers hosted in a colo to be closer to high-speed Internet connections.

What's It Take to Run This Thing?

Sergey Brin and Larry Page started Google with just four scavenged computers.[31] But in a decade, the infrastructure used to power the search sovereign has ballooned to the point where it is now the largest of its kind in the world.[32] Google doesn't disclose the number of servers it uses, but by some estimates, it runs over 1.4 million servers in over a dozen so-called **server farms** worldwide.[33] In the first three months of 2018, Google spent $7.3 billion—that's 3x what it spent a year earlier—most of it thought to have gone to building new server farms and laying the cabling connecting them to the rest of the Internet.[34] Building massive server farms to index the ever-growing Web is now the cost of admission for any firm wanting to compete in the search market. This is clearly no longer a game for two graduate students working out of a garage.

Tour a Google Data Center

At this video link, watch a tour of a Google data center. Or visit http://www.google.com/about/datacenters/inside/streetview to explore one of Google's data centers using the firm's Street View technology.



View the video online at: //www.youtube.com/embed/avP5d16wEp0?rel=0

The size of this investment not only creates a barrier to entry, it influences industry profitability, with market-leader Google enjoying huge economies of scale. Firms may spend the same amount to build server farms, but if Google has roughly two-thirds of this market while Microsoft's search draws just a fraction of this traffic, which do you think enjoys the better return on investment?

Google's server farms contain hardware that is custom built to contain just what Google needs and eliminate everything it doesn't (e.g., no graphic cards, since servers aren't attached to monitors, or enclosures, since all servers are rack-mounted). In most cases the firm uses the kind of Intel or AMD processors, low-end hard drives, and RAM chips that you'd find in a commercial PC. These components are housed in racks, slotted like very tight shelving. Each server is about 3.5 inches thick yet contains processors, RAM memory, and hard drives.[35] Google buys so many components for its custom-built servers that it, not a PC manufacturer, is Intel's fifth largest customer.[36]

In some cases, Google mounts racks of these servers inside standard-sized shipping containers, each with as many as 1,160 servers per box.[37] A given data center may have dozens of these server-filled containers all linked together. Redundancy is the name of the game. Google assumes individual components will regularly fail, but no single failure should interrupt the firm's operations (making the setup what geeks call **fault-tolerant**). If something breaks, a technician can easily swap it out with a replacement.

Google does make some custom components. Since it's such a big target for hackers, the firm designs its own custom hardware security chips that are inside its servers and peripherals. These chips allow Google to identify and authenticate its own infrastructure at the hardware level.[38] Google has also designed several versions of its own custom silicon for machine learning, something it calls the TPU for tensor processing unit (TensorFlow is a type of Google-nurtured

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machine learning tool). These chips are akin to the GPUs that were mentioned in the Moore's Law chapter, and the firm will gladly sell cloud access to other firms that want to use Google smarts at scale.[39] The first TPU outperformed standard processors by a factor of 30 to 80 times when measuring the calculating speed while taking into account energy cost—so much so that Google credits the TPU with saving it from having to open "dozens [more] data centers."[40]

Each server farm layout has also been carefully designed with an emphasis on lowering power consumption and cooling requirements. Instead of using big uninterrupted power supply (UPS) systems common in most data centers, Google put smaller battery backups next to each server. These cost less; are more efficient, because they leak about 15 percent less energy than big units; and don't have heavy cooling costs. Employees usually wear shorts inside the data center since the "cool aisle" in the front of machines is around 80°F. The hot aisles venting out the back and cooled via constantly circulating, heat-absorbing water coils can get up to 120°F. That's hotter than most corporate data centers, but Google learned that its systems could take the heat. These practices allow Google to set the bar high for energy efficiency. The standard used to measure data center efficiency is PUE—power usage effectiveness. 1.0 is a perfect score—it means all the power a facility draws is put to use. Everyone loses power; 2.0 (meaning half the power drawn is wasted) is considered a "reasonable number." Google regularly runs PUEs below 1.1—astonishingly efficient.[41] Saving energy helps the firm meet its green goals—the firm is formally committed to being carbon neutral and offsetting its fossil fuel energy needs—but the data centers also help meet other "green" goals: massive cash savings. The firm's infrastructure chief claims that the savings through the firm's ultraefficient data center designs are vital to keeping costs low enough to keep services like Gmail free.[42] Google also uses artificial intelligence to monitor data center performance. If it finds that one of its predicted outcomes doesn't match a current finding (e.g., the temperature is higher than what formulas suggest), this acts as a sort of data center equivalent of a car's "check engine light." AI will then suggest a course of action, like clean an air-filtering heat exchanger or check other systems.[43]

The firm's custom software (much of it built upon open source products) allows all this equipment to operate as the world's largest grid computer. Web search is a task particularly well suited for the massively parallel architecture used by Google and its rivals. For an analogy of how this works, imagine that working alone (the human equivalent of a single-server effort), you need to try to find a particular phrase in a hundred-page document. That'd take a while. Next, imagine that you can distribute the task across five thousand people, giving each of them a separate sentence to scan (that's the human equivalent of a multiserver grid). The speed difference between a single searching entity and a search involving many entities simultaneously focused on a subset of the same task gives you a sense of how search firms use massive numbers of servers and the divide-and-conquer approach of grid computing to quickly find the needles you're searching for within the Web's haystack. (For more on grid computing, see Chapter 5 and for more on the server farms employed by cloud computing providers, see Chapter 14).

Google's got a lot of data centers, but not all Google-served data comes to you straight from Google's own server farms. The firm also scatters racks of servers in scores of spots all over the world so that it can quickly get you copies of high-value rich media content, like trending YouTube videos, or fast services for businesses using Google's cloud computing services. These racks of Google content and code are tucked away, sometimes within data centers run by big telecom firms like Comcast or AT&T, or kept inside **colocation facilities** (colos), big warehouse-like facilities where several telecom companies come together to exchange traffic.[44]

Google will even sell you a bit of its technology so that you can run your own little Google in-house without sharing documents with the rest of the world. Google's line of search appliances are rack-mounted servers that can index documents within the servers on a corporation's own network, even managing user password and security access on a per-document basis. Selling hardware isn't a large business for Google, and other vendors offer similar solutions, but search appliances can be vital tools for law firms, investment banks, and other document-rich organizations.

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Key Takeaways

- Ranked search results are often referred to as organic or natural search results. PageRank is Google's algorithm for ranking search results. PageRank orders organic search results based largely on the number of websites linking to them, and the "weight" of each page as measured by its "influence."
- Search engine optimization (SEO) is the process of improving a website's organic search ranking. The scope and influence of search has made SEO an increasingly vital marketing function.
- Users don't really search the Web; they search an archived copy stored on a search firm's computers. A firm creates these copies by crawling and indexing discoverable documents.
- Google operates from a massive network of server farms containing hundreds of thousands of servers built from standard, off-the-shelf parts. The cost of the operation is a significant barrier to entry for competitors. Google's share of search suggests the firm realizes economies of scale over rivals required to make similar investments while delivering fewer results (and hence ads).
- Website owners can hide pages from popular search engine Web crawlers using a number of methods, including HTML tags, a no-index file, or ensuring that websites aren't linked to other pages and haven't been submitted to websites for indexing.

Questions and Exercises

1. How do search engines discover pages on the Internet? What kind of capital commitment is necessary to go about doing this? How does this impact competitive dynamics in the industry?
2. How does Google rank search results? Investigate and list some methods that an organization might use to improve its rank in Google's organic search results. Are there techniques Google might not approve of? What risk does a firm run if Google or another search firm determines that it has used unscrupulous SEO techniques to try to unfairly influence ranking algorithms?
3. Sometimes websites returned by major search engines don't contain the words or phrases that initially brought you to the site. Why might this happen?
4. What's a cache? What other products or services have a cache?
5. What can be done if you want the content on your website to remain off limits to search engine indexing and caching?
6. What is a "search appliance"? Why might an organization choose such a product?
7. Become a better searcher: Look at the advanced options for your favorite search engine. Are there options you hadn't used previously? Be prepared to share what you learn during class discussion.
8. Google offers several tools useful to managers trying to gain insight on the public use of search. One of these is Google Trends. Visit Google Trends. Explore the tool as if you were comparing a firm with its competitors. What sorts of useful insights can you uncover? How might businesses use these tools?

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9. Some websites are accused of being "content farms," offering low-quality content designed to attract searchers that include popular query terms and using this content to generate ad revenue. Demand Media, which went public at $1.5 billion, and Associated Content, which Yahoo! purchased for $100 million, have been accused of being content farms. Investigate the claims and visit these sites. Do you find the content useful? Do you think these sites are or are not content farms? Research how Google changed its ranking algorithm to penalize content farms. What has been the impact on these sites? Would you put a site like BuzzFeed in the same category as content farms? Why or why not? Make a list of categories of firms and individuals that would likely be impacted by such moves. What does this tell you about Google's influence?
10. Consider Google's influence on society, understanding, education, and perception. When Google delivers the majority of search results and most users default first to Google's products, do you feel that gives a single firm too much power? Do you think governments have a role in regulating a firm with this amount of influence? Why or why not?

18.3 Understanding the Increase in Online Ad Spending

Learning Objectives

1. Understand how media consumption habits are shifting.
2. Be able to explain the factors behind the growth and appeal of online advertising.

For several years, Internet advertising has been the only major media ad category to show significant growth. There are three factors driving online ad growth trends: (1) increased user time online, (2) improved measurement and accountability, and (3) targeting.

Americans (and citizens in many other nations) spend more time on mobile devices than they do watching TV.[45] Even senior citizens spend more time online than they do reading magazines and newspapers, or listening to the radio.[46] So advertisers are simply following the market. Online channels also provide advertisers with a way to reach consumers at work—something that was previously much more difficult to do.

impressions
Each time an ad is shown to a user.

Many advertisers have also been frustrated by how difficult it's been to gauge the effectiveness of traditional ad channels such as TV, print, and radio. This frustration is reflected in the old industry saying, "I know that half of my advertising is working—I just don't know which half." Well, with the Internet, now you know. While measurement technologies aren't perfect, advertisers can now count ad **impressions** (the number of times an ad is shown on a website), whether a user clicks on an ad, and the product purchases or other website activity that comes from those clicks.[47] And as we'll see, many online ad payment schemes are directly linked to ad performance.

Various technologies and techniques also make it easier for firms to target users based on how likely a person is to respond to an ad. In theory a firm can use targeting to spend marketing dollars only on those users deemed to be its best prospects. Let's look at a few of these approaches in action.

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Key Takeaways

- Three key reasons for the increase in online ad growth are: (1) increasing user time online, (2) improved measurement and accountability, and (3) targeting.
- Digital media is decreasing time spent through traditional media consumption channels (e.g., radio, TV, newspapers), potentially lowering the audience reach of these old channels and making them less attractive for advertisers.
- Measurement techniques allow advertisers to track the performance of their ads—indicating things such as how often an ad is displayed, how often an ad is clicked, where an ad was displayed when it was clicked, and more. Measurement metrics can be linked to payment schemes, improving return on investment (ROI) and accountability compared to many types of conventional advertising.
- Advertising ROI can be improved through targeting. Targeting allows a firm to serve ads to specific categories of users, so firms can send ads to groups it is most interested in reaching, and those that are most likely to respond to an effort.

Questions and Exercises

1. How does your media time differ from your parents'? Does it differ among your older or younger siblings, or other relatives? Which media are you spending more time with? Less time with?
2. Put yourself in the role of a traditional media firm that is seeing its market decline. What might you do to address decline concerns? Have these techniques been attempted by other firms? Do you think they've worked well? Why or why not?
3. Put yourself in the role of an advertiser for a product or service that you're interested in. Is the Internet an attractive channel for you? How might you use the Internet to reach customers you are most interested in? Where might you run ads? Who might you target? Who might you avoid? How might the approach you use differ from traditional campaigns you'd run in print, TV, or radio? How might the size (money spent, attempted audience reach) and timing (length of time run, time between campaigns) of ad campaigns online differ from offline campaigns?
4. List ways in which you or someone you know has been targeted in an Internet ad campaign. Was it successful? How do you feel about targeting?

18.4 Search Advertising

Learning Objectives

1. Understand Google's search advertising revenue model.
2. Know the factors that determine the display and ranking of advertisements appearing on Google's search results pages.
3. Be able to describe the uses and technologies behind geotargeting.

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The practice of running and optimizing search engine ad campaigns is referred to as **search engine marketing (SEM)**.[48] SEM is a hot topic in an increasingly influential field, so it's worth spending some time learning how search advertising works on the Internet's largest search engine.

search engine marketing (SEM)
The practice of designing, running, and optimizing search engine ad campaigns.

Over two-thirds of Google's revenues come from ads served on its own sites, and the vast majority of this revenue comes from search engine ads.[49] During Google's early years, the firm actually resisted making money through ads. In fact, while at Stanford, Brin and Page even coauthored a paper titled "The Evils of Advertising."[50] But when Yahoo! and others balked at buying Google's search technology (offered for as little as $500,000), Google needed to explore additional revenue streams. It wasn't until two years after incorporation that Google ran ads alongside organic search results. That first ad, one for "Live Mail Order Lobsters," appeared just minutes after the firm posted a link reading "See Your Ad Here."[51]

Google regularly experiments with incorporating video and image ads into search (you'll see images, for example, in paid-product search results), but for the most part, the ads you'll see to the right (and sometimes top) of Google's organic search results are text ads. These ads are **keyword advertising**, meaning they're targeted based on the words in a user's search query. Advertisers bid on the keywords and phrases that they'd like to use to trigger the display of their ad. Linking ads to search was a brilliant move, since the user's search term indicates an overt interest in a given topic. Want to sell hotel stays in Tahiti? Link your ads to the search term "Tahiti Vacation." Google ads show up when many users have some sort of *purchasing intent*. This makes Google search ads far more effective than standard display ads like those on Facebook (see Chapter 11). Google's ability to tie advertising to purchasing intent (or to some other action that advertisers are willing to pay for) is the main reason the firm's ads are so valuable.

keyword advertising
Advertisements that are targeted based on a user's query.

Not only are search ads highly targeted, advertisers only pay for results. Text ads appearing on Google search pages are billed on a **pay-per-click (PPC)** basis, meaning that advertisers don't spend a penny unless someone actually clicks on their ad. Note that the term pay-per-click is sometimes used interchangeably with the term cost-per-click (CPC).

pay-per-click (PPC)
A concept where advertisers don't pay unless someone clicks on their ad.

If an advertiser wants to display an ad on Google search, they can set up a Google AdWords advertising account in minutes, specifying just a single ad, or multiple ad campaigns that trigger different ads for different keywords. Advertisers also specify what they're willing to pay each time an ad is clicked and how much their overall ad budget is, and they can control additional parameters, such as the timing and duration of an ad campaign.

If no one clicks on an ad, Google doesn't make money, advertisers don't attract customers, and searchers aren't seeing ads they're interested in. So in order to create a winning scenario for everyone, Google has developed a precise ad ranking formula that rewards top performing ads by considering three metrics: the maximum CPC that an advertiser is willing to pay (sometimes referred to as an ad's *bid value*), the advertisement's **quality score**—(a broad measure of ad performance) and the expected impact of extensions (e.g., added info like a phone number, address, store rating) and ad formats (in some cases images or video may be expected to perform higher). Create high-quality ads and your advertisements might appear ahead of competition, even if your competitors bid more than you. But if ads perform poorly they'll fall in rankings or even drop from display consideration.

quality score
A measurement of ad performance (CTR) and ad relevance, and landing page experience. Ads that are seen as relevant and that consumers respond to have higher quality scores. The firm uses quality score multiplied by the maximum CPC to determine an ad's display ranking.

Below is the rough formula used by Google to determine the rank order of sponsored links appearing on search results pages.

Ad Rank = f (Maximum CPC, Quality Score, expected impact of extensions and formats)

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click-through rate (CTR)

The number of users who clicked an ad divided by the number of times the ad was delivered (the impressions). The CTR measures the percentage of people who clicked on an ad to arrive at a destination-site.

landing page

The Web page displayed when a user clicks on an advertisement.

dynamic search ads

Ads generated automatically based on the content of a website. Dynamic ads are particularly useful for firms with rapidly updating inventory or firms struggling to keep up with new search terms that may be relevant to their product lines.

Google is deliberately vague about precisely how quality score is calculated, and the firm's metrics are regularly tweaked, but factors that determine an ad's quality score have included an ad's **click-through rate (CTR)**, or the number of users who clicked an ad divided by the number of times the ad was delivered (the impressions). The CTR measures the percentage of people who clicked on an ad to arrive at a destination-site. Factors that have also appeared in the quality score weighting include things like the overall history of click performance for the keywords linked to the ad, the relevance of an ad's text to the user's query, and Google's automated assessment of the user experience on the **landing page**—the Web page displayed when a user clicks on the ad. Ads that don't get many clicks, ad descriptions that have nothing to do with query terms, and ads that direct users to generic pages that load slowly or aren't strongly related to the keywords and descriptions used in an ad will all lower an ad's chance of being displayed. In general, the more relevant your ad, and the better the experience of the consumer who clicks that ad, the higher your quality score, and the higher your quality score, the better your ad's position and the less you'll have to pay per click.[52]

Google provides tools that firms can use to identify popular words and phrases for selecting keywords to associate with an ad, and for assessing ad quality score. And Google also offers **dynamic search ads**, where the firm will automatically generate ads based on your website. This is useful if you have a constantly changing and updating inventory or are having difficulty tracking the ever-evolving search terms that may be relevant to users looking for products and services that your site offers.

When an ad is clicked, advertisers don't actually pay their maximum CPC; Google discounts ads to the minimum necessary to maintain an ad's position on the page. So if you bid one dollar per click, but your overall ad rank is so good that you could have beat the ad ranked below yours even if you bid just ninety cents, then you'll pay just ninety cents if the ad is clicked. Discounting was a brilliant move. No one wants to get caught excessively overbidding rivals, so discounting helps reduce the possibility of this so-called bidder's remorse. And with this risk minimized, the system actually encouraged higher bids![53]

Ad ranking and cost-per-click calculations take place as part of an automated auction that occurs *every time* a user conducts a search. Advertisers get a running total of ad performance statistics so that they can monitor the return on their investment and tweak promotional efforts for better results. And this whole system is automated for self-service—all it takes is a credit card, an ad idea, and you're ready to go.

How Much Do Advertisers Pay per Click?

Google rakes in billions on what amounts to pocket change earned one click at a time. Most clicks bring in between thirty cents and one dollar. However, costs can vary widely depending on industry and current competition. Since rates are based on auctions, top rates reflect what the market is willing to bear. As an example, law firms, which bring in big bucks from legal fees, decisions, and settlement payments, often justify higher customer acquisition costs. Bids for certain legal phrases, such as those referring to structured settlements (a term often referring to payment terms of a legal settlement), or mesothelioma (a type of asbestos-associated cancer and the subject of several big money lawsuits) have been known to go for hundreds of dollars.[54] And firms that see results will keep spending. Los Angeles–based Chase Law Group has said that it brings in roughly 60 percent of its clients through Internet advertising.[55] Top Google advertisers among larger, consumer firms include Amazon, Quicken Loans, State Farm, Home Depot, Apple, Sears, Expedia, Capital One, Walmart, JCPenney, BestBuy, and eBay.[56]

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IP Addresses and Geotargeting

Geotargeting occurs when computer systems identify a user's physical location (sometimes called the *geolocation*) for the purpose of delivering tailored ads or other content. On Google AdWords, for example, advertisers can specify that their ads only appear for Web surfers located in a particular country, state, metropolitan region, or a given distance around a precise locale. They can even draw a custom ad-targeting region on a map and tell Google to only show ads to users detected inside that space.

Ads in Google Search (as well as in Maps and many other offerings) can be geotargeted based on **IP address**. Every device connected to the Internet has a unique IP address assigned by the organization connecting the device to the network. Normally you don't see your IP address. It's likely a set of four numbers, from 0 to 255, separated by periods (e.g., 136.167.2.220), but this standard (known as IPv4) is gradually being replaced by the IPv6 standard, which offers far more potential addresses. IP addresses are used in targeting because the range of IP addresses "owned" by major organizations and Internet service providers (ISPs) is public knowledge. In many cases it's possible to make an accurate guess as to where a computer, laptop, or mobile phone is located simply by cross-referencing a device's current IP address with this public list.

For example, it's known that all devices connected to the Boston College network contain IP addresses starting with the numbers 136.167. If a search engine detects a query coming from an IP address that begins with those two numbers, it can be fairly certain that the person using that device is in the greater Boston area.

geotargeting

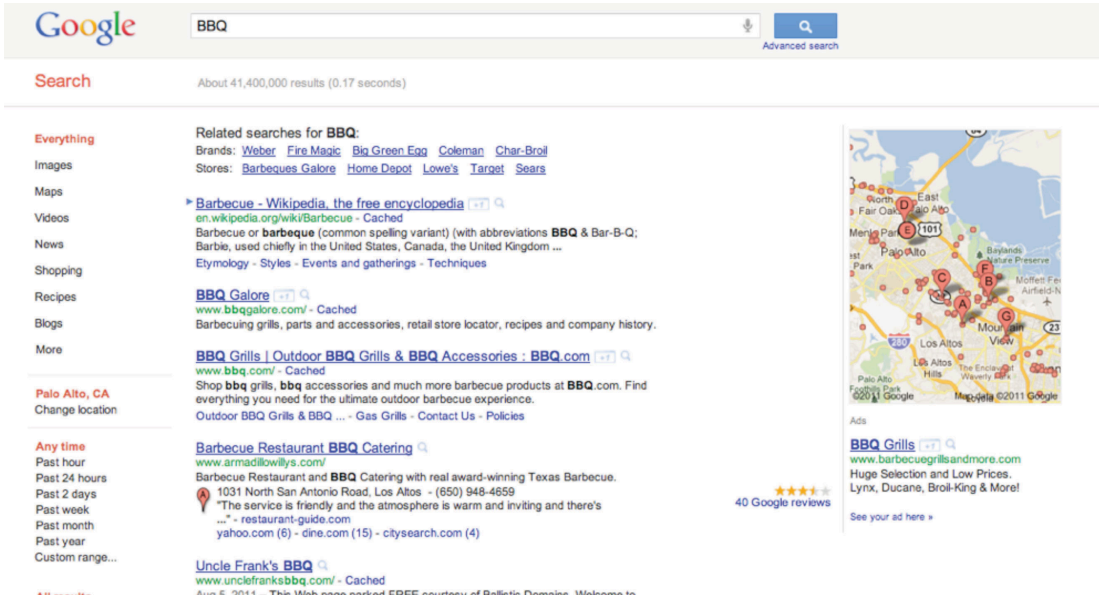
Identifying a user's physical location (sometimes called geolocation) for the purpose of delivering tailored ads or other content.

IP address

A value used to identify a device that is connected to the Internet. IP addresses are usually expressed as four numbers (from 0 to 255), separated by periods.

FIGURE 18.5 An Example of Geotargeting

In this geotargeting example, the same search term is used at roughly the same time on separate computers located in Silicon Valley area (Figure 18.5) and Boston (Figure 18.6). Note how geotargeting impacts the search results and that the Boston-based search includes a geotargeted ad that does not show up in the Palo Alto search.

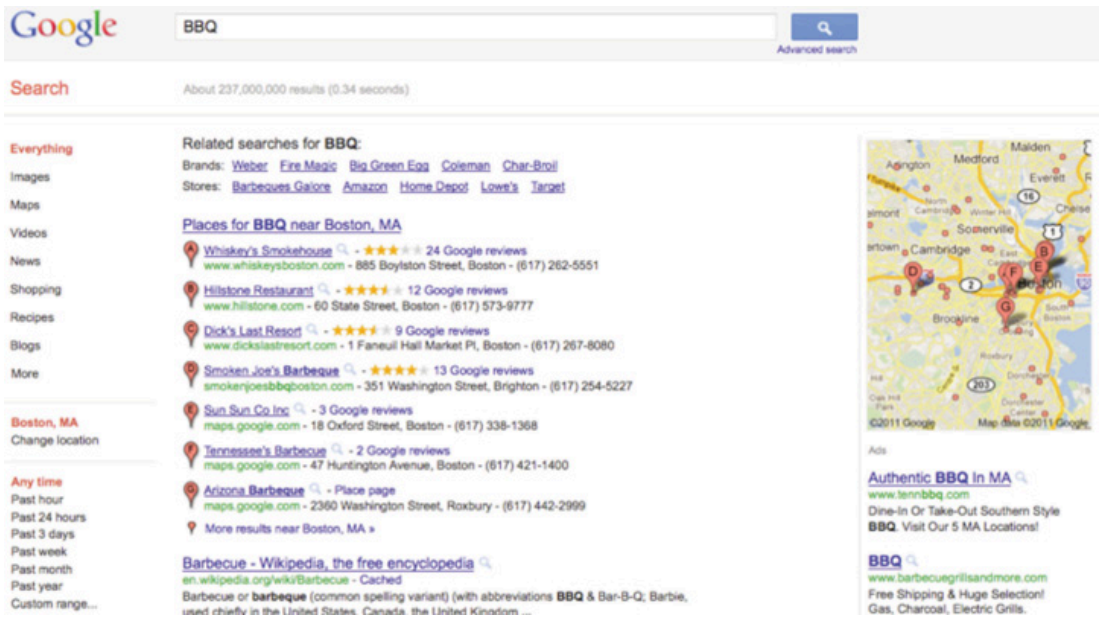


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FIGURE 18.6 An Example of Geotargeting



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IP addresses will change depending on how and where you connect to the Internet. Connect your laptop to a hotel's Wi-Fi when visiting a new city, and you're likely to see ads specific to that location. That's because your Internet service provider has changed, and the firm serving your ads has detected that you are using an IP address known to be associated with your new location.

Geotargeting via IP address is fairly accurate, but it's not perfect. For example, some Internet service providers may provide imprecise or inaccurate information on the location of their networks. Others might be so vague that it's difficult to make a best guess at the geography behind a set of numbers (values assigned by a multinational corporation with many locations, for example). And there are other ways locations are hidden, such as when Internet users connect to **proxy servers**, third-party computers that pass traffic to and from a specific address without revealing the address of the connected users.

proxy servers

A third-party computer that passes traffic to and from a specific address without revealing the address of the connected user.

Wi-Fi

A term used to brand wireless local-area networking devices. Devices typically connect to an antenna-equipped base station or hotspot, which is then connected to the Internet. Wi-Fi devices use standards known as IEEE 802.11, and various versions of this standard (e.g., b, g, n) may operate in different frequency bands and have access ranges.

global positioning system (GPS)

A network of satellites and supporting technologies used to identify a device's physical location.

Geotargeting Evolves Beyond the IP Address

There are several other methods of geotargeting. Firms like Skyhook Wireless/TruePosition, Apple, and Google can identify a location based on mapping **Wi-Fi** hotspots and nearby cell towers. Many mobile devices come equipped with **global positioning system (GPS)** chips (identifying location via the GPS satellite network). And if a user provides location values such as a home address or zip code to a website, then that value might be stored and used again to make a future guess at a user's location.

Many firms build and maintain accurate location databases by regularly collecting location information from smartphones and using this data to refine maps. Phones submit data anonymously; however, this process can be controversial.

Mobile Apps and the Challenge for Google Search

US mobile users spend roughly three hours each day on smartphones and tablets. While most online desktop time happens via the Web browser, mobile users spend an estimated 86 percent of their time in apps and only 14 percent on the Web. This shift concerns Google. When you search for restaurant reviews in Google's search engine, it can serve you ads and continue to build your user profile. But if you search via Yelp's app on an iPhone, Google can't see you at all. Yelp is thought to

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have earned about $550 million in ad revenue 2015, up over by 45 percent from the prior year and with the vast majority coming from mobile.[57] The growing list of context-specific apps that siphon users away from Google's Web search include Kayak and TripAdvisor for travel, Shazam for music, and even Amazon for shopping. And Apple's Siri is delivering results directly from its partners, making it the search broker, not Google. This fragmenting of mobile is having an impact on Google's share of mobile advertising.[58]

App owners are becoming even more useful advertisers with the rise of so-called **deep linking**. Deep linking allows an advertisement to launch an app and call up requested information, say, clicking a Pinterest link for a vintage handbag and jumping immediately to bag vendor's page within the Etsy app. And, of course, this app-to-app advertising cuts out Google even further.

deep linking

A link that takes a user to a specific webpage (rather than the home page), or which launches an app and brings up a unique location rather than just launching the app. As an example, a deep link from Pinterest might take a user directly to the Etsy web page or app listing featuring the vendor of that item, rather than generically opening Etsy.com or the Etsy app.

In 2012, Google had an 82.8 percent share of mobile searches, but research firm eMarketer estimates that when you consider the long tail of app-based searches that are occurring, Google's share was around 65.7 percent in 2014. The app-based niche searches like those mentioned previously have grown from 5.4 percent of mobile search to 22.9 percent in just two years.[59] Even though Google's percentage of mobile search ad revenue is declining, the firm's mobile search ad revenue is still going up. That's because the search ad pie is getting bigger as more users conduct more searches online. But the trends underscore how mobile is different (for more on the challenges of mobile, see Chapter 11). Google has offered additional features to give users a reason to stick with its search and map products. For example, a new hotel format offers the ability to see high-quality photos, hotel ratings and book a hotel right from within a Google listing. A new car format allows a panoramic scroll through the car, the ability to "build and price" a car, and find a dealer. A mortgage format allows for side-by-side comparisons.[60] And a new restaurant format can directly summon a food delivery service via deep link.[61]

Making Google more relevant, especially on mobile, makes sense, but the new functionality comes with risks. Google's move into travel booking is upsetting some of the firm's biggest customers. Priceline spends over $1.5 billion advertising with Google each year. Expedia spends over $1 billion. Just these two firms account for about a 5 percent chunk of Google revenue. If Google can create increased ad revenue directly from hotels, airlines, and other travel providers, this might help make up the difference, but that's a serious bit of channel pressure and market shift that would need to happen. More troubling are potential legal issues. Priceline and Expedia are also members of FairSearch.org, a group that accuses Google of using its dominance in search and other products to favor its own services above those of rivals.[62]

Key Takeaways

- More than two-thirds of Google's revenues come from ads served on its own sites, and the vast majority of this revenue comes from search engine ads.
- Search ads on Google are both more effective (in terms of click-through rate) and more sought after by advertisers, because they are often associated with a user's purchasing intent.
- Advertisers choose and bid on the keywords and phrases that they'd like to use to trigger the display of their ads.
- Advertisers pay for cost-per-click advertising only if an ad is clicked on. Google makes no money on CPC ads that are displayed but not clicked.
- Google determines ad rank by multiplying CPC by quality score. Ads with low ranks might not display at all.
- Advertisers usually don't pay their maximum CPC. Instead, Google discounts ads to just one cent more than the minimum necessary to maintain an ad's position on the page—a practice that encourages higher bids.
- Geotargeting occurs when computer systems identify a user's physical location (sometimes called geolocation) for the purpose of delivering tailored ads or other content.
- Google uses IP addresses to target ads.

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- Geotargeting can also be enabled by the satellite-based global positioning system (GPS) or based on estimating location from cell phone towers or Wi-Fi hotspots.
- The rise of apps as an alternative to search is a threat to Google and has shrunk the firm's percentage of mobile search. Deep linking allows websites and apps to link directly with content in other sites and apps, bypassing Google altogether. However, Google's revenues continue to rise as more users conduct more searches online.
- Google offers Web and app deep-linking, and new ad formats give the ability to do more in search and maps (e.g., compare and book hotel rooms, car shop). However, offering these services may alienate advertisers, some of whom spend $1 billion or more with Google. It also adds to concerns that Google uses its dominance in search and other categories to favor its products and services over those of rivals.

Questions and Exercises

1. Which firm invented pay-per-click advertising? Why does Google dominate today and not this firm?
2. How are ads sold via Google search superior to conventional advertising media such as TV, radio, billboard, print, and yellow pages? Consider factors like the available inventory of space to run ads, the cost to run ads, the cost to acquire new advertisers, and the appeal among advertisers.
3. Are there certain kinds of advertising campaigns and goals where search advertising wouldn't be a good fit? Give examples and explain why.
4. Can a firm buy a top ad ranking? Why or why not?
5. List the four factors that determine an ad's quality score.
6. How much do firms typically pay for a single click?
7. Sites like SpyFu.com and KeywordSpy.com provide a list of the keywords with the highest cost per click. Visit the Top Lists page at SpyFu, KeywordSpy, or a comparable site, to find estimates of the current highest paying cost per click. Which keywords pay the most? Why do you think firms are willing to spend so much?
8. What is bidder's remorse? How does Google's ad discounting impact this phenomenon?
9. Visit WhatIsMyIPaddress.com (or a similar website that displays a device's IP address) using a desktop, laptop, and mobile phone (work with a classmate or friend if you don't have access to one of these devices). How do results differ? Why? Are they accurate? What factors go into determining the accuracy of IP-based geolocation?
10. List and briefly describe other methods of geotargeting besides IP address, and indicate the situations and devices where these methods would be more and less effective.
11. The field of search engine marketing (SEM) is relatively new and rising in importance. And since the field is so new and constantly changing, there are plenty of opportunities for young, knowledgeable professionals. Which organizations, professional certification, and other resources are available to SEM professionals? Spend some time searching for these resources online and be prepared to share your findings with your class.
12. How do you, your friends, or your family members search on mobile devices? How has search changed over time? Are there certain product categories that you used to go to Google for, but where you'll now rely on an app? How do you suppose this impacts Google's revenue? If you were Google, how might you combat challenges as search shifts from a single search engine to niche apps?
13. What is Google doing to combat users migrating to other apps and services for their search? What are the risks in this approach?

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18.5 Ad Networks: Distribution Beyond Search

Learning Objectives

1. Understand ad networks, and how ads are distributed and served based on website content.
2. Recognize how ad networks provide advertiser reach and support niche content providers.
3. Be aware of content adjacency problems and their implications.
4. Know the strategic factors behind ad network appeal and success.

Google runs ads not just in search, but also across a host of Google-owned sites like Gmail, Google News, and Blogger. It will even tailor ads for its map products and for mobile devices. But close to 20 percent of Google's revenues come from running ads on websites and apps that the firm doesn't even own.

Next time you're surfing online, look around the different websites that you visit and see how many sport boxes labeled "Ads by Google." Those websites are participating in Google's **ad network**, which means they're running ads for Google in exchange for a cut of the take. Participants range from small-time bloggers to some of the world's most highly trafficked sites. Google lines up the advertisers, provides the targeting technology, serves the ads, and handles advertiser payment collection. To participate, content providers just sign up online, put a bit of Google-supplied HTML code on their pages, and wait for Google to send them cash (websites typically get about seventy cents for every AdSense dollar that Google collects).[63]

ad network

An effort that links advertisers to websites and other content providers (e.g., app firms, games) that are willing to host advertisements, typically in exchange for payment.

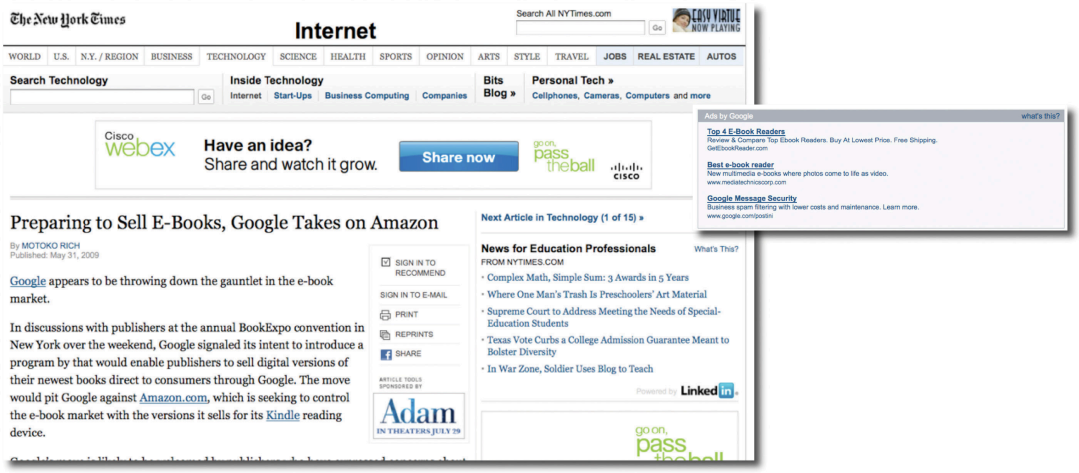
Google originally developed AdSense to target ads based on keywords automatically detected inside the content of a website. A blog post on your favorite sports team, for example, might be accompanied by ads from ticket sellers or sports memorabilia vendors. Ads can also be targeted based on other criteria, such as the profile of the user visiting a web page. And Google will serve ads to be displayed inside apps, as well. AdSense and similar online ad networks provide advertisers with access to the long tail of niche websites by offering both increased opportunities for ad exposure as well as more-refined targeting opportunities.

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FIGURE 18.7 Example of Embedded Advertising

The images show advertising embedded around a story on the *New York Times* website. The page runs several ads provided by different ad networks. For example, the WebEx banner ad above the article's headline was served by the AOL Advertising network. The "Ads by Google" box appeared at the end of the article. Note how the Google ads are related to the content of the *Times* article.



Source: The New York Times.

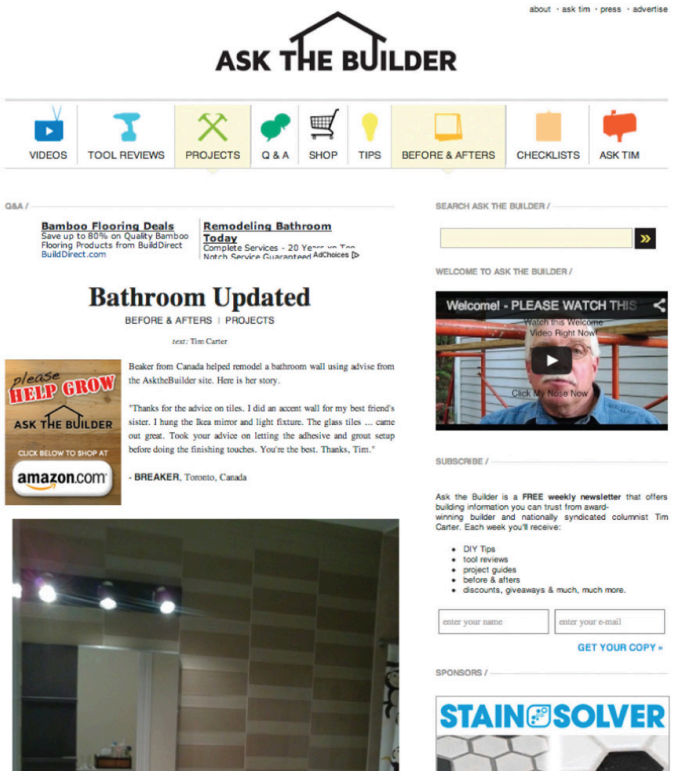
Some 65 percent of the top 200 ad-supported websites use AdSense for at least a portion of their ad revenue.[64] Google's AdSense program forks over more than $7 billion a year to more than 2 million publishers. There are now quite a few AdSense millionaires.[65] Running ads on your website is by no means a guaranteed path to profits. The Internet graveyard is full of firms that thought they'd be able to sustain their businesses on ads alone. But for many websites, ad networks can be like oxygen, sustaining them with revenue opportunities they'd never be able to achieve on their own.

AdSense content publishers ranging from the history buff behind HistoryOrb.com to the green-thumbed, silver-haired schoolteacher heading MooseysCountryGarden.com have quit their day jobs and now live off of their AdSense-fueled businesses. Handyman column writer Tim Carter saw his first-year AdSense income leap to more than $350,000.[66] AdSense even provided early revenue for the multimillion-dollar *TechCrunch* media empire (now owned by AOL, which itself is owned by Verizon).

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FIGURE 18.8 Examples of Different Ad Formats
Tim Carter's Ask the Builder website runs ads from Google and other ad networks. Note different ad formats surrounding the content. Video ads are also integrated into many of the site's video tutorials.



Source: AsktheBuilder.com.

Beware the Content Adjacency Problem

Contextual advertising based on keywords is lucrative, but like all technology solutions it has its limitations. Vendors sometimes suffer from **content adjacency problems** when ads appear alongside text they'd prefer to avoid. In one particularly embarrassing example, a *New York Post* article detailed a gruesome murder where hacked up body parts were stowed in suitcases. The online version of the article included contextual advertising and was accompanied by…luggage ads.[67]

To combat embarrassment, ad networks provide opportunities for both advertisers and content providers to screen out potentially undesirable pairings based on factors like vendor, website, and category. Advertisers can also use **negative keywords**, which tell networks to avoid showing ads when specific words appear (e.g., setting negative keywords to "murder" or "killer" could have spared luggage advertisers from the embarrassing problem mentioned above). Ad networks also refine ad-placement software based on feedback from prior incidents (for more about content adjacency problems, see Chapter 11).

contextual advertising
Advertising based on a website's content.

content adjacency problems
A situation where ads appear alongside text the advertiser would like to avoid.

negative keywords
Keywords that prevent an ad from showing up when specific terms are present.

Google bundles its third-party AdSense partners in with its own content properties (e.g., YouTube, Google Finance, Blogger, Gmail), calling this big pool of distribution for your ads the Google Display Network. And Google is by no means the only company to run an ad network; nor was it the first to come up with the idea. Rivals include Yahoo! and AOL's Advertising.com. Advertisers also aren't limited to choosing just one ad network. In fact, many websites will serve ads from several ad networks (as well as exclusive space sold by their own sales force), oftentimes mixing several different offerings on the same page.

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Ad Networks and Competitive Advantage

While advertisers can use multiple ad networks, there are several key strategic factors driving the industry. For Google, its ad network is a distribution play. The ability to reach more potential customers across more websites attracts more advertisers to Google. And content providers (the websites that distribute these ads) want there to be as many advertisers as possible in the ad networks that they join, since this should increase the price of advertising, the number of ads served, and the accuracy of user targeting. If advertisers attract content providers, which in turn attract more advertisers, then we've just described network effects! It also doesn't hurt that Google's search ad business is a great way to gain exposure for its other ad offerings. More participants bringing in more revenue also help the firm benefit from scale economies—offering a better return on investment from its ad technology and infrastructure. All this has worked to help Google build an ad network that serves nearly four times the ads of its nearest rival.[68] No wonder Google's been on such a tear—the firm's loaded with assets for competitive advantage!

Key Takeaways

- Google also serves ads through non-Google partner sites that join its ad network. These partners distribute ads for Google in exchange for a percentage of the take.
- AdSense ads are targeted based on keywords that Google detects inside the content of a website.
- AdSense and similar online ad networks provide advertisers with access to the long tail of niche websites.
- Ad networks handle advertiser recruitment, ad serving, and revenue collection, opening up revenue-earning possibilities to even the smallest publishers.

Questions and Exercises

1. On a percentage basis, how important is AdSense to Google's revenues?
2. Why do ad networks appeal to advertisers? Why do they appeal to content providers? What functions are assumed by the firm overseeing the ad network?
3. What factors determine the appeal of an ad network to advertisers and content providers? Which of these factors are potentially sources of competitive advantage?
4. Do dominant ad networks enjoy strong network effects? Are there also strong network effects that drive consumers to search? Why or why not?
5. How difficult is it for a website to join an ad network? What does this imply about ad network switching costs? Does it have to exclusively choose one network over another? Does ad network membership prevent a firm from selling its own online advertising, too?
6. What is the content adjacency problem? Why does it occur? What classifications of websites might be particularly susceptible to the content adjacency problem? What can advertisers do to minimize the likelihood that a content adjacency problem will occur?

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18.6 More Ad Formats and Payment Schemes

Learning Objectives

1. Know the different formats and media types where Web ads can be displayed.
2. Know the different ways ads are sold.
3. Know that games can be an ad channel under the correct conditions.

Online ads aren't just about text ads paid for on a cost-per-click (CPC) basis. Ads running through the Google Display Network or on most competitor networks can be displayed in several formats and media types, and can be billed in different ways. The specific ad formats supported depend on the ad network but can include the following: **display (or image) ads** (such as horizontally oriented banners, smaller rectangular buttons, and vertically oriented "skyscraper" ads); **rich media ads** (which can include animation or video and sometimes encourage user engagement or interaction); and **interstitials** (ads that run before a user arrives at his or her intended destination in a website or app). There are also various formats for other forms of digital advertising, as such video and in-app ads. The industry trade group, the **Internet Advertising Bureau (IAB)**, sets common standards for display ads so that a single creative (the design and content of the advertisement) can run unmodified across multiple ad networks and websites.[69]

And there are lots of other ways ads are sold besides cost-per-click. Most graphical display ads are sold according to the number of times the ad appears (the number of impressions). Ad rates are quoted in **CPM**, meaning cost per thousand impressions (the M representing the roman numeral for one thousand). Display ads sold on a CPM basis are often used as part of branding campaigns targeted more at creating awareness than generating click-throughs. Such techniques often work best for promoting products like soft drinks, toothpaste, or movies.

display (or image) ads

Graphical advertising (as opposed to text ads).

rich media ads

Online ads that include animation, audio, or video.

interstitials

Ads that run before a user arrives at his or her intended destination in a website or app.

Internet Advertising Bureau (IAB)

A nonprofit industry trade group for the interactive advertising industry. The IAB evaluates and recommends interactive advertising standards and practices and also conducts research, education, and legislative lobbying.

CPM

Cost per thousand impressions (the M representing the roman numeral for one thousand).

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cost-per-action (CPA)

A method of charging for advertising whenever a user responds to an ad by performing a specified activity such as signing up for a service, requesting material, or making a purchase.

affiliate programs

A cost-per-action program, where program sponsors (e.g., Amazon, iTunes) pay referring websites a percentage of revenue earned from the referral.

Cost-per-action (CPA) ads pay whenever a a user responds to an ad by performing a specified activity such as signing up for a service, requesting material, or making a purchase. **Affiliate programs** are a form of cost-per-action, where vendors share a percentage of revenue with websites that direct purchasing customers to their online storefronts. Amazon runs the world's largest affiliate program, and referring sites can earn 4 percent to 15 percent of sales generated from these click-throughs. Purists might not consider affiliate programs as advertising (rather than text or banner ads, Amazon's affiliates offer links and product descriptions that point back to Amazon's website), but these programs can be important tools in a firm's promotional arsenal.

And rather than buying targeted ads, a firm might sometimes opt to become an exclusive advertiser on a site. For example, a firm can purchase all ads served on a site's main page; it could secure exclusive access to a region of the page (such as the topmost banner ad); or it may pay to sponsor a particular portion or activity on a website (say a parenting forum, or a "click-to-print" button). Such deals can be billed based on a flat rate, CPM, CPC, or any combination of metrics.

Key Takeaways

- Web ad formats include, but are not limited to, the following: *display* (or *image*) *ads* (such as horizontally oriented *banners*, smaller rectangular *buttons*, and vertically oriented *skyscraper ads*), *rich media ads* (which can include animation or video), and *interstitials* (ads that run before a user arrives at a website's contents).
- In addition to cost-per-click, ads can be sold based on the number of times the ad appears (impressions); whenever a user performs a specified action such as signing up for a service, requesting material, or making a purchase (cost-per-action); or on an exclusive basis which may be billed at a flat rate.
- CPM (cost per thousand impressions) ads are often best suited for brand or awareness campaigns that aren't looking to solicit a click-through or other action but rather are more focused on conveying a message to an audience.

Questions and Exercises

1. What is the IAB and why is it necessary?
2. What are the major ad format categories?
3. What's an interstitial? What's a rich media ad? Have you seen these? Do you think they are effective? Why or why not?
4. List four major methods for billing online advertising.
5. Which method is used to bill most graphical advertising? What's the term used for this method and what does it stand for?
6. How many impressions are recorded if a single user is served the same ad one thousand times? How many if one thousand users are served the same ad once?
7. Imagine the two scenarios below. Decide which type of campaign would be best for each: text-based CPC advertising or image ads paid for on a CPM basis. Explain your reasoning.
    a. Netflix is looking to attract new customers by driving traffic to its website in hopes that this will increase subscriptions.
    b. A movie studio would like to promote the upcoming theatrical release of a new major motion picture.
8. Which firm runs the world's largest affiliate program? Why is this form of advertising particularly advantageous to the firm (think about the ROI for this sort of effort)?

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18.7 Customer Profiling and Behavioral Targeting

Learning Objectives

1. Be familiar with various tracking technologies and how they are used for customer profiling and ad targeting.
2. Understand why customer profiling is both valuable and controversial.
3. Recognize steps that organizations can take to help ease consumer and governmental concerns.

cookies

A line of identifying text, assigned and retrieved by a given Web server and stored by your browser.

Advertisers are willing to pay more for ads that have a greater chance of reaching their target audience, and online firms have a number of targeting tools at their disposal. Much of this targeting occurs whenever you visit a website, where a behind-the-scenes software dialogue takes place between Web browser and Web server that can reveal a number of pieces of information, including IP address, the type of browser used, the computer type, its operating system, and unique identifiers, called **cookies**.

And remember, *any* server that serves you content can leverage these profiling technologies. You might be profiled not just by the website that you're visiting (e.g., nytimes.com), but also by any ad networks that serve ads on that site (e.g., Google, AOL, Yahoo!/Bing).

IP addresses are leveraged extensively in customer profiling. An IP address not only helps with geolocation, it can also indicate a browser's employer or university, which can be further matched with information such as firm size or industry. IBM has used IP targeting to tailor its college recruiting banner ads to specific schools, for example, "There Is Life After Boston College, Click Here to See Why." That campaign garnered click-through rates ranging from 5 to 30 percent[70] compared to average rates that are currently well below 1 percent for untargeted banner ads. DoubleClick once even served a banner that included a personal message for an executive at then-client Modem Media. The ad, reading "Congratulations on the twins, John Nardone," was served across hundreds of sites, but was only visible from computers that accessed the Internet from the Modem Media corporate network.[71]

The ability to identify a surfer's computer, browser, or operating system can also be used to target tech ads. For example, Google might pitch its Chrome browser to users detected running Internet Explorer, Firefox, or Safari; while Apple could target Mac ads just to Windows users.

But perhaps the greatest degree of personalization and targeting comes from cookies. Visit a website for the first time, and in most cases, a dialogue between server and browser takes place that goes something like this:

Server: *Have I seen you before?*

Browser: *No.*

Server: *Then take this unique string of numbers and letters (called a cookie). I'll use it to recognize you from now on.*

The cookie is just a line of identifying text assigned and retrieved by a given Web server and stored on your computer by your browser. Upon accepting this cookie your browser has been tagged, like an animal. As you surf around the firm's website, that cookie can be used to build a profile associated with your activities. If you're on a portal like Yahoo! you might type in your zip code, enter stocks that you'd like to track, and identify the sports teams you'd like to see scores for. The next time you return to the website, your browser responds to the server's "*Have I seen you before?*"

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question with the equivalent of "*Yes, you know me*," and it presents the cookie that the site gave you earlier. The site can then match this cookie against your browsing profile, showing you the weather, stock quotes, sports scores, and other info that it thinks you're interested in.

Google and others provide a service called **remarketing** (also called **retargeting**), where site operators can tag users according to which page they visit on their site. They can then use this info to serve up tailored ads and special offers to that user as they browse the Web. Visited a scuba suit page on an e-commerce site? That same website can target you with special promotions, custom ads, or even dynamically generated ads when searching Google or visiting any site in the Google Display Network.[72]

Cookies are used for lots of purposes. Retail websites like Amazon use cookies to pay attention to what you've shopped for and bought, tailoring websites to display products that the firm suspects you'll be most interested in. Sites also use cookies to keep track of what you put in an online "shopping cart," so if you quit browsing before making a purchase, these items will reappear the next time you visit. And many websites also use cookies as part of a "remember me" feature, storing user IDs and passwords. Beware this last one! If you check the "remember me" box on a public Web browser, the next person who uses that browser is potentially using *your* cookie, and can log in as you!

An organization can't read cookies that it did not give you. So businessweek.com can't tell if you've also got cookies from forbes.com. But you can see all of the cookies in your browser. Take a look and you'll almost certainly see cookies from dozens of websites that you've never visited before. These are **third-party cookies** (sometimes called *tracking cookies*), and they are usually served by ad networks or other customer-profiling firms.

By serving and tracking cookies in ads shown across partner sites, ad networks can build detailed browsing profiles that include sites visited, specific pages viewed, duration of visit, and the types of ads you've seen and responded to. And that surfing might give an advertising network a better guess at demographics like gender, age, marital status, and more. Visit a new parent site and expect to see diaper ads in the future, even when you're surfing for news or sports scores!

remarketing

Lets a website show custom, targeted ads to a user when visiting other sites if that user has already visited a given page on the advertiser's site. This technique allows firms to "reintroduce" products to users or target them with special messages or promotions.

retargeting

Also known as *remarketing*, a form of online targeted advertising where ads are personalized for consumers based on previous Internet activity that did not result in a sale or conversion. Surf the Web and see ads for products you've looked at on other sties? This is likely a result of retargeting.

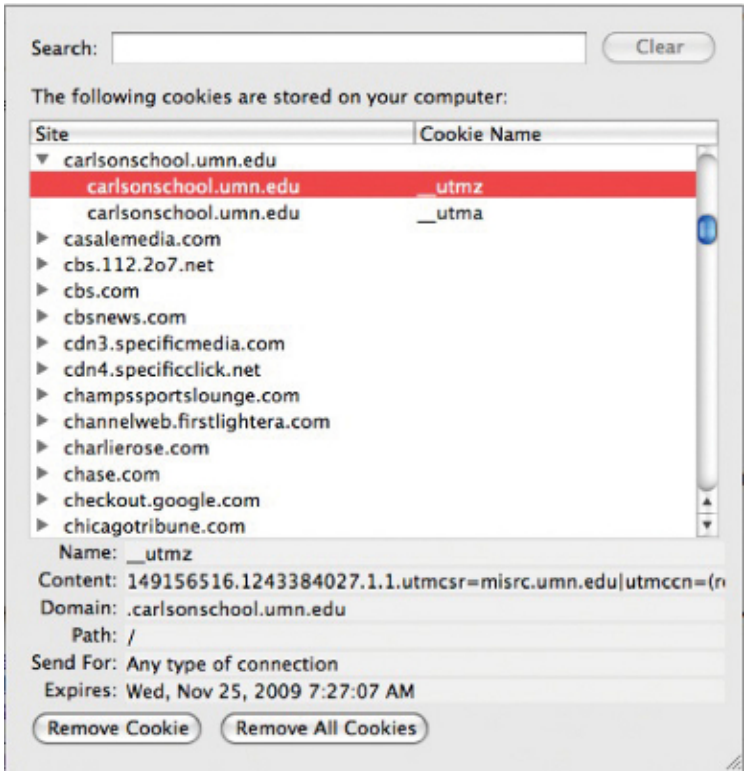
third-party cookies

Sometimes called "tracking cookies" and are served by ad networks or other customer-profiling firms. Tracking cookies are used to identify users and record behavior across multiple websites.

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FIGURE 18.9 Web Browser Preference Settings
The Preferences setting in most Web browsers allows you to see its cookies. This browser has received cookies from several ad networks, media sites, and the University of Minnesota Carlson School of Management.



But What If I Don't Want a Cookie!

If all of this creeps you out, remember that you're in control. The most popular Web browsers allow you to block all cookies, block just third-party cookies, purge your cookie file, or even ask for your approval before accepting a cookie. Of course, if you block cookies, you block any benefits that come along with them, and some website features may require cookies to work properly. Also note that while deleting a cookie breaks a link between your browser and that website, if you supply identifying information in the future (say by logging into an old profile), the site might be able to assign your old profile data to the new cookie.

While the Internet offers targeting technologies that go way beyond traditional television, print, and radio offerings, none of these techniques is perfect. Since users are regularly assigned different IP addresses as they connect and disconnect from various physical and Wi-Fi networks, IP targeting can't reliably identify individual users. Cookies also have their weaknesses. They're assigned by browsers and associated with a given user's account on that computer. That means that if several people use the same browser on the same computer without logging on to that machine as separate users, then all their Web surfing activity may be mixed into the same cookie profile. (One solution is to create different log-in accounts on that computer. Your PC will then keep separate cookies for each account.) Some users might also use different browsers on the same machine or use different computers. Unless a firm has a way to match up these different cookies assigned across browsers (say by linking cookies on separate machines to a single log-in used at multiple locations), then a site may be working with multiple, incomplete profiles.

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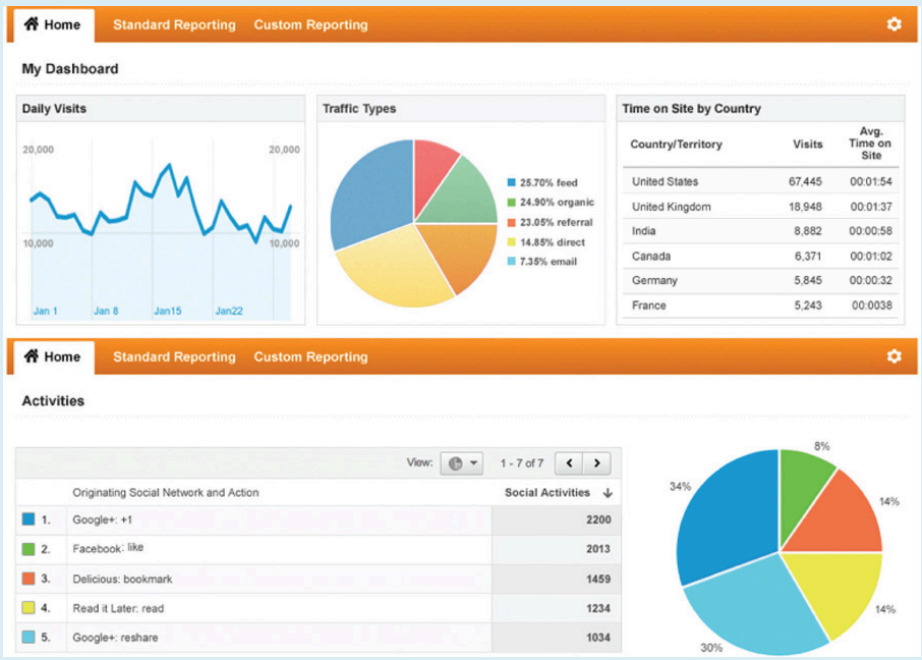
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Big Data Analytics: Even for the Little Guy

In order to help arm firms with the insight needed for SEO, SEM, improved website design, and effective online marketing and promotion, Google offers a suite of tracking and analysis tools via a service it calls Google Analytics. The base service is offered free to websites of all sizes, with premium offerings and support available for a fee.

Using analytics, a content provider can collect statistics on its website or app's traffic, traffic sources (search engine, website, app, geographic origin, or even e-mail or .pdf link), user behavior on site (new/returning visitor stats, pages visited, etc.), sales and advertising success, social media analysis, and more. Analytics typically involve harvesting data that browsers and servers produce on their own, along with data from pages and apps that a firm will tag in advance and data from tracking cookies used to identify users. Google Analytics has more than an 80 percent market share.[73]

FIGURE 18.10 Google Analytics Sample Screens



Source: Google. © 2017 Google Inc. All rights reserved.

Apps, Mobile Browsing, and Default Settings: The Shifting Landscape of Profiling Technology

Mobile apps don't use cookies, as cookies are a Web-based technology. The technologies for providing a cookie-like feature in mobile apps continue to be developed. Google offers an in-app tracking scheme called Advertising ID; Apple's is called IDFA (Identifier for Advertisers). These technologies are critical for tracking things like ad impression views and click-throughs, but the two schemes behave differently and standards for both schemes have changed in just the past year.

Apple's Safari browser also disables third-party cookies by default. This is a big deal because while Android holds a much larger market share than iOS, Apple users browse way more than anyone else, and Safari holds more than 50 percent share of mobile browser usage.[74] Microsoft has also disabled cookies as the default option for Internet Explorer.[75] When these settings are in effect, traditional cookie-based user profiling by ad networks simply isn't possible.

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Apple has also shut down another way mobile users were being tracked using the MAC (media access control) address. The MAC address is a permanent and unique identifier baked into every network-connected device (think of it as an unchanging IP address). All desktop, laptop, tablets, and smartphones have a MAC address. Many retailers were using MAC addresses on Wi-Fi–enabled phones to surreptitiously track store foot traffic.[76] In iOS8, Apple began randomizing the MAC number when these sorts of "Wi-Fi probe" requests were made, making it impossible to rely on any reported MAC number as a unique identifier for a repeat visitor. Apple is promoting a new location-based tracking system called iBeacon, which uses Bluetooth and (unlike MAC address snooping) can be turned off by users who wish to stay anonymous.

Taken collectively, these developments show that tracking technologies remain in flux, what works on the desktop doesn't necessarily work on mobile, and that default settings may be changed over time in ways that make life difficult for Google and other firms that rely on digital ad revenue. One analyst suggests that about half of all digital advertising spending leverages third-party cookies, and the shifts previously mentioned put these dollars in jeopardy.[77] Anyone with a stake in the digital advertising world—that is, advertisers, content operators, ad networks, even employees, investors, and regulators—will need to continually monitor the shifting landscape. It's not an understatement to say that billions in revenues are at stake.

Key Takeaways

- The communication between Web browser and Web server can identify IP address, the type of browser used, the computer type, its operating system, time and date of access, and duration of Web page visit, and can read and assign unique identifiers, called cookies—all of which can be used in customer profiling and ad targeting.
- An IP address not only helps with geolocation; it can also be matched against other databases to identify the organization providing the user with Internet access (such as a firm or university), and that organization's industry, size, and related statistics.
- A cookie is a unique line of identifying text, assigned and retrieved by a given Web server and stored on a computer by the browser, that can be used to build a profile associated with your Web activities.
- The most popular Web browsers allow you to block all cookies, block just third-party cookies, purge your cookie file, or even ask for your approval before accepting a cookie.
- Retargeting, or remarketing, allows advertisers to serve targeted ads to consumers who may have viewed a product page but did not buy that product. Google and other ad networks support retargeting.
- Cookies are a web-based technology, so they don't work in apps. Firms like Google and Apple have app-based tracking technology to help monetize ads (tracking clicks and impressions), but these technologies differ across platforms.
- Apple and Microsoft have also limited the use of cookies in their browser and mobile products. Apple has also shut off the ability of third parties to reach the MAC address, a unique number that many used to track mobile users. All these developments suggest that the future of profiling and ad technology is in flux, and managers who have a stake in this game will need to pay attention to future developments.

Questions and Exercises

1. Give examples of how the ability to identify a surfer's computer, browser, or operating system can be used to target tech ads.
2. Describe how IBM targeted ad delivery for its college recruiting efforts. What technologies were used? What was the impact on click-through rates?
3. What is a cookie? How are cookies used? Is a cookie a computer program? Which firms can read the cookies in your Web browser?

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4. Does a cookie accurately identify a user? Why or why not?
5. What is the danger of checking the "remember me" box when logging in to a website using a public computer?
6. What's a third-party cookie? What kinds of firms might use these? How are they used?
7. How can users restrict cookie use on their Web browsers? What is the downside of blocking cookies? Check your desktop and mobile devices. What is your current setting for cookie tracking?
8. As firms like Microsoft and Apple block tracking technologies or set defaults for higher levels of user privacy, how might this impact the future of the ad-based Internet?
9. What is remarketing? Have you ever seen an ad that you suspect was part of a remarketing effort? If so, describe what you experienced. Do you think remarketing is effective? Why or why not?
10. Work with a faculty member and join the Google Online Marketing Challenge (held in the spring of every year—see http://www.google.com/onlinechallenge). Google offers ad credits for student teams to develop and run online ad campaigns for real clients and offers prizes for winning teams. Some of the experiences earned in the Google Challenge can translate to other ad networks as well, and firsthand client experience has helped many students secure jobs, internships, and even start their own businesses.

18.8 Profiling and Privacy

Learning Objectives

1. Understand the privacy concerns that arise as a result of using third-party or tracking cookies to build user profiles.
2. Be aware of the negative consequences that could result from the misuse of third-party or tracking cookies.
3. Know the steps Google has taken to demonstrate its sensitivity to privacy issues.
4. Know the kinds of user information that Google stores, and the steps Google takes to protect the privacy of that information.

While AdSense has been wildly successful, contextual advertising has its limits. For example, what kind of useful targeting can firms really do based on the text of a news item on North Korean nuclear testing?[78] For more accurate targeting, Google offers what it calls "interest-based ads," which is based on a third-party cookie that tracks browsing activity across Google properties and AdSense partner sites. AdSense builds a profile, identifying users within dozens of broad categories and over six hundred subcategories.[79] Of course, there's a financial incentive to do this too. Ads deemed more interesting should garner more clicks, meaning more potential customer leads for advertisers, more revenue for websites that run AdSense, and more money for Google.

Click-throughs and online purchases are great, but online ads influence offline sales, too. A study by Forrester found mobile devices were used in over one-third of all US retail sales at some point in the buying process—including research, price comparisons, and purchases. That's involvement in about $1 trillion in sales.[80] If Google can prove its ads drive in-store sales, it can make the case for greater online ad spending. In a scheme similar to Facebook's, Google is partnering with Axciom, a firm that collects information on customer e-mail addresses. If the Google cookie can be matched to a user's e-mail address, then we can identify that a user has seen an ad. If that user walks into a store, buys something, and the vendor can match their e-mail address to that purchase (perhaps they gave it to receive e-mail coupons or a loyalty card, or they've previously bought

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online), then a trail from "Saw the ad" to "bought the product" can be drawn. To avoid a total user creep-out, the user tracking is collected and reported in aggregate and anonymously, and that in this system, no identifying information on users is stored or reported. It's also far from a completely representative system. On Android phones Google's partners can connect just 15 to 20 percent of mobile ads to a customer account, and far fewer for harder-to-track iPhones, but for some retailers, that's enough of a sample to demonstrate ROI on ad spending. Home Depot's VP of online marketing says the data "confirmed our commitment" to search ads on smartphones.[81] Target execs claim that one-third of Target's mobile-search ads led to a user visiting one of its stores during the 2014 holiday season.[82]

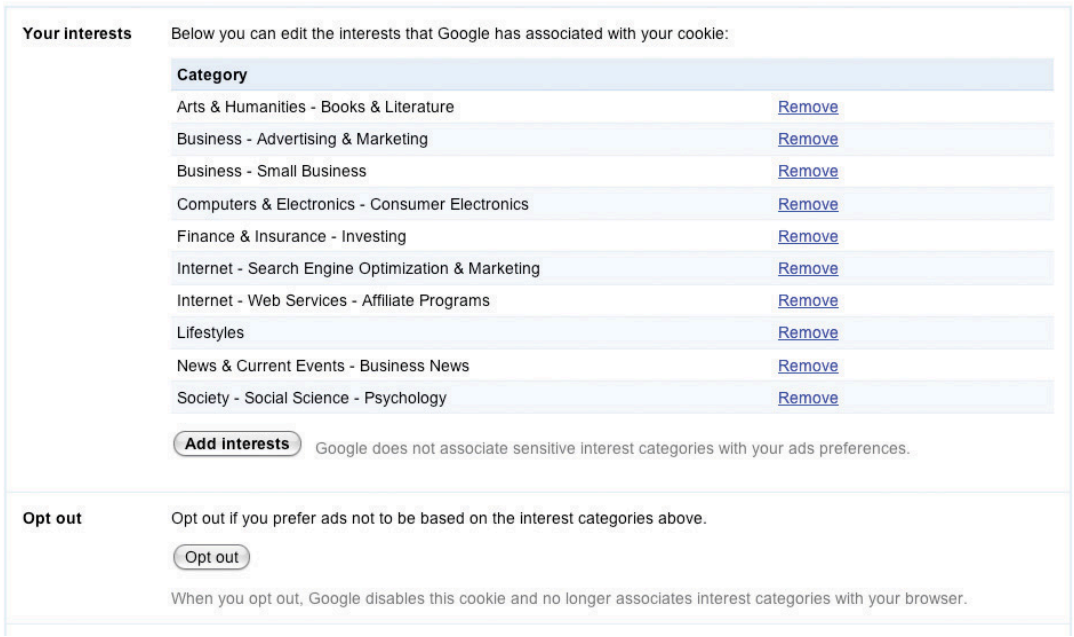
While targeting can benefit Web surfers, users will resist if they feel that they are being mistreated, exploited, or put at risk. Negative backlash might also result in a change in legislation. The US Federal Trade Commission has already called for more transparency and user control in online advertising and for requesting user consent (**opt-in**) when collecting sensitive data.[83] Mishandled user privacy could curtail targeting opportunities, limiting growth across the online advertising field. And with less ad support, many of the Internet's free services could suffer.

opt-in

Program (typically a marketing effort) that requires customer consent. This program is contrasted with opt-out programs, which enroll all customers by default.

FIGURE 18.11 Example of User Interests Tracked by Google

Here’s an example of one user’s interests, as tracked by Google’s “Interest-based Ads” and displayed in the firm’s “Ad Preferences Manager.”



 Source: © 2017 Google Inc. All rights reserved.

Google's roll-out of interest-based ads shows the firm's sensitivity to these issues. The firm has also placed significant control in the hands of users, with options at program launch that were notably more robust than those of its competitors.[84] Each interest-based ad is accompanied by an "Ads by Google" link that will bring users to a page describing Google advertising and which provides access to the company's "Ads Preferences Manager." This tool allows surfers to see any of the hundreds of potential categorizations that Google has assigned to that browser's tracking cookie. Users can remove categorizations, and even add interests if they want to improve ad targeting. Some topics are too sensitive to track, and the technology avoids profiling race, religion, sexual orientation, health, political or trade union affiliation, and certain financial categories.[85]

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plug-in

A small computer program that extends the feature set or capabilities of another application.

opt-out

Programs that enroll all customers by default, but that allow consumers to discontinue participation if they want to.

Google also allows users to install a cookie that opts them out of interest-based tracking. And since browser cookies can expire or be deleted, the firm has gone a step further, offering a browser **plug-in** that will remain permanent, even if a user's **opt-out** cookie is purged.

Google, Privacy Advocates, and the Law

Google's moves are meant to demonstrate transparency in its ad targeting technology, and the firm's policies may help raise the collective privacy bar for the industry. While privacy advocates have praised Google's efforts to put more control in the hands of users, many continue to voice concern over what they see as the increasing amount of information that the firm houses.[86] For an avid user, Google could conceivably be holding e-mail (Gmail), photos (Picasa), social media activity (Google+), a Web-surfing profile (AdSense and DoubleClick), location (Google Maps), appointments (Google Calendar), music and other media (Google Play), files stored in the cloud (Google Drive), transcripts of phone messages (Google Voice), work files (Google Docs), and more.

Google insists that reports portraying it as a data-hoarding Big Brother are inaccurate. Data is not sold to third parties. Any targeting is fully disclosed, with users empowered to opt out at all levels.[87] Google has introduced several tools, including Google Dashboard and Google Ad Preferences Manager, that allow users to see information Google stores about them, clear their browsing history, and selectively delete collected data.[88] But critics counter that corporate intentions and data use policies (articulated in a website's Terms of Service) can change over time, and that a firm's good behavior today is no guarantee of good behavior in the future.[89] Google has modified its policy several times in the past, including changes that now allow the firm to link search history to ad targeting. It has also unified its privacy policy in a way that allows for greater profiling, sharing, and tailored services across Google offerings.[90]

Google does enjoy a lot of user goodwill, and it is widely recognized for its unofficial motto "Don't Be Evil." However, some worry that even though Google might not be evil, it could still make a mistake, and that despite its best intentions, a security breach or employee error could leave data dangerously or embarrassingly exposed.

Gaffes have repeatedly occurred. A system flaw inadvertently shared some Google Docs with contacts who were never granted access to them.[91] When the firm introduced its now-scuttled Google Buzz social networking service, many users were horrified that their most frequently used Gmail contacts were automatically added to Buzz, allowing others to see who you're communicating with. As one report explained, "Suddenly, journalists' clandestine contacts were exposed, secret affairs became dramatically less secret, and stalkers obtained a new tool to harass their victims. Oops."[92] Google admitted that some of its "Street View" cars, while driving through neighborhoods and taking photos for Google maps, had inadvertently collected personal data, including e-mails and passwords.[93] Google scrambled to plug a hole that could potentially allow hackers to access the contacts, calendars, and photos on Android phones connecting to the Internet over open Wi-Fi networks.[94] A rogue employee was fired for violating the firm's strict guidelines and procedures on information access.[95] In addition, the firm has been accused of bypassing privacy settings in Apple's Safari Web browser in order to better track users.[96]

Privacy advocates also worry that the amount of data stored by Google serves as one-stop shopping for litigators and government investigators—a concern that gained even more attention following the disclosure of the US government's Prism surveillance program.[97] The counterargument points to the fact that Google has continually reflected an aggressive defense of data privacy in court cases. Following Prism disclosures, Google asked the US Foreign Intelligence Surveillance Court to rescind a gag order barring the firm from revealing government information requests.[98] When Viacom sued Google over copyright violations in YouTube, the search giant successfully fought the original subpoena, which had requested user-identifying information.[99] Google has also resisted Justice Department subpoenas for search queries, while rivals have complied.[100] Google has also claimed that it has been targeted by some foreign governments that are deliberately hacking or interfering with the firm's services in order to quash some information sharing and to uncover dissident activity.[101]

Google is increasingly finding itself in precedent-setting cases where the law is vague. Google's Street View, for example, has been the target of legal action in the United States, Canada, Japan, Greece, and the United Kingdom. Varying legal environments create a challenge to the global rollout of any data-driven initiative.[102] European courts have ruled that EU citizens have the so-called

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right to be forgotten and can demand that search engines remove links to information deemed "inadequate, irrelevant or no longer relevant, or excessive in relation to the purposes for which they were processed."[103] Does this sound vague? Enforcement of this ruling may be challenging for Google.[104] And rivals are ready to cast Google as a voracious data tracker. Apple has begun to play up the firm's contrast with Google, claiming "You are not our product."[105]

Ad targeting brings to a head issues of opportunity, privacy, security, risk, and legislation. Google is now taking a more active public relations and lobbying role to prevent misperceptions and to be sure its positions are understood. While the field continues to evolve, Google's experience will lay the groundwork for the future of personalized technology and provide a case study for other firms that need to strike the right balance between utility and privacy. Despite differences, it seems clear to Google, its advocates, and its detractors that with great power comes great responsibility.

Key Takeaways

- Possible consequences resulting from the misuse of customer tracking and profiling technologies include user resistance and legislation. Mishandled user privacy could curtail targeting opportunities and limit growth in online advertising. With less ad support, many of the Internet's free services could suffer.
- Google has taken several steps to protect user privacy. The firm offers several tools that enable users not only to see information that Google collects but also to delete, pause, or modify data collection and profiling terms.
- Google's "Ads Preferences Manager" allows surfers to see, remove, and add to any of the categorizations that Google has assigned to that browser's tracking cookie. The technology also avoids targeting certain sensitive topics. The firm's Privacy Dashboard provides additional access to and user control over Google's profiling and data collection.
- Google allows users to install a cookie or plug-in that opts them out of interest-based tracking.
- Google has begun to partner with third-party firms to tie together its data on consumer ad viewership to in-store visits. While not perfect, the data has shown that many users who view online ads go on to make in-store purchases. Google's data is reported in aggregate, and not on any individual user.
- Some privacy advocates have voiced concern over what they see as the increasing amount of information that Google and other firms collect. Apple is among the firms that have contrasted their approach to products, privacy, and business models with Google's ad-driven, profiling methods.
- Even the best-intentioned and most competent firms can have a security breach that compromises stored information. Google has suffered privacy breaches from product flaws and poorly planned feature rollouts, as well as deliberate hacks and attacks. The firm has also changed policies regarding data collection and privacy as its services have evolved. Such issues may lead to further investigation, legislation, and regulation.

Questions and Exercises

1. Gmail uses contextual advertising. The service will scan the contents of e-mail messages and display ads off to the side. Test the "creep-out" factor in Gmail—create an account (if you don't already have one), and send messages to yourself with controversial terms in them. Which ones showed ads? Which ones didn't?
2. Google has never built user profiles based on Gmail messages. Ads are served based on a real-time scanning of keywords. Is this enough to make you comfortable with Google's protection of your own privacy? Why or why not?
3. List the negative consequences that could result from the misuse of tracking cookies.

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4. What steps does Google take to protect the privacy of user information? What steps has Google taken to give users control over the user data that the firm collects and the ads the users wish to see?
5. Which topics does "Ads Preferences Manager" avoid in its targeting system?
6. Visit Google's Ad Preferences page. Is Google tracking your interests? Do you think the list of interests is accurate? Browse the categories under the "Ad Interest" button. Would you add any of these categories to your profile? Why or why not? What do you gain or lose by taking advantage of Google's "Opt Out" option? Visit rival ad networks. Do you have a similar degree of control? More or less?
7. Visit Google Dashboard. What information is Google collecting about you? Does any of this surprise you? How do you suppose the firm uses this to benefit you? After seeing this information, did you make any changes to the settings in the privacy center? Why or why not?
8. List the types of information that Google might store for an individual. Do you feel that Google is a fair and reliable steward for this information? Are there Google services or other online efforts that you won't use due to privacy concerns? Why?
9. What do you think of the Google-Acxiom partnership to show online ad influence for offline purchasing. Does this concern you? Why or why not?
10. Google's "interest-based advertising" was launched as an opt-out effort. What are the pros and cons for Google, users, advertisers, and AdSense partner sites if Google were to switch to an opt-in system? How would these various constituencies be impacted if the government mandated that users explicitly opt in to third-party cookies and other behavior-tracking techniques?
11. What is Google's unofficial motto?
12. What is "Street View"? Where and on what grounds is it being challenged?
13. Cite two court cases where Google has mounted a vigorous defense of data privacy.
14. *Wired News* quoted a representative of privacy watchdog group. the Center for Digital Democracy, who offered a criticism of online advertising. The representative suggested that online firms were trying to learn "everything about individuals and manipulate their weaknesses" and that the federal government should "investigate the role [that online ads] played in convincing people to take out mortgages they should not have."[106] Do you think online advertising played a significant role in the mortgage crisis? What role do advertisers, ad networks, and content providers have in online advertising oversight? Should this responsibility be any different from oversight in traditional media (television, print, radio)? What guidelines would you suggest?
15. Even well-intentioned firms can compromise user privacy. How have Google's missteps compromised user privacy? As a manager, what steps would you take in developing and deploying information systems that might prevent these kinds of problems from occurring?
16. Research the EU's "right to be forgotten" ruling and the current status as it pertains to Google. Why is the ruling so challenging to Google? How does it burden Google? Does this harm other civil liberties like free speech? Why or why not? Advocate in favor of or against the ruling.
17. Research how Apple has contrasted its approach to privacy against those of Google and other rivals that rely on ad-driven business models. Does this contrast influence your decision to choose Apple or Google products? Why or why not?
18. The issue of civil liberties versus national security may be one of the most defining tensions of modern times. Research the US government's Foreign Intelligence Surveillance Act (FISA) and related legislation or programs. What role do tech companies play in this effort? What are the arguments made for and against these programs? Are US firms put at risk by perceived or actual government efforts in this area? How so? If you were leading Google or another well-known US Internet firm, how would you address the tension? Be prepared to discuss and debate issues in class.

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18.9 Search Engines, Ad Networks, and Fraud

Learning Objectives

1. Be able to identify various types of online fraud, as well as the techniques and technologies used to perpetrate these crimes.
2. Understand how firms can detect, prevent, and prosecute fraudsters.

There's a lot of money to be made online, and this has drawn the attention of criminals and the nefarious. Online fraudsters may attempt to steal from advertisers, harm rivals, or otherwise dishonestly game the system. But bad guys beware—such attempts violate terms-of-service agreements and may lead to prosecution and jail time.

Studying ad-related fraud helps marketers, managers, and technologists understand potential vulnerabilities, as well as the methods used to combat them. This process also builds tech-centric critical thinking, valuation, and risk assessment skills.

Some of the more common types of fraud that are attempted in online advertising include the following:

click fraud
Generating bogus clicks, either for financial gain (enriching fraud), or to attack rivals by draining their online ad budgets (depleting fraud).

- *Enriching* **click fraud**—when site operators generate bogus ad clicks to earn CPC income.
- *Enriching impression fraud*—when site operators generate false page views (and hence ad impressions) in order to boost their site's CPM earnings.
- *Depleting click fraud*—clicking a rival's ads to exhaust their CPC advertising budget.
- *Depleting impression fraud*—generating bogus impressions to exhaust a rival's CPM ad budget.
- *Rank-based impression fraud*—on sites where ad rank is based on click performance, fraudsters repeatedly search keywords linked to rival ads or access pages where rival ads appear. The goal is to generate impressions without clicks. This process lowers the performance rank (quality score) of a rival's ads, possibly dropping ads from rank results, and allowing fraudsters to subsequently bid less for the advertising slots previously occupied by rivals.
- *Disbarring fraud*—attempting to frame a rival by generating bogus clicks or impressions that appear to be associated with the rival, in hopes that this rival will be banned from an ad network or punished in search engine listings.
- *Link fraud (also known as spamdexing or link farming)*—creating a series of bogus websites, all linking back to a page, in hopes of increasing that page's results in organic search.
- *Keyword stuffing*—packing a website with unrelated keywords (sometimes hidden in fonts that are the same color as a website's background) in hopes of either luring users who wouldn't normally visit a website, or attracting higher-value contextual ads.
- *Social influence fraud*—generating fake followers, likes, +1s, retweets, shares, or YouTube views.

Disturbing stuff, but firms are after the bad guys and they've put their best geeks on the case. Widespread fraud would tank advertiser ROI and crater the online advertising market, so Google and rivals are diligently working to uncover and prosecute the crooks.

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Busting the Bad Guys

On the surface, enriching click fraud seems the easiest to exploit. Just set up a website, run CPC ads on the page, and click like crazy. Each click should ring the ad network cash register, and a portion of those funds will be passed on to the perpetrating site owner—*ka ching*! But remember, each visitor is identified by an IP address, so lots of clicks from a single IP make the bad guys easy to spot.

click farms

A network of users and computers engaged in coordinated click fraud. Since the different computers leverage different IP addresses, click farms can be more difficult to detect.

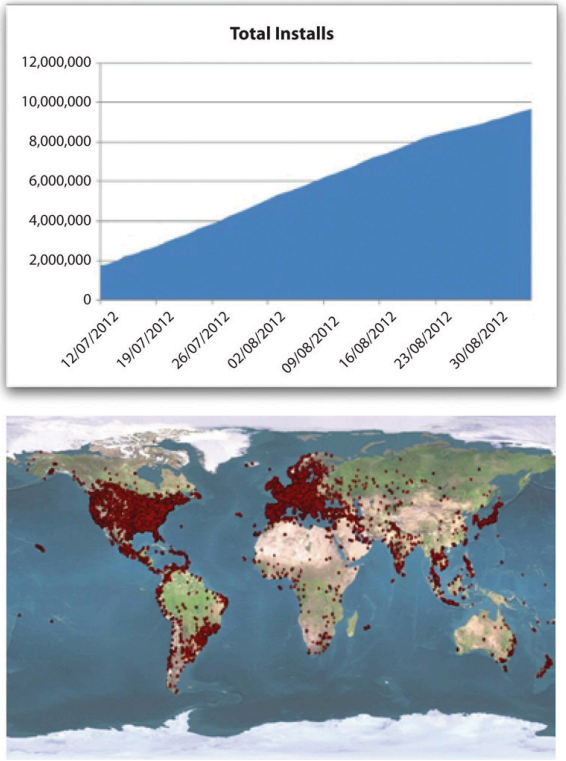
botnets

Hordes of surreptitiously infiltrated computers, linked and controlled remotely, also known as zombie networks.

So organized crime tried to raise the bar, running so-called **click farms** to spread fraud across dozens of IP addresses. *The Times of India* uncovered one such effort where Indian housewives were receiving up to twenty-five cents for each ad click made on fraudster-run websites.[107] But an unusually large number of clicks detected as coming from Indian IP addresses foiled these schemes as well.

Fraudsters then moved on to use **botnets** (or zombie networks)—hordes of surreptitiously infiltrated computers, linked and controlled by rogue software.[108] To create botnets, hackers exploit security holes, spread viruses, or use so-called phishing techniques to trick users into installing software that will lie dormant, awaiting commands from a central location. The controlling machine then sends out tasks for each bot (or zombie), instructing them to visit websites and click on ads in a way that mimics real traffic. The ZeroAccess botnet is said to have infected over nine million PCs worldwide that were used in click fraud schemes, among other scams.[109]

FIGURE 18.12 Spread of the ZeroAccess Botnet



Source: Sophos, http://nakedsecurity.sophos.com/2012/09/19/zeroaccess-botnet-uncovered.

Scary, but this is where scale, expertise, and experience come in. The more activity an ad network can monitor, the greater the chance that it can uncover patterns that are anomalous. Higher click-through rates than comparable sites? Caught. Too many visits to a new or obscure site? Caught. Clicks that don't fit standard surfing patterns for geography, time, and day? Caught.

Sometimes the goal isn't theft, but sabotage. Google's Ad Traffic Quality Team backtracked through unusual patterns to uncover a protest effort targeted at Japanese credit card firms. Ad clicks were eventually traced to an incendiary blogger who incited readers to search for the Japan-

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ese word *kiyashinku* (meaning cashing credit, or credit cards), and to click the credit card firm ads that show up, depleting firm search marketing budgets. Sneaky, but uncovered and shut down, without harm to the advertisers.[110]

Social influence fraud is used for many things: ego stroking (my follower count is bigger than yours), attempts at creating social proof (e.g., with so many followers this must be legitimate), attempts at making a post seem popular in hopes it will be highlighted and promoted to others (e.g., trending, among "top tweets"), and trying to influence search results (since Google and Bing take social media into account when computing organic rankings). Among the well-known accused of social influence fraud: Pepsi, Coca-Cola, Mercedes-Benz, and Louis Vuitton, 50 Cent, Paris Hilton, Mitt Romey,[111] and even the US State Department.[112] A *New Republic* piece on "farms" for creating fake social influence included a photograph of one Philippines-based boss of bogusness pictured lounging on hundreds of brick-like stacks of SIM cards used by his extensive staff to create the perception that social accounts are the work of individual users on separate phones.[113]

Search firm and ad network software can use data patterns and other signals to ferret out most other types of fraud, too, including rank-based impression fraud, spamdexing, keyword stuffing, and social influence fraud. While many have tried to up the stakes with increasingly sophisticated attacks, large ad networks have worked to match them, increasing their anomaly detection capabilities across all types of fraud.[114] Here we see another scale and data-based advantage for Google. Since the firm serves more search results and advertisements than its rivals do, it has vastly more information on online activity. And if it knows more about what's happening online than any other firm, it's likely to be first to shut down anyone who tries to take advantage of the system. The tech behind fraud busting is impressive. Tech that Google developed in-house, called PowerDrill, has been described as "a freak computer system" capable of processing a half trillion cells of data in less than five seconds.[115] The system looks for fraud patterns and also spits out graphical representations for human inspection. A sort of **Turing test** emerges from the data. If what turns up doesn't follow patterns you'd expect from humans—for example, if clicks look too evenly distributed or concentrated in certain places (e.g., uniformly around the edges of some ads instead of being distributed like most other ads)—then that's a giveaway.

Turing test

A test of artificial intelligence that, if passed, would mean a computer is indistinguishable from a human being. Originally proposed by renowned computer scientist Alan Turing.

Click Fraud: How Bad Is It?

The rise in ad fraud botnets has come about because other security is getting stronger. Despite repeated high-profile data breaches, banks are tougher to hack, and credit cards are becoming more secure. AdAge claims ad fraud is "the most lucrative endeavor a cybercriminal can undertake today," and, says one expert interviewed, "We're at a point now where malware is being used principally for ad fraud."[116] Accounts on the actual rate of click fraud vary widely. A study by the Association of National Advertisers and the anti-fraud consultancy White Ops pegs ad fraud losses in 2015 at an estimated $6.3 billion.[117] Some third-party firms contend that nearly one in five clicks is fraudulent.[118] But Google adamantly disputes these headline-grabbing numbers, claiming that many such reports are based on logs that reflect false data from conditions that Google doesn't charge for (e.g., double counting a double click, or adding up repeated use of the browser back button in a way that looks like multiple clicks have occurred). The firm also offers monitoring, analytics, and reporting tools that can uncover this kind of misperceived discrepancy.

Google contends that all invalid clicks (mistakes and fraud) represent less than 10 percent of all clicks, that the vast majority of these clicks are filtered out, and that Google doesn't charge advertisers for clicks flagged as mistakes or suspicious.[119] In fact, Google says their screening bar is so high and so accurate that less than 0.02 percent of clicks are reactively classified as invalid and credited back to advertisers.[120]

So who's right? While it's impossible to identify the intention behind every click, the market ultimately pays for performance. And advertisers are continuing to flock to CPC ad networks (and to Google in particular). While that doesn't mean that firms can stop being vigilant, it does suggest that for most firms, Google seems to have the problem under control.

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Key Takeaways

- Fraud can undermine the revenue model behind search engines, ad networks, and the ad-based Internet. It also threatens honest competition among rivals that advertise online.
- There are many forms of online fraud, including enriching fraud (meant to line the pockets of the perpetrators), depleting fraud (meant to waste the ad budgets of rivals), disbarring fraud (meant to frame the innocent as fraudsters), and methods to lower rival ad rank performance, or gain search engine ranking algorithms.
- While fraudsters have devised ingenious ways to exploit the system (including click farms and botnets), IP addresses and detailed usage pattern monitoring increasingly reveal bogus activity.
- Fraud rates are widely disputed. However, it is clear that if widespread fraud were allowed to occur, advertisers would see lower ROI from online ad efforts, and Internet business models would suffer. The continued strength of the online advertising market suggests that while fraud may be impossible to stop completely, most fraud is under control.

Questions and Exercises

1. Why is it difficult for an unscrupulous individual to pull off enriching click fraud simply by setting up a website, running ad network ads, and clicking?
2. Why did hackers develop botnets? What advantage do they offer the criminals? How are they detected? Why do larger ad networks have an advantage in click fraud detection?
3. How can you prevent botnet software from inhabiting your computers? Are you reasonably confident that your computer is free from a botnet infection? Why or why not?
4. What are spamdexing and keyword stuffing? What risks does a legitimate business run if it engages in these practices, and if they are discovered by search engines? What would this mean for the career of the manager who thought he could game the system?
5. Which types of fraud can be attempted against search advertising? Which are perpetrated over its ad network?
6. What are the consequences if click fraud were allowed to continue? Does this ultimately help or hurt firms that run ad networks? Why?

18.10 The Battle Unfolds

Learning Objectives

1. Understand the challenges of maintaining growth as a business and industry mature.
2. Recognize how technology is a catalyst, causing the businesses of many firms in a variety of industries to converge and compete, and that as a result of this, Google is active on multiple competitive fronts.
3. Critically evaluate the risks and challenges of businesses that Google, Microsoft, and other firms are entering.
4. Appreciate the magnitude of this impending competition, and recognize the competitive forces that will help distinguish winners from losers.

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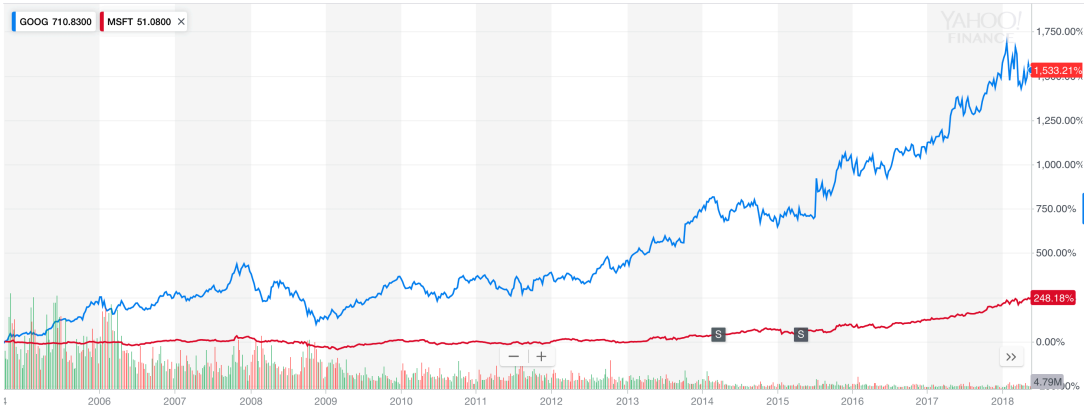
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Google has been growing like gangbusters, but the firm's twin engines of revenue growth—ads served on search and through its ad networks—will inevitably mature. And it will likely be difficult for Google to find new growth markets that are as lucrative as these. Emerging advertising outlets such as social networks and mobile have lower click-through rates than conventional advertising,[121] and Google has struggled to develop a presence in social media—trends suggesting that Google will have to work harder for less money. Google's reorganization as a holding firm named Alphabet with a Google subsidiary breaks many of the new, smaller, riskier but potentially growth-oriented efforts into separate businesses. Says co-founder Page, the firm chose the name alpha-bet as a bet on the financial term alpha, which refers to "investment return above benchmark."[122] An additional way to think of this is that Google is hoping to be the first (alpha) big player to double-down (bet) on risky but promising new markets.[123]

To understand what can happen when maturity hits, look at Microsoft. The house that Gates built is more profitable than Google (roughly $21 billion versus about $12.7 billion in 2017) and continues to dominate the incredibly lucrative markets served by Windows and Office. But these markets haven't grown much for over a decade, and if Google hadn't taken that big 2017 tax hit, it may have been, for the first time, more profitable that Microsoft,[124] Google already brings in more revenue. In industrialized nations, most Windows and Office purchases come not from growth, but when existing users upgrade or buy new machines. And without substantial year-on-year growth, the stock price doesn't move.

FIGURE 18.13 A Comparison of Stock Price Change—Google (GOOG) versus Microsoft (MSFT)

Google/Alphabet has never been more profitable than Microsoft, and only beat Microsoft in revenue in 2017, but Google's incredible growth has been rewarded by Wall Street, with a stock price that has outperformed Microsoft's, roughly five-fold.



Source: finance.yahoo.com.

For big firms like Microsoft and Google, pushing stock price north requires not just new markets, but billion-dollar ones. Adding even $100 million in new revenues doesn't do much for firms bringing in nearly $90 billion and $111 billion a year, respectively. That's why you see Microsoft swinging for the fences, investing in the uncertain but potentially gargantuan markets of video games, mobile phone software, cloud computing (see Chapter 14) music, video, virtual and augmented reality, and of course, search and everything else that fuels online ad revenue. Finding new billion-dollar markets is wonderful, but rare. Apple seems to have done it with the iPhone and iPad. But trying to unseat a dominant leader possessing strategic resources can be ferociously expensive, with unclear prospects for success. Microsoft's Bing group had thirteen consecutive years where it lost big bucks on Bing—well over $11 billion in total,[125] winning almost no share from Google despite the lavish spend.[126]

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semantic Web

Sites that wrap data in invisible tags that can be recognized by search engines, analysis tools, and other services to make it easier for computer programs to accurately categorize, compare, and present this information.

Search: Google Rules, but It Ain't Over

PageRank is by no means the last word in search, and offerings from Google and its rivals continue to evolve. Google supplements PageRank results with news, photos, video, and other categories. Yahoo! is continually refining its search algorithms and presentation. And Microsoft's third entry into the search market, the "decision engine" Bing, sports nifty tweaks for specific kinds of queries. Restaurant searches in Bing are bundled with ratings stars, product searches show up with reviews and price comparisons, and airline flight searches not only list flight schedules and fares, but also a projection on whether those fares are likely to go up or down. Apple's Siri service delivers search results from Bing, not Google, offering a potentially key new channel for pumping up Bing search volume. Apple is also aggressively cutting deals with category players like Yelp and the Weather Channel, and iOS has empowered app firms to integrate Siri into their own offerings, as well, all of which further cut Google out of new emerging channels for search. Google is the default search in iOS, but that costs Google over $3 billion a year.[127] And don't count out Alexa, either. With Amazon's lead in search and it's status as the first place consumers go to shop, Google has yet another well funded rival[128].

Websites are also starting to wrap data in invisible tags that can be recognized by search engines, analysis tools, and other services. If a search engine can tell that a number on a restaurant's website is, for example, either a street address, an average entrée price, or the seating capacity, it will be much easier for computer programs to accurately categorize, compare, and present this information. This is what geeks are talking about when they refer to the **semantic Web**.

And with the Google Now app, the firm is trying to deliver results to you before you even ask for them. Google Now will send you personalized information throughout the day—calendar reminders, weather updates. But it will also take a guess at what you might be interested in—reviews of nearby restaurants if it's lunchtime, train timetables if you're at a station, flight info if you're at an airport. Land in a new city? Google will send hotel and rental car info based on confirmation messages sent to Gmail. Users have to give Google permission to access data from other services, but one can immediately see how on-demand information could be served up not only via phone but also via other products, like Google Glass or Android TV.

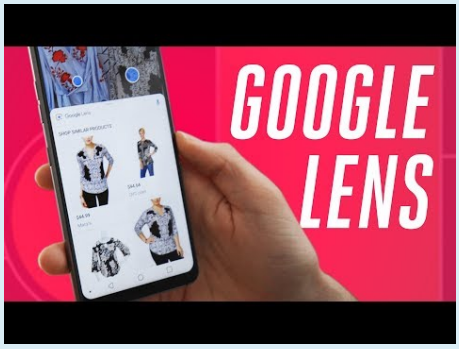
And who says you need to use words to conduct a search? Google voice search challenges Siri in Android devices and in Google apps, and has taken the lead with the Google Home speaker, which far outsells Apple's pricey, but so far "less smart" HomePod. Google Lens uses the camera in your mobile phone to "enter" search criteria. Snap a picture of a landmark, piece of artwork, or puppy for example, and Google will use that image to retrieve search results. Like those shoes? Google Lens will identify the brand and search for shopping deals so you can make them your own. The product can even return translations of foreign text. All signs point to more innovation, more competition, and an increasingly more useful Internet!

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Google Lens

In yet another example of how machine learning is changing search, watch Google's AI working with your camera to identify clothing and find deals, identify the breed of that cute dog, or translate the otherwise unreadable menu while you are traveling.



View the video online at: http://www.youtube.com/embed/0kHhc0nlal8?rel=0

Both Google and Microsoft are on a collision course. But there's also an impressive roster of additional firms circling this space, each with the potential to be competitors, collaborators, merger partners, or all of the above. While wounded and shrinking, Yahoo! is still a powerhouse, ranking ahead of Google in some overall traffic statistics. Google's competition with Apple in the mobile phone business prompted Google's then CEO Eric Schmidt to resign from Apple's board of directors. Google's three-quarters-of-a-billion-dollar purchase of the leading mobile advertiser AdMob was quickly followed by Apple snapping up number-two mobile ad firm Quattro Wireless for $275 million. Now Google and Apple seem to compete in most markets, with each offering web-based office suites, consumer cloud storage, music systems, TV devices, wearables, home automation software, auto platforms, and more. Add in Amazon, Facebook, eBay, Twitter, Salesforce.com, Netflix, the video game industry, telecom and mobile carriers, cable firms, and the major media companies, and the next few years have the makings of a big, brutal fight.

Strategic Issues

As outlined earlier, Google enjoys major scale advantages in search, and network effects in advertising. The firm's dominance helps grow a data asset that can be used in service improvement, all while its expertise in core markets continues to grow over time. Google's competitive position outside of its core markets is much less clear.

Within Google's ad network, there are *switching costs* for advertisers and for content providers. Google partners have set up accounts and are familiar with the firm's tools and analytics. Content providers would also need to modify websites to replace Google-served ads with those from rivals. But choosing Google doesn't cut out the competition. Many advertisers and content providers participate in multiple ad networks, making it easier to shift business from one firm to another. This likely means that Google will have to keep advertisers by offering superior value rather than relying on lock-in. Facebook's ad network may pose an especially worrisome threat, as some suggest that Facebook's profiles contain more accurate demographics than Google collects.[129]

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Another vulnerability may exist with search consumers. While Google's brand is strong, switching costs for search users are incredibly low. Move from Google.com to Bing.com and you actually save two letters of typing!

Still, there are no signs that Google's search leadership is in jeopardy. So far users have been creatures of habit; no rival has offered technology compelling enough to woo away the Googling masses. Defeating Google with some sort of technical advantage will be difficult since Web-based innovation can often be quickly imitated. Google now rolls out over 550 tweaks to its search algorithm annually, with many features mimicking or outdoing innovations from rivals.[130]

How Big Is Too Big?

Microsoft's dominance has incurred the wrath of regulators in the United States and Europe. The firm has spent roughly half of its existence as a corporation battling various antitrust allegations in the United States and billions in settlement fees.[131] European antitrust officials have taken action against Redmond's bundling its own media player and browers with Windows, forcing the firm to offer alternatives alongside its own products and incurring additional fines.[132] Is Google in for a similar or even worse fate?

Being big isn't enough to violate US antitrust laws. Harvard Law School Professor Andrew Gavil says, "You've got to be big, and you have to be bad. You have to be both."[133] While Google has many critics, the firm also has a history of being a relentless supporter of open computing standards. And as mentioned earlier, there's no forcing users to stick with Google—the firm must continue to win this market on its own merits.

That said, a big firm is a big target for attracting serious scrutiny in the United States and abroad. For example, Google was forced to abandon a search advertising partnership with Yahoo! after the Department of Justice indicated its intention to block the agreement (Yahoo! and Microsoft have since inked a deal to share search technology and ad sales). Among the more serious questions: Does Google have an unfair advantage, favoring its own properties, like Maps and YouTube over rivals? Results from these properties are integrated with Google search, and the toolbar that appears across the top of most Google websites also provides preferred access to Google rather than rival properties. The firm's regulatory outlook seems to differ by region. In the United States, after a nearly two-year probe, one of the biggest investigations in history (generating over nine million pages in testimony), the Federal Trade Commission (FTC) has essentially said "no," at least for now. The FTC voted unanimously to close its antitrust investigation without bringing charges. The ruling concluded that Google's practices improved search for the benefit of users and that "any negative impact on actual or perceived competitors was incidental to that purpose."[134] Google does face some minor concessions from the FTC's work. Firms like Yelp can opt out of having their results scraped by Google and incorporated into search results. Google will stop offering contractual restrictions preventing ad customers from advertising on competing search platforms. And Google must allow firms (including rivals) to license some of its key mobile patents when offered fair compensation. Still, the *New York Times* has received documents from FTC officials that have written that Google has "adopted a strategy of demoting, or refusing to display, links to certain vertical websites in highly commercial categories" and "Google has strengthened its monopolies over search and search advertising through anticompetitive means," which "will have lasting negative effects on consumer welfare." Concerns over consumer data privacy, the platform's use as a font for fake news and terrorism (YouTube now flags videos from RT, for example, as associated with the Russian Government), and its algorithms as the leading discovery engine worldwide may put the firm under even more pressure as its influence strengthens.[135]

The situation in Europe looks like the most immediate challenge. The European Union has accused Google of violating antitrust laws, displaying Google-provided results such as shopping, travel, and insurance, over rival products. Google's share of the search market in Europe is actually even larger than in the United States, averaging around 90 percent in most countries.[136] The European Union is also investigating Google's Android business, including tactics requiring hardware firms to comply with the exclusive pre-installation or bundling of Google's apps and services, and restricting modifications or forks of the Android operating system. The EU already fined Google the equivalent of $2.7 billion in 2017, and more legal action is likely to follow.[137] And as concerns in Europe and elsewhere heat up, there's no guarantee that continued Google dom-

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inance might not once again cause the Department of Justice to consider whether Google's size and practices disadvantage others. Increased antitrust scrutiny is a downside that comes along with the advantages of market-dominating scale.

More Ads, More Places, More Formats

Google has been a champion of increased Internet access. But altruism aside, more net access also means a greater likelihood of ad revenue.

Google's effort to catalyze Internet use worldwide comes through on multiple fronts. In the United States, Google has supported (with varying degrees of success) efforts to offer free Wi-Fi. Google announced it would offer high-speed, fiber-optic net access to homes in select US cities, with Kansas City, Kansas; Kansas City, Missouri; Provo, Utah; and Austin, Texas chosen for the first roll-outs.[138] The experimental network offers competitively priced Internet access of up to 1 GB per second—that's one hundred times faster than many Americans have access to today. The networks are meant to be open to other service providers, and Google hopes to learn and share insights on how to build high-speed networks more efficiently. Google will also be watching to see how access to ultrahigh-speed networks impacts user behavior and fuels innovation. Broadband competition from Google seems to be helping even those consumers who don't choose it, with many competitors matching Google on increased speeds and lower prices.[139] Globally, Google is also a major backer (along with Liberty Global and HSBC) of the O3b satellite network. O3b stands for "the other three billion" of the world's population who currently lack Internet access. O3b has begun launching multiple satellites circling the globe, blanketing underserved regions with **low latency** (low delay), high-speed Internet access.[140] Google's experimental Project Loon hopes to bring the Internet to even more underserved, by blanketing regions with twelve-mile-high balloons that act as floating Internet relay points.[141] And Google combined O3b with Project Loon to deliver Internet access to Puerto Rico following the ravaging from Hurricane Maria.[142] If balloons aren't enough, maybe solar-powered drones beaming Internet access while orbiting continuously at heights that put them above clouds and inclement weather might do the trick. Google's purchase of Titan Aerospace is reportedly targeted at exactly that prospect.[143] And the firm is experimenting with delivering Internet throughout South Africa via unused or "white" space in the nation's television broadcast spectrum. Google's Project Link initiative has also built massive fiber optic networks in Ghana and Uganda. Instead of selling directly to consumers, Google built fiber infrastructure to local ISPs and MNOs, who then compete to provide lower-cost, higher-capacity coverage to their customers. Originally known as Project Link, Google has spun out the effort and invited in additional partners in an organization now known as CSquared, committing over $100 million to African broadband.[144] With Moore's Law dropping computing costs as world income levels rise, Google hopes to empower the currently disenfranchised masses to start surfing. Good for global economies, good for living standards, and good for Google.

low latency
Low delay.

For US consumers, Google can also be your wireless provider. Project Fi offers low-cost mobile data plans with unlimited talk, text, and international data roaming with no added fee in 120 countries worldwide, access to hotspots, and a usage-based pricing model where customers receive a refund for the unused data portion of their bill.[145] Google isn't building its own network Instead it's becoming an **MVNO** (mobile virtual network operator), licensing capacity from T-Mobile and Sprint at a discount for resale under its own brand and plans.[146] Google has said "we don't intend to be a carrier at scale" but instead will use the network for experimental services and pricing models, influencing telecom firms by example.[147] Efforts like this mean that for some users, Google will be one of the most vertically integrated tech firms the world has seen, offering OS, services, software, hardware, stores, broadband, and mobile.

MVNO
Mobile virtual network operator. A wireless telecommunications services provider that doesn't own its own infrastructure. Instead, MVNOs pay a reduced price to license capacity from other providers and repackage the service under their own brand.

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walled gardens

A closed network or single set of services controlled by one dominant firm. Term is often applied to mobile carriers that act as gatekeepers, screening out hardware providers and software services from their networks.

Google has also successfully lobbied the US government to force wireless telecom carriers to be more open, dismantling what are known in the industry as **walled gardens**. Before Google's lobbying efforts, mobile carriers could act as gatekeepers, screening out hardware providers and software services from their networks. Today, paying customers of carriers that operate in the United States have access to a choice of hardware and less restrictive access to websites and services.

Android Everywhere

Another way Google can lower the cost of surfing is by giving away an operating system and other software. That's the thinking behind the firm's Android offering, which started on smartphones and has now extended way beyond your pocket. With Android, Google provides hardware firms with a Linux-based operating system, supporting tools, standards, and an application marketplace akin to Apple's App Store. Android itself isn't ad-supported—there aren't Google ads embedded in the OS. But the hope is that if manufacturers don't have to write their own software, the cost of various devices will go down. And cheaper devices mean that more users will have access to the Internet.

For mobile and tablet users this, of course, means more ads (note the Google-Lens-as-search example in the video earlier in this section). Android is now the world's most popular mobile operating system by a long shot—it holds an 80 percent share of the smartphone OS market, according to one survey.[148] Google already controls 97 percent of fast-growing paid search on mobile devices.[149] A court filing related to Oracle's Java suit suggested that Android delivered $31 billion to Google through 2016,[150] helping Google deliver that rare, new billion-dollar growth opportunity sought by large, maturing firms (notably, Oracle won its lawsuit in 2018).[151]

Android has the largest market share in the tablet OS market.[152] Android Wear is targeted at watches and other wearables. At the launch of Android Auto, some forty car makers signed up to sell vehicles integrated with the OS. Alongside Google's ultra-slim, ultra-cheap Chromecast streaming stick, Android TV (which is sold via a separate box, and comes built into Sharp and Sony TVs)[153] is a more robust solution that brings apps to your living room with a particular emphasis on game play. Android apps are also on Google's Chromebook, the lightweight laptop that moves much of the hard drive to the cloud—that is Google's cloud, which further strengthens the switching costs that bind Android users to Big G. And Chromebooks are growing into the PC industry's biggest headache, already accounting for nearly 60 percent of K–12 education sales[154]—that's a generation of users who will think of a computer as simply a screen, keyboard, and Wi-Fi connection to the cloud. Google's $3.2 billion purchase of Nest, bringing Nest founder and former Apple iPod chief Tony Fadell into the Google family, has offered a glimpse of how Android could run your life. For example, when your Android car approaches your empty home, Android could automatically turn on the heat or A/C.[155] Google has even taken a very Android swipe at Facebook's Oculus VR purchase when it gave out foldable Google Cardboard to developers at the Google I/O conference. Fold it into VR goggles, strap in your Android phone with the included Velcro, look through the embedded lenses to skew the view, and you'll see Larry and Sergey give a cheeky poke to Zuckerberg's $2 billion baby.[156] The expansion of apps, hardware, and other offerings in the Android ecosystem strengthens *network effects* through ever-increasing *complementary benefits*. Taken in concert, the free OS looks like a clear money-maker.

Android isn't without challenges. Since Google doesn't control most of its hardware sales, Android is a fragmented platform, where only a small fraction of devices upgrade to the latest OS offerings. This hurts Android developers since there are more devices to code and test for (see "Is This Good for Innovation?" in Chapter 8). It also complicates things for consumers, who may see different user experiences across devices.[157] Amazon uses Android in its various Kindle Fire offerings (i.e., phone, tablet) and TV but has altered the OS so much that many Android apps don't run on these platforms. Amazon also diverts customers to its own app store rather than Google Play.[158] Google has had similar "forking" squabbles with Samsung and others,[159] and a firm named Cyanogen has raised money from a series of well-known investors, plus Twitter, to build an open source, "Google-free" version of Android.[160]

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In Case of Emergency, Wear Glass

Google Glass, the firm's wearable headset technology with a tiny screen in the upper right-hand corner, has endured lots of ridicule. Some cite the unfashionable dork factor, calling the product a "Segway for your face."[161] Others lament creepy "Glassholes" (a term even Google used in a dos and don'ts doc).[162] Several establishments and governments have sought to ban or limit the device's use (e.g., in casinos, movie theaters, gyms, and bars) since the device has a video camera.[163] Some have questioned Glass's future as a consumer device, especially after the firm canceled its Glass Explorer sales program. However, transfer of the unit from Google's experimental X group to the division where Nest lives may help.[164]

While Google Glass never had the consumer-killer app, it looks like it's got a few life-saving ones. A 2017 pivot focuses on business customers, and an update is sold as the Glass Enterprise Edition.[165] Boston's Beth Israel Deaconess is the first US hospital to employ Google Glass for everyday medical care. The hospital has posted unique, patient-specific QR codes on patient room doorways, with each code linked to a patient's medical records. Doctors look up and scan the QR code with Glass before entering the room, providing access on the device's display. Early tests have expanded to the entire emergency department, with doctors donning Glass at the start of their shifts. In one example of impact, a patient with a brain bleed told an ER doctor that he was allergic to blood pressure medications but wasn't sure which ones. The doctor was able to access the patient's records on Glass, speeding the administration of life-saving treatment.

FIGURE 18.14 Google Glass in Use



Source: Peppinuzzo / Shutterstock.com.

Glass in the medical community has made a successful breakout. Surgeons at the Indiana University Health Methodist Hospital in Indianapolis have used Glass during an operation to remove an abdominal tumor. "Voice commands enabled the doctors to call up the patient's MRI scans and keep the images in their field of vision for easy reference, without having to put down a scalpel."[166] At the University of California Irvine Medical Center, Glass-wearing residents stream live videos to experienced mentors so they can share their field of view. That facility announced it would be the first in the country to hand out Google Glass to all incoming residents.[167] A Cambridge, Massachusetts, firm named Twiage is developing Glass apps for EMTs so they can use voice commands to snap photos of patient injuries, dictate notes, and send them along to the nearest ER. The firm's cofounder states this is "the holy grail of hospital IT." Researchers in the UK are testing Glass for patients with Parkinson's, using the device's motion sensors to track symptoms and motor movements and providing reminders for taking medication.[168] Firefighters are also using Google Glass to map and provide video feeds of the insides of burning buildings.[169] A growing list of firms including Boeing and DHL has also found different uses: streaming repair information to technicians, guiding soldiers, providing heads-up service reports in the hospitality industry, and more.[170] Maybe Glass isn't ready for the fashion-forward hipster crowd, but it's starting to look like it offers a real and measurable impact across several industries.[171]

YouTube

It's tough to imagine any peer-produced video site displacing YouTube. Users go to YouTube because there's more content, while amateur content providers go there seeking more users (classic two-

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sided network effects). This critical advantage was the main reason why Google paid $1.65 billion for what was then just a twenty-month-old startup. In terms of query volume alone, YouTube, not Bing or Yahoo!, is the Internet's second largest search engine. But mobile video competition is heating up. Facebook now serves as many streams as YouTube,[172] Twitter's Periscope offers real-time video streaming, and Facebook-owned Instagram battles to be the preferred platform for snippets of socially shared video. While the mobile upstarts attack at the low end of the Internet video market with shorter, mostly webcam-made videos, YouTube is looking to move a portion of its content beyond online amateur hour. The site now "rents" hundreds of TV shows and movies at prices ranging from $.99 to $3.99, and also offers YouTube Red, a $10/month advertisement-free video service offering exclusive programming (care for the *Cobra Kai*, *Karate Kid*–inspired series with the now-geezerly stars of the '80s movie [173]?) and a vast selection of music. It's also been offering seed grants of several million dollars to producers of original content for YouTube.[174] YouTube even poached a senior Netflix executive to help grow the premium content business.[175]

Google says YouTube's primetime audience is bigger than the 10 biggest US TV shows, combined [176] and that *Cobra Kai* performed better than the second season of Netflix's *13 Reasons Why* and Hulu's *Handmaid's Tale*.[177] However, YouTube's popularity comes at a price. Even with falling bandwidth and storage costs, at three hundred hours of video uploaded to YouTube every minute, the cost to store and serve this content would, for most firms, seem cripplingly large.[178] The good news is that YouTube is booming, and while Alphabet doesn't break out the unit's contribution, analysts suggest it's somewhere between $12 billion and $15 billion.[179] Alphabet also hasn't told us if YouTube is reliably profitable, to the annoyance of shareholders wanting more transparency, although the firm has said in the past that YouTube has swung into the black.[180] YouTube head Susan Wojcicki has been busy on multiple fronts. Moves to compete in live offerings against Facebook Live and Twitter Periscope, and a challenge to Amazon's Twitch video game–focused video stream all promise new revenue and growth.[181] A deal with the NFL, a YouTube-branded music streaming service, and improved targeting integration with the rest of Google might collectively act to further boost YouTube's appeal and bring in more revenue.[182]

As the Internet's dominant video platform, YouTube, like Facebook, Twitter, and other social media services, also suffers from trolls, fake news, and exploiters. YouTube search was surfacing conspiracy theories following the Parkland school shooting,[183] terrorists have used the service for propaganda purposes, copyrighted content still surfaces, inappropriate and harmful videos took the spotlight when Logan Paul (a YouTuber allegedly making over $12 million a year) made flippant comments over a dead body found in an area around Japan's Mt. Fuji known as "suicide forest,"[184] and, of course, there's porn. But Google has used AI to remove over eight million videos in three months, and its tech is getting smarter.[185] It has also begun to surface Wikipedia articles to notify users in cases where a poster's motivations may not be transparent, and it has begun working with many of the same third-party organizations that Facebook has used. It has pledged $300 million in the next three years on initiatives to remove deliberately deceptive content; it will be working to help surface and support journalism—including directing users to sign up for partner paid content; and has even partnered to launch educational programs to make children more critical online media consumers.[186]

FIGURE 18.15 YouTube Warning about an RT Post Affiliated with the Russian Government
YouTube will be combating websites that may have opaque motives by adding a notice surfacing information about the poster and a link to find out more on YouTube.



Source: Youtube.

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Google Pay

Google's payment product seems like it's in a name-change race with rapper Sean Combs. Known previously as Google Wallet, Android Pay, and terrain trekked by the dearly departed Google Checkout, Google's O.G. payment system is now called Google Pay, and is another example of how the search giant is looking to deliver value through mobile devices.[187] The service allows phones to replace much of the "stuff" inside your wallet. It can be used to pay for goods, store gift cards, collect and redeem coupons and special offers, and manage loyalty programs.[188] Like Apple Pay (and Google Wallet before it), Google Pay will leverage **NFC** (near field communication), a payment technology finally making its way into retailer point-of-sale systems. Google Pay and Apple Pay both use a process called tokenization that essentially sends temporary, one-time-use codes for payment, and which credit card companies map to actual cards behind the scenes. Even if tokens are stolen, thieves can't use it for anything. This should prevent damage from major credit card hacks that have occurred at Home Depot and Target.[189]

NFC

Near field communication—a short-range, wireless communication standard. NFC is being used to support contactless payment and transactions over NFC-equipped mobile devices.

Google should be able to leverage Google Pay in many ways that dovetail with advertising offerings. The new system will work on websites, too, removing the need for data entry in online ordering.[190] This may be a boon to efforts to bake a "Buy" button into Google ads. Tap from your mobile and it's yours, no data entry required.[191] Integration between ads, loyalty programs, and coupons might also create new products for Google. Google Pay will even automatically prompt you to use a loyalty card or gift card if you have one.[192]

Google and Social

Google's success in social media has been mixed. Its two biggest successes—YouTube and Blogger—were both acquired from other firms. Internally developed Orkut had for years ranked as the top social network in Brazil but is unheard of throughout most of the rest of the world; and Google-hatched Buzz and Wave were both dismal failures. Google+ hasn't captured anywhere near the user loyalty of Facebook, Twitter, Snapchat, Instagram, or other services, and many have wondered if the service's days are numbered.[193] However, to Google's credit, the service has spawned several successful products and updates that have been given stand-alone status outside their initially tight tie-in with Google+. Among them, Hangouts is a video chat service that can support groups, and enables screen-sharing and group document editing. Photos, which evolved from Picasa into Google+, has since been broken out into an incredibly robust product, offering unlimited storage and incredibly robust tools that leverage Google artificial intelligence for photo editing, auto-select of best picture (who's smiling and has eyes open), gallery creation and more.[194] Gaining more social sharing via Google's platform could eventually help the firm serve more ads; grow additional revenue lines; and gain additional data and insight that can be used to help in search, content recommendations, and ad targeting. However, as the firm has learned, competing in winner-take-most markets where network effects dominate is tough, even when you bring deep pockets and a stable of existing, successful products to the battle. While its own social networking efforts have yet to take off, Google has incorporated timeliness into search, striking a partnership to surface tweets in organic results.[195]

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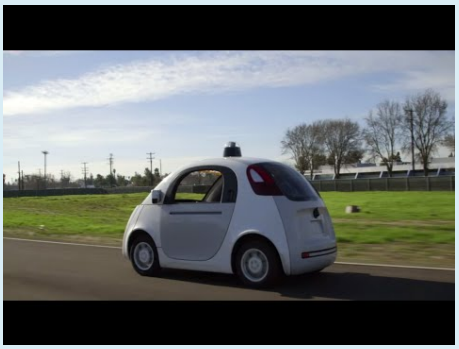
What's Google Up To?

With all this innovation, it's tough to stay current with Google's cutting-edge product portfolio. But the company does offer "beta" releases of some projects and invites the public to try out and comment on its many experiments. To see a current list of many of the firm's offerings, check out http://www.google.com/about/products.

Experimentation and innovation are deeply ingrained in Google's tech-centric culture, and this can produce both hits and misses. While Google introduces scores of products each year,[196] it has also canceled several along the way, including Jaiku (which couldn't beat Twitter); Google Video (which was superseded by the YouTube acquisition); the aforementioned social flops Wave and Buzz; the payments-offering Checkout; and a bunch more you've likely not heard of, like Dodgeball, Notebook, Catalog Search, and Mashup Editor.[197] But the firm's relentless commitment to developing new products and services, coupled with wildly profitable core businesses, allows Google to survive the flops and push the edge of what's possible. The firm's secretive lab, Google X, is the home of Google's driverless car project, the Project Loon balloon initiative, and Google Glass. The group is working on all sorts of other gee-whiz offerings, including space elevators, smart contact lenses, and refrigerators that can order your groceries when they run low.[198]

Self-Driving Cars

Google X has several bold projects cooking, including self-driving cars, now navigating the streets of the firm's home in Mountain View, California, and beyond.



View the video online at: http://www.youtube.com/embed/uCezICQNgJU?rel=0

Apps, Cloud, and the Post-Hard-Drive World

Google's "apps" are mostly Web-based software-as-a-service offerings. Apps include an Office-style suite that sports a word processor, presentation tool, and spreadsheet, all served through a browser. While initially clunky, the products are constantly being refined. The spreadsheet product, for example, had been seeing new releases every two weeks, with features such as graphing and pivot tables inching it closer in capabilities to desktop alternatives.[199] And new browser standards, such as HTML 5, make it even easier for what lives in the browser to mimic what you're currently using on your desktop, even allowing apps to be used offline when Internet access isn't available. That'll be critical as long as Internet access is less reliable than your hard drive, but online collaboration is where these products can really excel (no pun intended). Most Google apps allow not only group viewing, but also collaborative editing, common storage, and version control. And it seems Google

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isn't stopping at Office files, video, and photos—Google's cloud will hold your music and other media, too. Google's Play service allows you to upload thousands of the tracks that you already own to what some have called a sort of "locker in the sky." Users can stream the tracks over the Internet, sync frequently played songs and albums for offline play, and even share tracks with friends via Google+ (friends usually get one full listen for free).[200] And Google Drive offers several gigabytes of free cloud-based storage that can be shared and synced across computers. Photos are the ultimate keepsake, and by offering unlimited storage for the new Google Photos, Larry and Sergei have bolted your memories tightly onto their firm.

Unknown is how much money Google will make off all of this. Consumers and small businesses have free access to these products, with usage for up to fifty users funded by in-app ads. But is there much of a market serving ads to people working on spreadsheets? Enterprises can gain additional, ad-free licenses for a fee. While users have been reluctant to give up Microsoft Office, many have individually migrated to Google's Web-based e-mail and calendar tools. Google's enterprise apps group will now do the same thing for organizations, acting as a sort of outsourcer by running e-mail, calendar, and other services for a firm and all while handling upgrades, spam screening, virus protection, backup, and other administrative burdens. Virgin America, Jaguar, National Geographic, Genentech, and scores of school districts and universities are among the Google partners that have signed on to make the firm's app offerings available to thousands. Google Play doesn't just hold your music; it's also an iTunes-like marketplace where you can buy all sorts of media: movies, TV shows, books, and apps. Google Drive is free (the first 15 GB is shared between Drive, and Gmail), but if you want more, you'll have to pay.

And of course, Microsoft won't let Google take this market without a fight. Microsoft has experimented with offering simplified, free, ad-supported, Web-based, online options for Word, Excel, PowerPoint, and OneNote; Office 365 offers more robust online tools, ad free, for a low monthly subscription cost; and Microsoft can also migrate an organization's applications like e-mail and calendaring off corporate computers and onto Microsoft's server farms. Apple continues to build billion-dollar data centers and has introduced iWork Cloud, browser versions of its word processor, spreadsheet functionality, and presentation apps that have leapfrogged Google with products that are nearly as feature rich as desktop offerings. Amazon is also offering free, unlimited photo storage for Prime members. As the cloud becomes the new hard drive, don't look for anyone to yield ground soon.

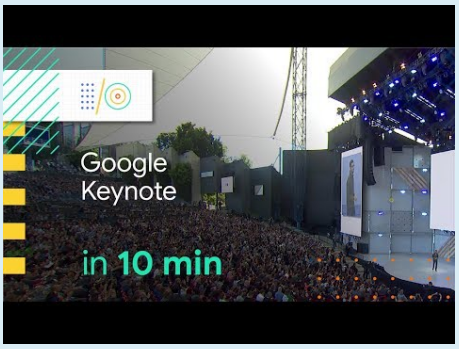
Google is also intent on not ceding the Enterprise Cloud business to Amazon's AWS. Google's cloud chief is Diane Greene, a woman credited with building VMware into a multibillion dollar powerhouse and taking that firm public. The shroud of secrecy on the size of Google's cloud business was partially lifted when the firm disclosed it had brought in over $1 billion in the first three months of 2018.[201] Google has been actively wooing clients of other cloud providers, and it has been locked in an escalating price war with AWS, Microsoft's Azure, and others, but Google has the perceived leadership in AI and machine learning, and, in its platform, an enormous laboratory for internally perfecting services that will eventually become commercial.

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Highlights from Google CEO Sundar Pichai's Keynote at the 2018 Google I/O Developer Conference

For a look at Google's current direction and its vision for integrating AI and machine learning into its product line, watch this 10-minute highlight of Google CEO Sundar Pichai's keynote at the 2018 Google I/O developer conference.



View the video online at: http://www.youtube.com/embed/NeF0zpT4gNE?rel=0

Google's Global Reach, Censorship, and Other Challenges

Google has repeatedly and publicly clashed with the government of China, a nation that many consider to be the world's most potentially lucrative market (already tops worldwide in sales of Apple's iPhone).[202] For four years at the request of the Chinese government, Google had censored results returned from the firm's google.cn domain (e.g., an image search on the term "Tiananmen" showed a kite flying on google.cn, but protesters confronting tanks on google.com). However, when reports surfaced of Chinese involvement in hacking attempts against Google and at least twenty other US companies and human rights dissidents, the firm began routing google.cn traffic outside the country. The days that followed saw access to a variety of Google services blocked within China, restricted by what many call the government's "Great Firewall of China." Even Gmail is blocked in China.[203]

Speaking for Google, the firm's deputy counsel Nicole Wong states, "We are fundamentally guided by the belief that more information for our users is ultimately better." But even outside of China, Google continues to be challenged by its interest in providing unfettered access to information on one hand, and the radically divergent laws, regulations, and cultural expectations of host nations on the other. Google has been prompted to block access to its services at some point in at least twenty-five of one hundred countries in which the firm operates.

The kind of restriction varies widely. French, German, and Polish law requires Google to prohibit access to Nazi content. A Spanish law mandating that online news aggregators pay compensation to Internet publishers for the use of even headlines (media firms couldn't waive their right to the fee) effectively shut down Google News in Spain.[204] French regulators are claiming that French law applying to Google shouldn't just be applied to Google's .fr (French) domains, but should also be reflected across all Google properties, giving French law a global reach, with hefty fines if Google doesn't comply.[205] Turkish law requires Google to block access to material critical of the nation's founder. Access in Thailand is similarly blocked from content mocking that nation's king. In India, Google has been prompted to edit forums or remove comments flagged by the government as violating restrictions against speech that threatens public order or is otherwise considered indecent or immoral. At the extreme end of the spectrum, Vietnam, Saudi Arabia, and Iran have aggressively moved to restrict access to wide swaths of Internet content.

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Google usually waits for governments to notify it that offensive content must be blocked. This moves the firm from actively to reactively censoring access. Still, this doesn't isolate the company from legal issues. Italian courts went after YouTube executives after a video showing local teenagers tormenting an autistic child remained online long enough to garner thousands of views.

In the United States, Google's organic results often reveal content that would widely be viewed as offensive. In the most extreme cases, the firm has run ads alongside these results with the text, "Offensive Search Results: We're disturbed about these results as well. Please read our note here."

Other Internet providers have come under similar scrutiny, and technology managers will continue to confront similar ethically charged issues as they consider whether to operate in new markets. But Google's dominant position puts it at the center of censorship concerns. The threat is ultimately that the world's chief information gateway might also become "the Web's main muzzle."

One needs to consider all of Google's offerings to get a sense of what Google has the potential to achieve. It's possible that increasing numbers of users worldwide will adopt light, cheap netbooks and other devices powered by free Google software (Android, Google's Chrome browser, Google TV, and Chrome OS). Productivity apps, e-mail, calendaring, and collaboration tools will all exist in the cloud, accessible through any browser, with files stored on Google's servers in a way that minimizes hard drive needs. Google will entertain you, help you find the information you need, help you shop, handle payment, and more. And the firms you engage online may increasingly turn to Google to replace their existing hardware and software infrastructure with corporate computing platforms like Google Apps Engine (see Chapter 14). All of this would be based on open standards, but switching costs, scale, and increasing returns from expertise across these efforts could yield enormous advantages.

Studying Google allowed us to learn about search and the infrastructure that powers this critical technology. We've studied the business of ads, covering search advertising, ad networks, and ad targeting in a way that blends strategic and technology issues. And we've covered the ethical, legal, growth, and competitive challenges that Google and its rivals face. Studying Google (or Alphabet, if you're inclined to use the "new" name) in this context should not only help you understand what's happening today, it should also help you develop critical thinking skills for assessing the opportunities and threats that will emerge across industries as technologies continue to evolve.

Key Takeaways

- For over a decade, Google's search business has been growing rapidly, but that business is maturing.
- Slower growth will put pressure on the firm's stock price, so a firm Google's size will need to pursue very large, risky, new markets—markets that are also attractive to well-financed rivals, smaller partners, and entrepreneurs.
- Rivals continue to innovate in search. However, those who choose to compete with Google using technology should recognize that it is often easy for a firm to mimic the innovations of a pioneer with a substitute offering, and Google has additional strategic resources, such as brand, scale, and network effects, that will make it a challenge to displace.
- European and US regulators have investigated Google for antitrust violations and, at least initially, have reached different results, demonstrating the challenges dominant firms face as they grow globally.
- Google is investing heavily in methods that promote wider Internet access. These include offering free software to device manufacturers and several telecommunications and lobbying initiatives meant to lower the cost of getting online. The firm hopes that more users spending more time online will allow it to generate more revenue through ads and perhaps other services.

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- Google Glass has struggled to achieve consumer acceptance, but several applications have demonstrated broad impact across various industries, improving productivity, lowering costs, speeding delivery time, and potentially even saving lives.
- Android Pay uses NFC communications to allow mobile phones to make credit and debit card payments, manage loyalty programs, redeem coupons, and more. The service leverages tokenization to mask actual credit card numbers, potentially making it more secure to use than conventional credit cards. In order to receive broad adoption, Android Pay will need a critical mass of users with compatible handsets and retailers with hardware capable of taking these kinds of payments.
- Google continues to struggle in social networking and Google+ significantly lags behind Facebook and Twitter in user engagement and overall users, despite Google's attempts to integrate the service into its core offerings. Some efforts that have been part of Google+, such as Hangouts and Photos, have been allowed to operate as stand-alone products.
- YouTube demonstrates how a firm can create a large and vastly influential business in a short period of time, but a business that hosts and serves large files of end-user content can be costly. Like AdSense, YouTube channels have become a launching pad for content entrepreneurs.
- Google, Microsoft, and smaller rivals are also migrating applications to the Web, allowing Office-style software to execute within a browser, with portions of this computing experience and storage happening off a user's computer, "in the cloud" of the Internet. Revenue models for this business are uncertain.
- With scale and influence comes increased governmental scrutiny. Google has increasingly become a target of antitrust regulators. The extent of this threat is unclear. Google's extreme influence is clear. However, the firm's software is based on open standards; competitors have a choice in ad networks, search engines, and other services; switching costs are relatively low; users and advertisers aren't locked into exclusive contracts for the firm's key products and services; and there is little evidence of deliberate, predatory pricing or other "red-flag" activity that usually brings government regulation.

Questions and Exercises

1. Perform identical queries on both Google and rival search engines (Bing, Yahoo!, Blekko, and DuckDuckGo are all possibilities). Try different categories (research for school projects, health, business, sports, entertainment, local information). Which sites do you think give you the better results? Why? Would any of these results cause you to switch to one search engine versus the other?
2. Investigate new services that attempt to extend the possibilities for leveraging online content. Visit Wolfram Alpha and any other such efforts that intrigue you. Assume the role of a manager and use these engines to uncover useful information. Assume your role as a student and see if these tools provide valuable information for this or other classes. Are you likely to use these tools in the future? Why or why not? Under what circumstances are they useful, and when do they fall short?
3. Assume the role of an industry analyst: Consider the variety of firms mentioned in this section that may become competitors or partners. Create a chart listing your thoughts on which firms are likely to collaborate and work together and which firms are likely to compete. What are the advantages or risks in these collaborations for the partners involved? Do you think any of these firms are "acquisition bait?" Defend your predictions and be prepared to discuss them with your class.
4. Assume the role of an IT manager: To the extent that you can, evaluate online application offerings by Google, Microsoft, Apple, and rivals. In your opinion, are these efforts ready for primetime? Why or why not? Would you recommend that a firm choose these applications? Are there particular firms or users that would find these alternatives particularly appealing? Would you ever completely replace desktop offerings with online ones? Why or why not?
5. Does it make sense for organizations to move their e-mail and calendaring services off their own machines and pay Google, Microsoft, or someone else to run them? Why or why not? Has your university "Gone Google"? What factors influenced this decision?

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6. What are Chrome, the Chrome OS, and Android? Are these software products successful in their respective categories? Investigate the state of the market for products that leverage any of these software offerings. Would you say that they are successful? Why or why not? What do you think the outlook is for Chrome, the Chrome OS, and Android? As an IT manager, would you recommend products based on this software? As an investor, do you think it continues to make sense for Google to develop these efforts? Why or why not?
7. Apple's CEO Tim Cook calls Android a "toxic hellstew" of security vulnerabilities and fragmentation running on so many kinds of devices that it fails to offer the latest features to users. Reach out to friends or visit stores to compare Android and Apple devices and conduct research online. Do you think Cook's claims are valid? Which platform do you favor, Android, iOS, or another? Why?
8. Do research on Google Glass. Come to class with powerful, interesting, or fun examples of Glass use. Advocate for industries that should be using Glass and how the product could deliver value. What challenges does Glass present to IT managers, users, legislators, and society in general?
9. What will it take for Android Pay to be successful? What challenges must the effort overcome? Research the current state of Android Pay's competitors. What competing efforts exist? Which firms are best positioned to dominate this market? How large could this market become?
10. Google's unofficial motto is "Don't be evil." But sometimes it's challenging for managers to tell what path is "most right" or "least wrong." Google operates in countries that require the firm to screen and censor results. Short term, this is clearly a limitation on freedom of speech. But long term, access to the Internet could catalyze economic development and spread information in a way that leads to more democratization. Investigate and consider both of these arguments and be prepared to argue the case either for limiting work in speech-limiting countries or working within them as a potential agent of change. What other pressures is a publicly traded firm under to choose one path or the other? Which path would you choose and why?
11. Investigate Google+. Are you a Google+ user? Why or why not? What will it take for Google+ to attract users and usage? Compared with rivals, how has the service performed? What advantages does Google have that it can leverage with Google+? What competitive advantages do rivals have over Google?
12. Investigate how Google TV has performed on the market. Why does Google offer a TV product? How might the firm make money from this effort? What obstacles does the firm have to overcome in order for Google TV to grow?
13. Google innovation seems to be so far ahead that our legal regimes can't keep up. What legal issues are raised by driverless cars? Have any laws been changed to address this technology? Google Glass also raises potential privacy concerns. What are the main issues with Glass, and have laws or policies changed regarding the technology? Be prepared to discuss these issues in class.

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