



COMPETING

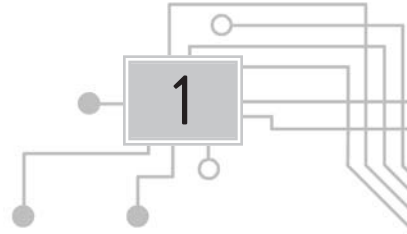
IN THE

AGE OF AI

**Strategy and Leadership When Algorithms
and Networks Run the World**

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The Age of AI

“It’s a Rembrandt!”

So shouted the neatly dressed, white-haired gentleman after quickly raising his hand. Several other members of the audience called out in agreement. One man, who ran a leading art museum in Australia, said he recognized the unique style of the seventeenth-century Dutch master, but he seemed puzzled that he couldn’t recall this specific painting, shown in figure 1-1.

FIGURE 1-1

The next Rembrandt



Source: reproduced by permission of ING and J. Walter Thompson.

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Then a video began to play, and the room fell silent as the narrator described the work's provenance.¹ The portrait, it turns out, was not a Rembrandt. Rather, it was created in 2016 by a team from advertising agency J. Walter Thompson and Microsoft as a promotion for ING Group, the Dutch bank. The painting consists of more than 148 million pixels, based on 168,263 scans of Rembrandt's three hundred known paintings. A team of data scientists, engineers, and Rembrandt experts applied learning algorithms to analyze the portraits and select specific characteristics that were typical in some way of the artist's work: they determined that the new painting would feature a Caucasian male between the ages of thirty and forty, with facial hair; he would wear a hat and a white collar; and he would face to the right. More algorithms were used to assemble the components into a fully formed composition. A 3-D printer then deposited thirteen layers of paint-based UV ink on a canvas in a way that closely imitated the master's brushstrokes. Thus *The Next Rembrandt*, as the work is called, came into being via artificial intelligence—some 350 years after the artist's death.

AI is becoming a force in the arts, connecting various disciplines and media and expanding the range of artistic possibilities. With its Arts and Machine Intelligence (AMI) program, for example, Google is organizing a community of artists and engineers to explore how creative practices are being transformed.² The community applies the kinds of style-transfer techniques used in *The Next Rembrandt* across a broad variety of subjects and media, from film to music.

But AMI and other similar programs are taking AI even further into the realm of creation: in addition to replicating existing styles, AI is being used to create completely new works of art.³ This endeavor transforms not only the method for crafting the work of art but also the organization and process that conceives and creates it. Ahmed Elgammal, director of the Art & Artificial Intelligence Lab at Rutgers University, is working with an art-generating algorithm called AICAN that is programmed to produce novelty without substantial help from human artists. The program starts with training data drawn from a vast assemblage of paintings dating from the fourteenth century and produces something fundamentally differ-

ent: paintings “inspired” by established artistic styles but entirely new. Thus, the AI algorithms do not merely expand the range of creation and distribution methods for artists; they also model the course of art history, offering insight into art’s long progression from figuration to abstraction and helping us understand processes that have been running in the collective unconscious for more than half a millennium.

This is only the beginning. If a computer, aided by a few computer scientists and some fairly basic AI, can simulate, collaborate with, or possibly even extend the work of creative genius, we can almost guarantee that no field of human endeavor will remain independent of artificial intelligence. In discipline after discipline and industry after industry, digital networks and AI are becoming pervasive, defining a new age for business and for all of us.

Competing in the Age of AI

AI is the “runtime” that is going to shape all of what we do.

—Satya Nadella, Microsoft CEO

AI is becoming the universal engine of execution. As digital technology increasingly shapes “all of what we do” and enables a rapidly growing number of tasks and processes, AI is becoming the new operational foundation of business—the core of a company’s operating model, defining how the company drives the execution of tasks. AI is not only displacing human activity, it is changing the very concept of the firm.

As such, the first truly dramatic implications of artificial intelligence may be less a function of simulating human nature and more a function of transforming the nature of organizations and the ways they shape the world around us.

This book describes the profound implications of artificial intelligence for business. It is transforming the very nature of companies—how they operate and how they compete. When a business is driven by AI, software instructions and algorithms make

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up the critical path in the way the firm delivers value. This is the “runtime”—the environment that shapes the execution of all processes—that Nadella refers to. In a digital operating model, humans may have designed the operational systems, but computers are actually doing the work in real time: painting the digital Rembrandt, setting a price on Amazon, recommending a product on Walmart’s mobile app, qualifying a customer for an Ant Financial loan—all processes that would traditionally have required human intelligence, not only to design but also to execute.

Having software shape the critical path of operational execution has substantial ramifications. Digital, AI-driven processes are more scalable than traditional processes. They enable greater scope (or variety), as they easily connect with a myriad of other digitized businesses, and they create powerful opportunities for learning and improvement, such as the ability to produce ever more accurate, complex, and sophisticated predictions and even gain fundamental understanding. In doing so, networks and AI are reshaping the operational foundations of firms, enabling digital scale, scope, and learning, and erasing deep-seated limits that have constrained firm growth and impact for hundreds of years.

We are already there, and the AI that is driving the explosive growth of firms like Facebook and Tencent isn’t even all that sophisticated. To bring about the kinds of dramatic changes we’re describing, AI need not be indistinguishable from human behavior, or capable of simulating human reasoning—what is sometimes referred to as *strong AI*. We need only a computer system to perform tasks that were traditionally performed by human beings, in what is traditionally referred to as *weak AI*. We don’t need a perfect human replica to prioritize content on a social network, make a perfect cappuccino, analyze customer behavior, set the optimal price, or even, apparently, paint in the style of Rembrandt. Imperfect, weak AI is already enough to transform the nature of firms and how they operate.

Even with relatively basic artificial intelligence, whose applications we have seen explode over the past ten years, we are witnessing unprecedented changes. We have entered a new age in which networks and algorithms are woven into the fabric of the firm,

changing how industries function and the way the economy operates. Across both new and old enterprises, digital savvy can no longer be treated as a discrete set of skills and AI can no longer be viewed as the purview of a specific job description or business function. Understanding the new opportunities and challenges has become essential to all of us. And in this new age of AI, many time-honored assumptions about strategy and leadership no longer apply.

Transforming Competition

As we enter the age of artificial intelligence, the emergence of digital operating models is transforming competition. Consider the case of photography. More than a hundred years ago, the invention of photography had a disruptive impact on the “technology” of painting by greatly reducing the demand for such work. Painters had trouble responding to this threat, but eventually they changed their approaches, inventing new techniques and styles. The important point here is that film-based photography threatened old norms and created new opportunities, but it did not dramatically transform the economy. The battle between film photography and painting resembled the pattern observed across a variety of industries, from disk drives to excavating machines, when one technological trajectory becomes disrupted by another.⁴ The new overtakes the old, creating challenges for existing competitors, while the rest of the economy continues more or less as it was.

In contrast, let’s look at what happened when *digital* photography came on the scene. With the invention of the first digital camera in 1975 (by Steven Sasson at Kodak), photographs could be captured as files of stored data that could be displayed and enhanced on a computer. Early digital photographs were blurry and expensive. Over time they became sharper and cheaper. Then they began to threaten traditional photography in a way at first similar to what a disruptive technology would do: undermining traditional players and creating opportunities for new businesses.

But digitizing photography did not simply provide an alternative to an older technology the way smaller disk drives disrupted the

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demand for larger disk drives. Digital representation completely transformed the nature and variety of activities connected to photography. It was suddenly easy and free to share pictures (benefiting from digital automation at essentially zero marginal cost), so people started snapping and sharing many more photos. No event, no activity, no meal is now too trivial to document and post on social media. This practice gave rise to a new breed of companies—Facebook, Tencent, Snapchat, Line, and TikTok are just a few of them—each of them featuring massively scalable digital operating models to help users select, shape, and share digital representations of their lives and of the world around them.

Increasingly sophisticated AI is dramatically expanding the impact of photography's transformation. Think of the vast number of photos being taken every day (now more than 10 trillion digital photographs each year, five orders of magnitude greater than the total number of traditional photographs ever taken) as a growing dataset—most of it now stored in the cloud on Google, Facebook, and WeChat, where it can be analyzed by algorithms. These troves are powering the improvement of algorithms used for facial recognition, photo sorting, and image enhancement. With the help of the additional data already available to them, and a little bit of “training,” social platforms like Google, Facebook, and WeChat can automatically identify (even predict) not only family and friends but also affinities (are the people in this shot members of the same family?) and backgrounds (is this person a schoolmate?). Photo apps are already recommending products, services, and even news feeds that users might like and some are making friend recommendations—offering to “introduce” you to someone based on shared affinities or backgrounds.

When digital technology collided with traditional photography, it did not simply replace it with something cheaper, more differentiated, or higher quality. It did not merely create a new value proposition to serve customers. It enabled the emergence of a new and increasingly powerful breed of company, one that leverages a different kind of operating model and competes in different ways. In doing so, it not only changed the photography industry but reshaped the world around it. This is because when an activity is digi-

tized (like converting a paint stroke into pixels), profound changes take place. A digital representation is infinitely scalable—it is now possible to easily and perfectly communicate the pattern it represents, replicate it, and transmit it at virtually zero marginal cost to a near infinite numbers of recipients, anywhere in the world. Moreover, digitizing the activity makes it easily connectable, also at zero marginal cost, to limitless other, complementary activities, dramatically increasing its scope. Finally, the digital activity can embed processing instructions—AI algorithms that shape behavior and enable a variety of possible paths and responses. This logic can learn as it processes data, continuously training and improving the algorithms that are embedded in it. The digital representation of a human activity can thus learn and improve itself in ways that analog processes cannot. These factors completely transform the ways a firm can (and should) operate.

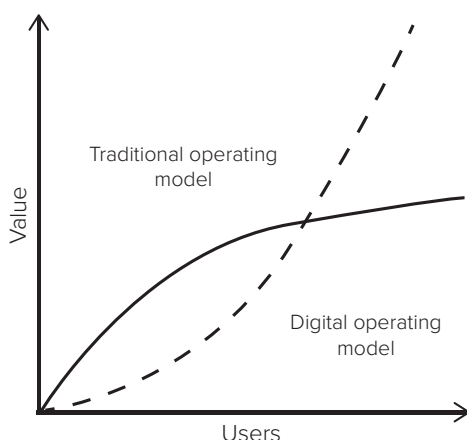
Traditionally, the intrinsic scalability, scope amplification, and learning potential of technology was limited by the operating architecture of the organizations that it was deployed in. But over the past decade, we have seen the emergence of firms that are designed and architected to release the full potential of digital networks, data, algorithms, and AI. Indeed, the more a firm is designed to optimize the impact of digitization, the greater its potential for scale, scope, and learning embedded in its operating model—and the more value it can create and capture (see figure 1-2). Increasing levels of digitization, analytics, and AI/ML can dramatically improve the scalability of a business, making the value curve increase more rapidly as a function of the number of users or their engagement. As it collides with a traditional company, a digital operating model can overwhelm the status quo.

The first losers were the traditional players that could not adapt. Ultimately, Kodak was not killed by Fuji or by a digital photography startup, but by the emergence of smartphone and social network firms. Instead of focusing on industry-level tasks like film processing and marketing, Facebook, Tencent, and Google focused on connecting users and on capturing and analyzing the information that flows through their networks. These firms create value differently, capture value differently, and rely on a completely different

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FIGURE 1-2

The collision between traditional and digital operating models



kind of operating model from Kodak's to deliver that value to their customers. The result is a fundamentally different way to compete. These companies never even considered Kodak a competitor; rather the film company was simply collateral damage in the newer companies' race to acquire users on networks that enabled photo sharing as a core service.

But the story does not end there. Just as the social and mobile platforms reached unprecedented levels of scale, scope, and learning, we began to discover that digital operating models introduced a new set of challenges while they crushed traditional competitors. Their unconstrained growth and unrestrained impact raised new risks. From privacy to cybersecurity, and from bias to fake news, the rise of the AI-driven firm is posing new kinds of threats. Traditionally, corporate leaders faced a bounded set of challenges, constrained by the relatively limited impact of their organizations on the surrounding economy, environment, and social system. Without the same intrinsic limits on scalability, scope, and impact, the new breed of digital firm requires new approaches to leadership, regulation, and even ethics.

Alexa, How Do You Transform the Economy?

Perhaps more than any other organization, Amazon embodies the way an organization can leverage a digital operating model to transform traditional industries. Amazon sells real things—goods and services we need every day—and in doing so it collides with all the businesses that have been selling those goods and services in the same way for generations. Amazon reinvents traditional business operations and puts them on digital foundations. In doing so it harvests the advantages of digital technology, analytics, and AI/ML in order to scale, extend its scope, and learn. And by colliding with traditional businesses, from books to consumer electronics to groceries, Amazon changes the rules of competition.

In a traditional business, size is a double-edged sword. As it grows, a business can usually deliver more value at a cheaper price. However, the advantages of scale tend to be limited by the firm's *operating model*, which encompasses all the assets and processes it uses to deliver the value it promises to its customers. As the firm gets bigger, its operating model becomes increasingly complex, and with complexity come all kinds of problems. Think of the long lines in your favorite retail store when there are too many customers, or the confusion that emerges when a rapidly growing firm hires too many new employees, or the quality problems that plague a manufacturing plant when demands for capacity or product variety are increased. Ultimately, complexity becomes the downfall of traditional organizations, increasing operational costs and decreasing service levels. All this despite the fact that dealing with operational complexity is the goal of many of the managerial and administrative systems developed over the past one hundred years, from the assembly line to the multidivisional company structure.

But when Amazon digitizes an operating task it embraces the advantages of *digital* scale, scope, and learning. Its digital systems scale more easily and continue to improve despite the size and complexity of its operation. When the order-taking system is fully digitized, it does not become harder to manage as more consumers use

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it, or as they demand more variety; it just gets better and better. As an increasing portion of the processes and tasks that deliver customer value are digitized, the advantages increase to create a much more scalable enterprise, capable of delivering an unprecedented scope of products and services, all characterized by an impressive rate of improvement and pinpointed targeting.

Take product suggestions. In traditional retail, product suggestions are made by employees in stores, but their numbers are limited by traditional recruitment and training processes along with personnel budgets. Getting the right sales expertise, furthermore, is difficult: people who are good at selling fishing rods aren't typically good at selling baby clothes. But the algorithm that creates suggestions on the Amazon website does not suffer from the same limitations. The system ingests huge amounts of data on what previous customers bought, and which product purchases were related to each other (for example, purchases that were together in the same shopping cart). The system processes all that data, factoring in product specifications and customer characteristics to suggest new, potentially appealing products. The engine learns and improves with the behavior of every relevant consumer and every relevant product—the more data, and the more scale and product diversity, the better, and Amazon's performance continues to improve. AI engines like Amazon's *collaborative filtering* algorithms do not incur human complexity costs like communication or coordination. The system does not decrease in efficiency as it grows and is thus much more scalable than a human (or organizational) learning engine. In addition, it connects easily across applications; much of what Amazon learns from a consumer's book preferences can be applied to suggestions of videos, clothing, or almost anything else.

The key to Amazon is its increasingly digital operating model. Amazon's operating philosophy centers on digitizing the best understanding of operational excellence through the broad-based application of artificial intelligence and machine learning, advanced robotics, and the instantiation of as much know-how as possible into software. In a traditional warehouse, people manage and carry out the process, with the organization suffering the same limitations we see in product suggestions. Not at Amazon. People are second-

ary in many of the most critical workflows. From demand forecasting to warehouse management, and from supply chain management to capacity planning, software and AI are increasingly running the show. Amazon does employ many people but deploys most of them on the edge of the digital network, doing things that computers are not yet capable of handling (such as picking an oddly shaped product from the warehouse shelf), while at the same time minimizing managerial complexity and maximizing the impact of digital scalability. And many times, computers are defining what humans should do, not the other way around, as in figuring out the optimal path to find and pick a specific product in the warehouse.

Over and over, Amazon has collided with traditional industrial settings and transformed them with a digitized, automated, and increasingly AI-capable alternative. Amazon's service improves with volume, whereas the traditional business runs into complexity costs. As Amazon grows, the traditional business loses out and the industry is transformed.

Echo, Amazon's smart speaker and microphone, extends the company's strategy to a new range of applications by utilizing Alexa, a voice interface to the company's AI platform. Echo started by understanding simple, almost trivial commands, such as "Alexa, play Rage Against The Machine" on Amazon's music service. The technology improved quickly as it gathered increasing quantities and types of data and used that data to train itself. As its functionality increases and improves over time, the Echo-Alexa duo continues to collide with and transform many traditional tasks, from ordering vitamins to reading books, and from ordering a car service to controlling home systems.

The Alexa service, furthermore, is designed as a true hub, with the potential to connect the user to a virtually limitless array of services and products. As of September 2018, Alexa had more than fifty thousand skills (actions that it could perform via voice command) developed by a large ecosystem of third-party developers.⁵ And as Echo continues on its course, the number of human needs that can be addressed by an Amazon-provided or -brokered solution will only continue to increase. Every time you tell Alexa about things you need to buy, Amazon Echo will build a shopping list and send you

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the items. And every time you return and exchange items, Amazon's algorithms will keep on learning and honing its ability to predict what you need.

Amazon's model is scaling spectacularly well. The company spurred collisions between analog and digital models in industries from apparel to computing, and from consumer products to entertainment, threatening traditional stalwarts from Walmart to Comcast. In the process, Amazon has become one of the quintessential drivers of industry transformation. It has changed the way people shop across the globe and raised the expectation of personalization across the entire array of consumer products and services. As it reaches scale in more of its markets, from books to groceries, its impact and market capitalization continue to soar.

As it continues to grow and transform, Amazon is facing increasing scrutiny from communities and regulators. Given its broad reach among many traditionally defined markets, its model is not easily challenged by existing antitrust practices. Sustainable growth will hinge on Amazon leadership's ability to balance its many consumer benefits against the dislocations it might force on the rest of the economy. At the same time, Amazon's competitors are not standing still.

Becoming a More Digital Company

No industry is feeling the impact of Amazon more keenly than retail.⁶ Amazon's convenience, low prices, personalization and recommendation capabilities, and software-enabled logistics infrastructure pose a formidable challenge to traditional firms. In 2017 we saw more than twenty long-standing retailers file for bankruptcy, and in 2018 even the 125-year-old giant Sears joined this list.⁷ Walmart—the world's largest company by revenue—is doing all it can to avoid that fate.

Founded by Sam Walton in 1962, Walmart has not shied away from technology. For decades it set the standard in retail supply chain technology and network infrastructure, with its constantly evolving Retail Link system and its early commitment to EDI and

RFID technologies.⁸ A data-rich supply chain has consistently been an important part of Walmart's operating model and a key to its impressive scale. And yet, even the most successful traditional operating models are not strong enough to confront Amazon's onslaught without substantial transformation.

To put up a credible fight with Amazon, Walmart is rearchitecting its operating model on a digital and AI-enabled foundation. Traditional siloed enterprise software systems are being replaced by an integrated, cloud-based architecture. This will increasingly expose Walmart's unique data assets to a variety of powerful new applications. This, in turn, will enable a growing number of operating tasks to be enhanced or automated by analytics and AI, and remove traditional bottlenecks to growth and transformation.

The company is also looking outside its operations for help. It has acquired a number of digital firms, including Jet.com (e-commerce) and Bonobos (an online retailer of menswear). In July 2018, Walmart announced a partnership with Microsoft, both to drive digital transformation and to access cloud capacity, technology, and AI capabilities on demand.

Walmart's online revenues have already seen substantial growth, increasing almost 50 percent year over year in 2018, and the company is waging a credible fight with Amazon. But to sustain its performance, Walmart will need to leverage data, analytics, and AI to transform its in-store experience. Stores are not going away, but the physical retail experience has to evolve both to delight shoppers and to complement the online experience. Walmart acknowledged as much in 2018 when it launched its Intelligent Retail Lab in Levittown, New York.

It's ironic that much of the effort to improve the in-store process involves learning how to apply the digital capabilities that are now routinely offered in the online world. Compared with online shopping, physical retail is often incredibly frustrating. Think about the amount of time wasted wandering a store looking for a specific item; the uncertainty of whether one is getting the best price; the lack of good recommendations, comparisons, or product choice. E-commerce has transformed consumer retail expectations, and traditional retailers have yet to evolve to match the convenience, personalization,

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and ease of their online counterparts. This provides an incredible opportunity.

Advanced analytics and AI can enable Walmart to bring online experiences into stores. By deploying cameras and sensors and by layering on computer vision and deep learning software, the in-store experience can acquire the convenience of online shopping. Walmart is experimenting with ways to capture customer movement and engagement patterns throughout the store, just as online retailers can track customers' journeys and clicks throughout the site. This data can be used at an aggregate level to create a heat map of customer patterns and reveal important information, such as areas where customers are converging or areas that receive little traffic. This information can help improve store offerings, product placement, store layout, or even supply chain and sourcing decisions.

Walmart and other retailers are also working on using real-time information from personal devices, such as location, integrated with past online interactions, to recognize customers and personalize the experience. Imagine a sales rep who is armed with details about your prior preferences to better recommend items or engage with customers. Implementation, however, is certainly not straightforward. Will consumers truly enjoy having a salesperson with as much information as the Amazon recommendation algorithm? How will they navigate the trade-offs between personalization and privacy? Will traditional salespeople really mediate this process, or will consumers feel better about receiving recommendations on their mobile devices?

We're already seeing dramatic changes in the store experience. Amazon Go stores, for example, have no cashiers and no lines to pay for purchases. You simply scan your Amazon app upon entry, and the store's technology tracks your movements and purchases. When you exit you are emailed a receipt. We tried to confuse the system, entering the store in a team of three, then grabbing multiple items off the shelves, putting things back in the wrong places, and exiting at various times. This stunt did not fool Amazon. We were promptly emailed a receipt with all the items everyone had in fact selected.

Without employees to hire, train, and manage, and with a sophisticated, digitally enabled supply chain, what is the bottleneck in building more stores? All that a retailer needs to do is access real estate, deploy the hardware, and install the software. The managerial cost in scaling to multiple operations is virtually nonexistent. In China, JD.com has already leveraged a less aggressive digital operating model to roll out *thousands* of convenience stores each week.⁹ Walmart should pay attention.

*WeChat, Xie Xie Ni . . .*¹⁰

Lu Xiaoxue earns a living by singing to entertain Chinese tourists at the Jalan Alor restaurant district in Kuala Lumpur, Malaysia. She thanked the passerby (who happened to be one of us, Karim Lakhani) for his donation—which he'd made by scanning her WeChat QR code with his smartphone.

Thus, beggars and street performers have entered the digital age. With a few swipes and touches on her WeChat (or Alipay) app, a passerby in Kuala Lumpur (and in almost any city in Asia) can now transfer money instantly, digitally, and securely to anyone. Western visitors are often shocked to find that the cash they brought with them is virtually useless, because app-based digital systems are now the preferred mode of payment in stores, restaurants, and even with panhandlers, driving a wave of new applications leveraging the resulting data, analytics, and AI. The 7-Eleven in the luxury mall within the Petronas Towers even requests WeChat Pay *instead of* credit cards. Far away from the rarefied atmosphere of Silicon Valley, digital technology is colliding with and reshaping all kinds of businesses, professions, and applications.

One of the companies behind these collisions is China's Tencent, the maker of the WeChat app. Founded in 1998 in Shenzhen, Tencent entered the market with a PC-based internet instant messaging service for Chinese users. A few of us may remember ICQ, a messaging service launched in the early days of the commercial web (1996) that allowed users to instantly chat with friends and colleagues around the world. Realizing that most Chinese internet

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users had to share computers in cafes or at work, Tencent adapted ICQ functionality and centralized user data and chat histories to Tencent servers, enabling portability across computing devices. Tencent called its service Open ICQ and launched it in February 1999. The service went viral and quickly became China's largest instant messaging service and social network.

After building scale, Tencent has monetized its messaging network with advertising and premium offerings (such as special icons). Increasingly, it is extending the scope of the application by linking its users to a broad variety of complementary products and services such as avatars, games, and virtual goods. Tencent launched WeChat in 2011 as a mobile messaging application built on the Tencent messaging network. Beyond mobile access, WeChat provided a new range of functionality for its users that includes sending voice messages, sharing videos, sharing pictures and GPS locations, and sending and receiving money.

WeChat was built as an open platform, with easily accessible application programming interfaces (APIs) for software developers. These interfaces can be used to plug in to all kinds of external services and activities, from paying utility bills to setting up doctor appointments. This is how Tencent has expanded into new markets.

As Tencent continues to connect global consumers, its digital operating model is driving enormous scale and scope. At its core is a data platform enabling analytics and AI opportunities with data on social interactions, spending patterns, search trends, and even political sentiment. Mirroring the success of its arch competitor, Alipay (part of Ant Financial Services Group, in the Alibaba Group), Tencent analyzes the data through machine learning algorithms to inform and automate an expanding variety of services. In China and beyond, Tencent and Ant Financial are thus leveraging the connections they have with large masses of consumers to collide with and transform industries from financial services to health care.

In only a few years, these organizations have reached out to ten times as many consumers as the largest banks in the United States and Europe; they offer a broader range of products that are continuously improving, leveraging the rapidly increasing value that can

be drawn from the network and the data it provides. Between them, Tencent and Ant Financial now claim the most widely used payment service, the largest money market fund, and one of the largest small business loan networks. And, as with Amazon, communities and regulators are starting to pay serious attention.

Today, Tencent is one of the world's most valuable companies, a crucial hub in the global economy, and on a collision course with a variety of industries (and regulatory bodies). Banks beware. Regulators beware. Amazon beware? Even street performers will never be the same again.

Understanding the New Age

When the digital Rembrandt was introduced, the reactions from the art world were truly remarkable. Some experts were intrigued by the obvious capabilities and potential of the technology, calling the efforts “spectacular” and “stunning.” Others viewed it as a painful, even immoral, endeavor. Jonathan Jones, the *Guardian*'s art critic, voiced what was possibly the harshest disapproval of the project, calling it a “horrible, tasteless, insensitive and soulless travesty.”¹¹

If truth be told, Jones's reaction is not very dissonant with what many of us feel when we witness AI-driven processes replacing traditional activities in settings that we have long known and cherished. Remember the first time you believed a news story you read online, only to learn later that it was fake? The emergence of digital networks and AI can challenge long-standing assumptions about the nature of work, firms, and institutions—assumptions such as the importance of unique, industry-specific core competencies or the value of many traditional capabilities. AI can render skills and talents obsolete, from driving a car to managing a traditional retail establishment. Digital networks can alter and transform accepted approaches to social and political interaction, from dating to voting. The broad deployment of AI could threaten millions of jobs in the United States alone. And beyond the erosion of capability, threats to traditional skills, and other direct economic and social impact,

we are increasingly vulnerable as an increasing portion of our economy and our very lives become embedded in digital networks. Not surprisingly, cybersecurity has become a central problem for organizations as different as Sony Pictures and the National Association of State Election Directors.

We cannot escape the fact that the digital and analog worlds are becoming one. We are no longer looking at some new technology, at a special kind of company, or at the “new” economy. We are looking at *the* economy—the entire economic system, every industry, every segment, and every country, across manufacturing, services, and software products. We have entered a new age that is redefining how *every* organization (and virtually any worker) in the economy needs to act to create, capture, and deliver value. Whether we like it or not, digital networks and AI are transforming business, and society.

The Promise of This Book

The emergence of digital operating models is framing a mandate for leaders, in both new and old firms. We need to better understand how to manage, transform, grow, and control our businesses in an era of virtually unbounded potential impact. That’s what we hope this book will do for you.

If you are leading a digital organization, you need to appreciate its full potential, along with both opportunities and challenges. If you are leading a traditional organization, you need to understand how to leverage your existing strengths in new ways and transform your operating capabilities to support the new strategies.

Apart from well-publicized failures, from Blockbuster to Nokia, we are starting to see a number of firms find new growth and opportunity by building a new runtime, investing in AI, and changing the way they operate. Several firms, from Mastercard to Fidelity Investments, and from Walmart to Roche, are leading the charge. As Vipin Mayar, who leads these efforts at Fidelity, told us, “AI is just making us better.”¹²

AI presents new opportunities—for startups, established firms, entrepreneurs and intrapreneurs, for new economic, social, and po-

litical institutions, and yes, even for artists. Startups can use the frameworks described in this book to target new processes to digitize and enable, through analytics and AI, from writing emails to interpreting X-rays. And just as the new generation of digital native firms is struggling with the downsides of their unbound scale and scope, more experienced firms can define new, better-governed models for sustained growth and transformation. AI-driven transformation not only prompts the creation of new companies but also motivates old companies to lead again, adopting the best of the new kind of operating model and appreciating the increased acceleration provided by a new, digital engine, without jettisoning traditional braking systems. Banking on past experiences and fueled by a new generation, some companies are taking the best of old and new to lead the way.

Our goal with this book is to provide leaders of organizations old and new, startups, and regulatory institutions a set of frameworks for understanding, competing, and operating in the age of AI.

Our Journey

Over the past decade, the two of us have led a broad portfolio of research projects at Harvard Business School to understand digital transformation, networks, and the impact of AI across companies. The research has encompassed hundreds of firms, in industries as diverse as financial services and agriculture, from San Francisco to New York, and from Bangalore to Shenzhen. Often in collaboration with our friends at Keystone Strategy, we have also been involved in literally hundreds of strategy and transformation efforts as teachers, consultants, experts in regulatory matters, board members, and direct participants.¹³ We have engaged with organizations from tiny startups to multinational corporations, and from internet pioneers like Amazon, Microsoft, Mozilla, and Facebook to traditional organizations like Disney, Verizon, and NASA. We have also been fortunate to engage with and learn from participants in HBS's global executive education programs and through courses in the MBA curriculum.

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This book is a vehicle to distill what we have learned. The implications target managers in existing firms as well as entrepreneurs.

The theories described in this book address an important phenomenon. Disruption theory defined an existential threat for traditional firms in the 1990s and 2000s, as they confronted waves of technological change. Our work describes a new observation: that a new breed of firm, characterized by digital scale, scope, and learning, is eclipsing traditional managerial methods and constraints, colliding with traditional firms and institutions, and transforming our economy. Software, analytics, and AI are reshaping the operational backbone of the firm.

But we believe this transformation is about more than technology; it's about the need to become a different kind of company. As we discuss in detail in later chapters, confronting this threat does not involve spinning off an online business, putting a laboratory in Silicon Valley, or creating a digital business unit. Rather, it involves a much deeper and more general challenge: rearchitecting how the firm works and changing the way it gathers and uses data, reacts to information, makes operating decisions, and executes operating tasks.

Our work stands on foundations built by many others. Carliss Baldwin and Kim Clark showed the dramatic impact information technology can have on the nature of industries.¹⁴ Hal Varian and Carl Shapiro first highlighted the many changes in economic theory brought about by the nature of information businesses.¹⁵ We are among many (Jean Tirole, Michael Cusumano, Annabelle Gawer, Geoff Parker, Marshall Van Alstyne, David Yoffie, Feng Zhu, Mark Rysman, Andrei Hagiu, Kevin Boudreau, Eric von Hippel, Shane Greenstein, and others) who have worked to explain the increasingly critical role of digital ecosystems, platforms, and communities on company strategy and business models.¹⁶ Most recently, still others (including Erik Brynjolfsson, Andrew McAfee, Kai-Fu Lee, Ming Zeng, Pedro Domingos, Ajay Agrawal, Joshua Gans, and Avi Goldfarb) revealed how computers are taking on increasingly central roles and changing the nature of work.¹⁷ This book extends these ideas and knits them together by describing how, when these factors are combined with the impact of software, analytics, and AI

on networks and organizations, something striking happens. For the first time in more than a hundred years we are seeing the emergence of a new kind of firm, which we claim is defining a new economic age. This book describes the implications of our new age of AI for strategy and leadership, targeting managers, entrepreneurs, and society as a whole.

This book is divided into ten chapters. Chapter 2, “Rethinking the Firm,” examines a new concept of the firm, driven by digital networks and AI. It dives into the nature of three digital *unicorns* (the industry term for a tech startup that reaches \$1 billion in value): Ant Financial, Ocado, and Peloton. We describe each firm’s business and operating model, its powerful digital components, and its striking capacity to drive scale, scope, and learning.

Chapter 3, “The AI Factory,” homes in on the core of the new firm, using Netflix as the central example. The core is to create a scalable “decision factory” to systematically enable data-driven and AI-driven automation, analysis, and insights. This chapter explores three critical factory components: the AI algorithms that make predictions and influence decisions, the data pipeline that feeds them, and the software, connectivity, and infrastructure that power them.

Chapter 4, “Rearchitecting the Firm,” explains why exploiting AI requires a new operating architecture. Using Amazon as a key example, we contrast traditional, siloed firm architectures, which evolved over hundreds of years, with the kind of integrated, data-centric and platform-based architectures that are enabling modern firms. We show how a new type of operating model is removing constraints on firm scale, growth, and learning.

Chapter 5, “Becoming an AI Company,” examines the transformation journey of deploying a digital operating model, centered on Microsoft’s transformation into a cloud and AI company. We generalize our findings by reporting on research on 350 enterprises, including the development of an AI readiness index, and show how the most advanced enterprises enjoyed superior growth and financial performance. The chapter also reports on some of the most popular and impactful enterprise AI implementation scenarios. The chapter concludes by depicting Fidelity’s AI transformation.

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Chapter 6, “Strategy for a New Age,” examines the strategic implications of the emergence of digital networks and AI. This chapter discusses the elements of strategic network analysis, which provides a systematic way to analyze business opportunities as digital networks and AI reshape the economy. The chapter is grounded in several examples and includes a discussion of Uber’s strategic options, strengths, and weaknesses.

Chapter 7, “Strategic Collisions,” continues our discussion of strategic implications by examining competitive dynamics. The chapter focuses on what happens when firms featuring digital operating models compete with more traditional firms. The examples range from historical competitive settings (smartphones) to current battlegrounds (home sharing and automotive). The chapter concludes by discussing some of the broader competitive implications of the emergence of digital firms.

Chapter 8, “The Ethics of Digital Scale, Scope, and Learning,” examines the new range of ethical challenges created by the combination of digital networks and AI. We look at several key issues, including digital amplification, algorithmic bias, data security and privacy considerations, as well as platform control and equity. We delineate some of the new challenges and responsibilities of business leaders and regulators.

Chapter 9, “The New Meta,” describes the book’s broadest implications for leaders of new and old firms, and for the governments and communities surrounding them. We lay out the new rules that are defining the new age, shaping key arenas, and transforming our collective future.

Chapter 10, “A Leadership Mandate,” concludes the book by delving into the leadership challenge to shape the new AI era. We begin by identifying immediate opportunities for managers and entrepreneurs as they drive transformation and consider new ventures. This chapter examines actions that should be taken by leaders of traditional as well as digital firms, and by regulators and communities. It concludes by summarizing the most important implications for leading the increasingly digital firm and outlines actions we can take as we participate in shaping our collective future.

Your AI Journey

Ultimately, we believe that AI-powered transformation can provide opportunities for any organization if it makes the required commitments and investments. Although digital startups naturally have an easier path forward than do legacy companies, we have seen decades-old businesses adapt and thrive. Our ambition is to give readers the insight to prepare for the collisions that will inevitably affect their businesses—to deal with the threats and to identify the opportunities, and to capitalize on them.

We hope this book can provide a useful perspective on the new nature of firms, their architecture, the kinds of capabilities they require, and the structure of the new settings they compete in. This book can guide legacy companies as they seek transformation, as well as new companies as they tackle the newfound opportunities and challenges. If we all embrace and invest in understanding, deploying, and managing new strategies and capabilities, and if we confront honestly the cultural and leadership transformation this requires, the new age can lead to sustainable growth and opportunity for new and existing institutions. And rather than oppose this all-encompassing trend, we are all better off by understanding it, owning it, and, most of all, shaping it.

We begin by showing how AI is changing the way firms create, capture, and deliver value—the topic of the next chapter.