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]

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.

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.

www.Welcome.AI

View the video online at: http://www.youtube.com/embed/I4qM33A2OH8?rel=0
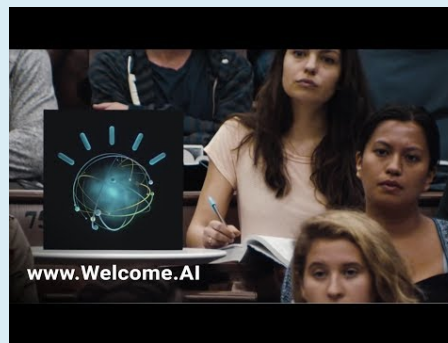
The world's second most populous nation, India, has ridden technology to become a global IT powerhouse. In two decades, India's tech sector has grown from almost nothing to a $120 billion industry, expanding even during the recent global recession.[10] Technology has enabled the once almost exclusively 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-

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]

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]

📹 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]

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?

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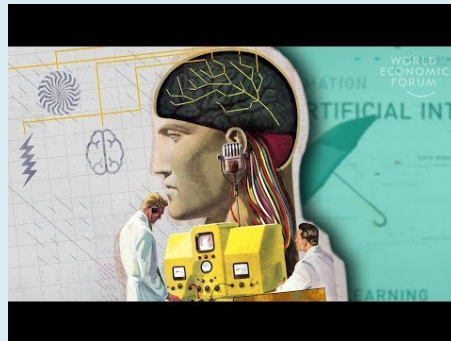
View the video online at: http://www.youtube.com/embed/Ls1_tqlpMww?rel=0

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.

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:

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]

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]

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-

Source: Wikimedia Commons.

FIGURE 1.4

Payal Kadakia, founder of ClassPass

Source: Image courtesy of ClassPass.

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

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

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

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

<mark>Technology has thrown a grenade onto the marketing landscape,</mark> and as a result, the skill set needed by today's marketers is radically different from what was leveraged by the prior generation. <mark>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,</mark> 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.

Human Resources

Technology helps firms harness the untapped power of employees. <mark>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.</mark> 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

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*

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.

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-

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-

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

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

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.

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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