

BCG TECHNOLOGY ADVANTAGE

- NICK JUE ON TRANSFORMING ING NETHERLANDS AND INTRODUCING AN AGILE WAY OF WORKING
- BEYOND THE HYPE: THE REAL CHAMPIONS OF BUILDING THE DIGITAL FUTURE
- HOW TO DESIGN AND RUN IT PROJECTS CEOs WILL LOVE
- DATA-DRIVEN TRANSFORMATION: ACCELERATE AT SCALE NOW
- BRIDGING THE TRUST GAP: HOW TO BECOME A TRUSTED DATA STEWARD
- WHAT DEEP-TECH STARTUPS WANT FROM CORPORATE PARTNERS
- POWERING THE SERVICE ECONOMY WITH RPA AND AI

The background of the entire page is a stylized, abstract graphic of a leaf. The leaf is divided into several large, rounded sections by dark veins. The color palette transitions from dark green at the top to a bright, warm orange at the bottom. The overall effect is clean, modern, and organic.

DESIGNING THE
TECH FUNCTION OF
THE FUTURE

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Preface



What is digitization doing to your company's current—and future—org chart? More specifically, where does your technology department fit? And where does the leadership of your digital transformation effort sit?

Right now in many companies, that leadership is dispersed to various business units, given the volume and magnitude of the change wrought by digital transformation. In the meantime, the traditional IT department is left handling only traditional technologies that have not yet been subsumed by the digital transformation.

In the long run, though, a singular function that brings together all of a company's technology efforts will prove to be a valuable and logical piece of most organizational structures. But the function must transform. Instead of being construed as a traditional IT value chain, it must be configured to work with the business in a matrix of multiple technology stacks. It must take advantage of the working aspects of digital—for instance, by becoming cross-functional and agile. In these ways, the technology function can assume world-class in-house engineering capabilities and deploy them alongside business units to compete successfully in the digital world.

CIOs who see the value of this kind of technology function will take steps to transform their organizations into key drivers and enablers of digital within the company. The feature article in this edition of *BCG Technology Advantage* is titled “Designing the Tech Function of the Future,” and it maps this transformative effort. Our interview with Nick Jue, about ING Netherlands' transformation, brings the potential outcomes to life.

Elsewhere in this collection of recent publications, you will read about how companies are tackling digital transformations: the internal changes they must make, the funding they require, the technologies they rely on. It's a complex and ongoing journey, one we will continue to travel with you. Along the way, we hope that you will share your thoughts with us at Technology.Advantage@bcg.com.

Ralf Dreischmeier
Global Leader, Technology Advantage practice

Contents

VIEWPOINT	
Designing the Tech Function of the Future	2
Q&A	
Nick Jue on Transforming ING Netherlands and Introducing an Agile Way of Working	7
FOCUS	
Beyond the Hype: The Real Champions of Building the Digital Future	9
VIEWPOINT	
How to Design and Run IT Projects CEOs Will Love	15
FOCUS	
Data-Driven Transformation: Accelerate at Scale Now	18
FOCUS	
Bridging the Trust Gap: How to Become a Trusted Data Steward	26
FOCUS	
What Deep-Tech Startups Want from Corporate Partners	33
INDUSTRY VIEWPOINT	
Powering the Service Economy with RPA and AI	39

DESIGNING THE TECH FUNCTION OF THE FUTURE

by Ralf Dreischmeier, Philip Evans, Michael Grebe, Heiner Himmelreich, and Sabine Döschl

THERE IS A STRANGE dynamic at play at many traditional companies: technology is increasingly important, yet in many cases, the IT function is not involved in the development of the new, differentiating products and services aimed at ever more discerning and empowered customers. Because many IT departments lack the agility and the in-house expertise to meet quickly evolving business needs, business units are appointing chief digital officers (CDOs) to lead initiatives.

As a result, more technology development is happening in the business units rather than in the classic IT department. Given the evolving demands of the business units, company leaders have a choice to make. They can transform the IT department so that it gains the expertise and agility necessary to work closely with business units to develop product and service technologies that differentiate the business. Or they can maintain an IT function that tends only to the internal mission-critical infrastructure, capabilities, and policies that keep the business it-

self functioning effectively and securely. For companies that choose the latter, business units have responsibility for independently developing new product and service technologies.

We expect that most companies will choose to transform the IT department under the direction of the CIO with the help of the CDO. We also expect that the most effective CDOs will be temporary, completing their digital programs in three to five years and then transitioning to other responsibilities within their companies.

From IT to Tech

IT transformation is part of a larger need to digitize businesses: the vast majority of companies are, or are becoming, technology companies—at least to a certain degree. Witness, for example, the rise of robotics and artificial intelligence, the Internet of Things, and advanced analytic solutions, which are permeating all sorts of businesses. Soon, technology will be embedded in nearly every product, service, and process, which will be integrated into a broader

digital ecosystem. Powerful software will be the backbone of products, services, and customer engagement. Data is already a highly valuable asset for every company, and the ability to analyze and act on that data is at the core of a company's competitive advantage.

To handle the digital shift, companies must bring business and technology together. More specifically, they must rethink how they manage three categories of technology: *product and service* (technology embedded in end products and technology that embeds end products into digital ecosystems and customer interfaces), *production* (technology in the industrial production processes of physical goods), and *enterprise* (infrastructure, platforms, and standard software packages).

Companies will increasingly build internal capabilities and focus resources on product and service technologies and production technologies for competitive advantage. For example, autonomous cars use a variety of product and service technologies—including radar, lasers, GPS, odometry, and

computer vision—to detect and interpret their surroundings. They also include apps that link the customer to the OEM. Meanwhile, companies will devote fewer internal resources to enterprise infrastructure, opting instead for cloud-based utilities.

Getting the digital transformation right not only improves a company’s operations but also boosts its valuation. According to our research, traditional asset-heavy companies often trade at low multiples, even below annual revenues, while pure digital companies typically trade at multiples that are several times revenues.

From Value Chains to Stacks

In the past, the benefits of sourcing technology—such as cloud-based utilities—from outside the company have not always outweighed the integration cost. But digitization has enabled “stack ar-

chitecture,” which significantly reduces this integration cost. (Exhibit 1 illustrates a model technology stack for the financial services and automotive industries.) At the bottom of the stack, nondifferentiating technologies such as infrastructure, platform, and standard software packages are now easily sourced from external providers, reducing costs while improving security, stability, and uptime. At the top of the stack are highly specific and differentiating product and service technologies that give companies access to innovation, agility to accelerate time to market, and flexibility to enable customization.

For example, Airbnb has organized its technology function and manages its more than 20 petabytes of data using stack architecture. The bottom of the stack consists of Hadoop infrastructure, the data warehouse, and other core data-processing applications and is provided entirely in the cloud. Meanwhile, the top of the stack consists of

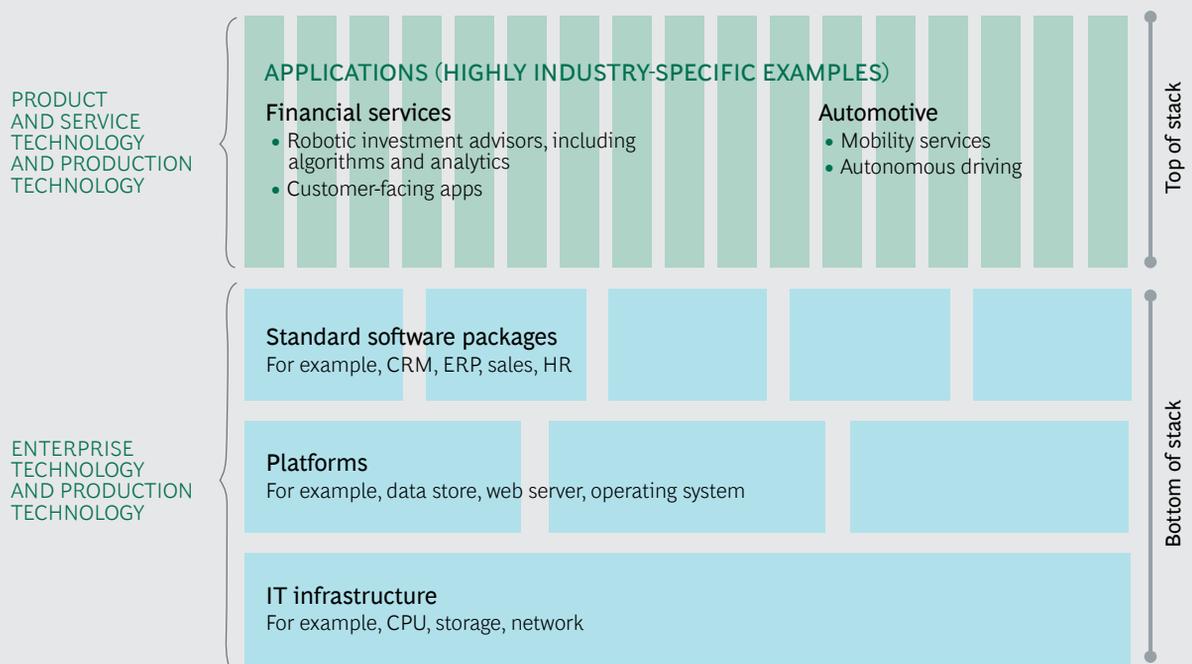
product and service technologies such as customized data models and predictive analytics, including search algorithms.

Creating the Tech Function of the Future

Because digitization and stack architecture are changing the game for companies, we have identified five design imperatives that leaders should consider when creating the technology function of the future.

Develop product and service technologies close to the business. With fewer internal resources devoted to enterprise technologies and technologies that are more integrated into the business units, leaders can turbocharge product and service technologies. Small teams can focus on working closely with product managers and customers on new products and services, speeding up iterations and time to market. By organizing

EXHIBIT 1 | A Model Technology Stack



Source: BCG analysis.

Note: CRM = customer relationship management; ERP = enterprise resource planning.

as closely as possible to customer products and services, the technology function can become a critical business differentiator.

For example, a large international and cross-industry service company largely outsources enterprise IT—such as for enterprise resource planning (ERP) and customer relationship management—while the internal technology function is mostly decentralized and organized around customer segments and services in customer-oriented business units. Each engineering team develops specific services and reports to the head of the business unit. Meanwhile, the central-solutions function develops only features and services that are common to all business units. A central platform unit governs the enterprise-wide architecture and security standards.

Integrate technology and the business. Today’s silo-like IT

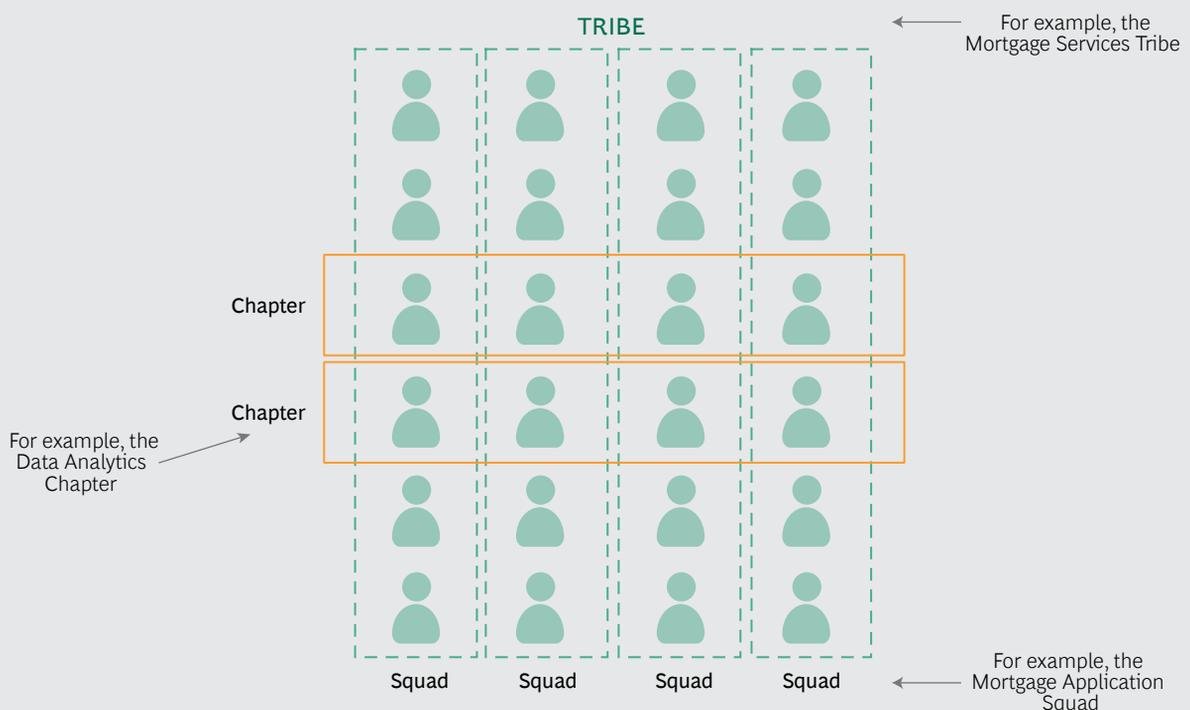
function will be transformed into an embedded and integrated business technology structure. In practice, this means that leaders need to create collocated, cross-functional teams for agile development and effective collaboration of business and technology resources. These teams can develop, test, learn, and iterate far faster than teams that use the old practices. In our work with clients, we have observed that agile development speeds up time to market (measured in the number of months to release) and improves quality (measured in the number of customer-identified product defects per month), each by about 50%.

ING, for example, uses an agile organization structure (inspired by Spotify) made up of “tribes” (consisting of a maximum of 150 people) that are divided into “squads” and “chapters.” (See Exhibit 2.) The tribe leader sets overall priori-

ties, ensures knowledge sharing, and allocates available budgets. Squads are empowered multidisciplinary teams of up to nine people who have all the skills and tools needed to design, develop, test, and release a specific product or service to production. The team members have backgrounds in marketing, product management, data analysis, user experience, IT, and other technologies. Chapters, meanwhile, ensure coordination of members of the same discipline—for example, all data analysts—across squads. The chapter leader is responsible for personnel development and performance management of chapter members.

Build the software engineering capability as a critical differentiator. We have seen large incumbent companies staffing more than 75% of the IT roles with generalists. Leaders need to make significant changes to this skill mix, moving the organization toward specialized

EXHIBIT 2 | The Agile Tribe Organization at ING



Source: ING.

engineering and analytical skills to develop products and services. Not too long ago, it was common for leaders to view software-engineering capabilities as commodity services that could be outsourced easily. In light of digitization and stack architecture trends, many companies will develop these capabilities because they impart a competitive advantage.

To build world-class engineering capabilities, leaders need to focus on recruiting, developing, and retaining scarce and highly specialized technology talent that is as good as that provided by outside agencies. To attract such talent, companies need to create a work environment that offers greater collaboration, risk taking, and adaptability. At least on an interim basis, companies might need to establish a technology center of excellence to support individual business units with scarce skills.

Ensure powerful governance and steering capabilities. In the future, business units will all have their own capabilities for developing products and services, so strict rules and regulations will be necessary. Leaders will need to ensure a strong governance and steering function to coordinate certain areas such as vendor management; ensure that standards are met in such areas as cybersecurity, data, and application architecture; and avoid unexpected side effects such as heavy loads affecting specific parts of the infrastructure.

Key steering capabilities include the following:

- **Technology architecture management** ensures that company-wide technology and architecture choices guarantee basic interoperability and lever-

age scale for both applications and infrastructure.

- **Data management** secures data throughout its entire life cycle by developing strong data architectures and creating and executing robust policies and procedures.
- **Vendor and ecosystem management** provides the capability to source and develop strategic vendors and sets a framework for interacting with all vendors connected to the company's ecosystem, taking into account the many ways vendors can link into the digital ecosystem.

Companies will need digital sourcing skills to scan the market for new technology solutions.

- **Security and cybersecurity management** ensures a consistent company-wide approach to security aimed at minimizing the risk of attack and focused on organization, processes, and people. (See "Building a Cyberresilient Organization," BCG article, January 2017.)

Microsoft exemplifies a company that has maintained a centralized shared-service function for internal mission-critical infrastructure, capabilities, and policies. The company CIO is responsible for providing the IT services that keep Microsoft itself—a business that relies heavily on IT to operate—functioning effectively and securely. Meanwhile, the customer-facing technology—code written for software and services, data centers, and the network infrastructure that runs Microsoft's cloud offerings—is decentralized to the business units.

Create a digital foundation using cloud services. Building a strong digital foundation includes simplifying and sourcing as much nondifferentiating bottom-of-the-stack functionality as possible from external providers to free up resources for more differentiating tasks. (See "Simplifying IT to Accelerate Digital Transformation," BCG article, April 2016.) In particular, we expect that enterprise technologies will be cloud based, with companies using just a handful of high-performance providers for IT infrastructure, platforms, and all nondifferentiating functions of enterprise technologies, such as HR and ERP systems. With this in mind, compa-

nies will need digital sourcing skills for frequently scanning the market for new technology solutions.

According to research from MIT, an effective digital foundation has three key elements.¹

- **An Operational Backbone.** Modular architecture ensures secure and stable operations, supports seamless end-to-end transaction processing, accesses "a single source of truth," and automates repetitive business processes.
- **A Digital Services Platform.** This provides access to business and technology services, facilitates data analysis, is accessible to external and internal partners, and leverages the cloud and open-source software. Many digital services platforms consist of a set of

business services that are constantly expanding and enabled by application programming interfaces; analytics engines with a growing set of data repositories, such as data lakes; and a developer platform that enables an increasing number of partner offerings.

- **Digital Linkages.** These link the operational backbone with the digital services platform so that digital services can access customer and product master data and transaction-processing systems.

From 2000 until about 2012, the Lego Group built an operational backbone to create a tightly integrated, durable production environment, ensuring the reliability and security of business transactions. But when the company started to use digitization for product innovation, it found that the existing enterprise platform lacked adequate agility, such as a scalable 24-7 environment that facilitated gathering customers' input. In response, Lego created a digital services platform to complement the existing enterprise platform. This empowered self-governing teams to do rapid iterations on the basis of customer input—related, for ex-

ample, to new Lego products—and thus deliver new functionality to the marketplace faster.

INFORMATION technology is at a crossroads and senior leaders need to respond in a coherent way that best serves the business. Leaders who want IT to retain its strategic role must transform it with an eye to agility, speed, and specialized skills. The alternative is for IT to focus only on internal mission-critical infrastructure, capabilities, and policies that keep the business itself functioning effectively and securely. This is still an important role, but it carries less strategic weight.

Ultimately, the role of the technology function will vary widely depending on the needs of the business and the ambition level of its leaders. Every company has the power to transform IT and improve its competitive positioning.

NOTE

1. MIT CISR, "Designing Digital Organizations—Summary of Survey Findings," 2017, https://c isr.mit.edu/blog/documents/2017/02/28/mit_cisrwp415_ddosurveyreport_rosssebastianbeathjhbcg.pdf.

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NICK JUE ON TRANSFORMING ING NETHERLANDS AND INTRODUCING AN AGILE WAY OF WORKING

AN INTERVIEW WITH THE CEO OF ING GERMANY

With fintechs and other new players disrupting the financial services sector, traditional institutions need to be faster and more flexible than ever before. ING Netherlands is one bank that responded to the new market dynamics by adopting agile practices, completely changing the way it works.

Nick Jue, who has been with ING since 1993, is currently the CEO of ING in Germany. In his previous role as CEO of ING Netherlands, he introduced an agile way of working in order to best position the company to respond to new competitors and find new sources of advantage in a rapidly changing world.

Nick spoke with Martin Danoesastro, a senior partner and managing director in The Boston Consulting Group's Amsterdam office, about the reasoning behind and the results of the company's transformation, and the key success factors. The following is an edited version of their conversation.

You successfully led ING Netherlands through three different transformations. What were the key success factors across those transformations?

In every transformation, one of the key elements is having a very inspiring vision, because you have to explain exactly what this transformation will bring to employees and customers. They have to understand why it's important to do it and be inspired by it.

Another element is having a fact-

based case for change. You have to know what it means for your margins and your volumes, and what it will bring in different economic scenarios. Facts make your case for change very powerful.

Last, you need a strong team to get through a transformation. You can have a lot of discussions and a lot of

NICK JUE

AT A GLANCE

- Year born: 1965
- Married, two daughters

EDUCATION

- Cedep, INSEAD at Fontainebleau
- Master of marketing, Tilburg University, the Netherlands
- Master's degree in business administration, Erasmus University Rotterdam, the Netherlands

CAREER HIGHLIGHTS

- 2017 to present, CEO, ING-DiBa AG; head of ING in Germany, Austria & Czech Republic
- 2010–2017, CEO, ING Netherlands
- 2006–2010, CEO, ING Retail Netherlands
- 2005–2006, general manager, corporate communications and affairs, ING Group
- 2003–2005, head of corporate communications, ING Group
- 2002–2003, board member, ING Insurance Belgium



debates throughout the process, but when you get into execution mode you need a team that fully supports the vision and really goes for it.

In your most recent transformation, you completely changed the culture and way of working to agile. And I remember that you used the analogy of a large elephant racing against greyhounds to illustrate what ING Netherlands had gone through. Why is that?

This picture of an elephant being chased by greyhounds is exactly how people look at banks. People view banks as big, inflexible animals, and they are chased every day by “greyhounds” such as fintechs and other new companies.

What I try to do is train our organization, the elephant, to be as fast and as flexible as a greyhound. I want to remain an elephant, because I want to keep the power of the elephant. But I also want to be fast and flexible.

Why would a bank want to be as fast as a greyhound?

The world around us is changing rapidly. We’re not competing just against the traditional institutions, so to stay relevant to our customers we need to innovate. With the switch to internet banking and mobile banking, the preferred channel for customers has changed, and the number of customer contacts has exploded.

So with new technology and new competitors, we really had to change very quickly. Clinging to the past was not going to make us future-proof.

But as the world around you is changing so rapidly, how do you know which direction to take?

That was exactly the question we asked ourselves. If you don’t know the direction, which one do you take? Do you jump on every new development? Do you pick one and just go for it?

Alternately, you can adapt your organization in such a way that you’re flexible if trends change, and you can adapt very quickly. I think we came to the conclusion that the only way to do this is to become agile, to start the agile way of working. This was the only way to be able to adapt very quickly to trends and developments.

What did you try to change about the way of working in the organization?

There are a few things. One of them is collaboration, and what I mean by that is removing obstacles so that teams and individuals can work more effectively together.

Another thing is empowering people, giving people a higher level of responsibility. People can decide things themselves, so they feel more empowered and more passionate.

And last but not least, I would say culture. Next to structure and organization, you need a strong culture—and you need to implement it in every detail in the organization.

ING Netherlands was one of the first traditional companies to completely transform to an end-to-end agile way of working. What advice do you have for companies who want to change their way of working as well?

BCG took us to Zappos and Spotify, companies completely outside our own industry, and they inspired us in the way they did things. Subsequently, BCG helped us by designing and implementing

a model based on the inspiration we got from those companies.

Next to that, I would say: think boldly and dare to change. When you start a change process to become more efficient and improve the company and you aim for 5%, at the end the outcome will be incremental. If you start the whole change process with the idea of improving by 50%, then you probably will end up around 40%—but it will be much more than the outcome from the other approach.

So my advice to anyone going through this process would be to look outside for inspiration, think boldly, and dare to change.

Martin Danoesastro is a senior partner and managing director in the Amsterdam office of The Boston Consulting Group. You may contact him by email at danoesastro.martin@bcg.com.

BEYOND THE HYPE

THE REAL CHAMPIONS OF BUILDING THE DIGITAL FUTURE

by Michael Grebe, Michael Rößmann, and Michael Leyh

THE GAP BETWEEN DIGITAL top performers and laggards is wide, according to a study that The Boston Consulting Group conducted with more than 1,300 companies in Europe and the US in 2017. While the top performers have set a high bar for digital performance, about 25% of the participating companies are significantly behind in their digital transformation.

In fact, digitization is creating a divide in the corporate landscape worldwide. Digital laggards face a real threat to their competitive standing and future prospects if they do not take steps to close the gap with digital top performers. Between now and 2020, according to our survey results, digital leaders plan to emphasize revenue-generating activities such as customer experience re-invention and next-generation sales. Digital low performers, meanwhile, are playing catch-up, trying to ramp up their basic digital capabilities.

The study's foundation is BCG's Digital Acceleration Index (DAI), a metric based on companies' self-assessments of their digital maturity on a scale of 0 to 100. (See the sidebar.) As part of our analysis of these results, we identified what top performers and laggards do differently. We also compared levels of digital performance between the US and Europe, as well as among specific industries, and we identified appropriate next steps for

companies that want to improve their digital game and close the gap between themselves and the leaders.

Common Traits of Digital Leaders

Our study identified three practical strategies that top performers have adopted to deal with major challenges that all companies face when transforming themselves into digital enterprises:

- **They invest.** In our survey, 43% of all companies mentioned financial resources as the biggest obstacle to implementing their digital vision. Over half of the top performers invest at least 5% of operating expenses in areas such as new digital offerings, products, and business models; digital customer engagement; and digitally optimized processes.
- **They recruit digital experts.** Just over one-third of companies see difficulty in recruiting digital experts as being one of the three biggest obstacles to digital transformation. Crucial measures to take include infusing digital talent throughout the workforce, dedicating a significant percentage of employees to digital functions, and engaging employees in digital processes. About 50% of the top performers have increased their share of digital jobs to more than 10%.

OUR METHODOLOGY

For our 2017 study, we asked 1,300 companies in Europe and the United States to estimate their digital maturity on a scale of 1 to 4 in 27 categories.

We then aggregated those raw scores, assigned values to their responses on a scale from 0 to 100, and weighted them to determine each company's overall performance on our Digital Acceleration Index (DAI). Companies with a DAI score of 67 to 100 qualify as top performers, while those with a DAI score of 43 or less are laggards.

Top performers had an average maturity level of at least 3 out of 4 on all maturity dimensions, whereas laggards had an

average maturity level of less than 2 in 66% of the assessed dimensions and an average maturity level of 3 in 33% of the assessed dimensions. Top performers had an average DAI score of 80, while laggards had an average DAI score of 30.

We collected data from companies with at least 2,500 employees in the US, Germany, the UK, France, and Austria across seven core industries: mechanical and electrical equipment manufacturing, chemicals, technology, banking, telecommunications, and consumer goods and retail. Only senior leaders participated: 30% were C-level, 30% were division leaders, and 40% were general managers.

- **They embed digital in their organization.** Nearly one-third of participating companies report that changing their corporate culture is among the top three challenges involved in digitization. To match the speed and agility of digital pure-plays, traditional companies need to manage the business digitally from end to end. To do so, they must integrate digital capabilities into existing functions and permit business units to manage digital in their own business lines. Top performers say that digital is well advanced and firmly embedded within their company.

In our survey, 85% of the digital top performers use at least one of these digital boosters, and those that use all three scored 16 points higher on the DAI, on average, than those that use one or two.

Digitization Results by Region

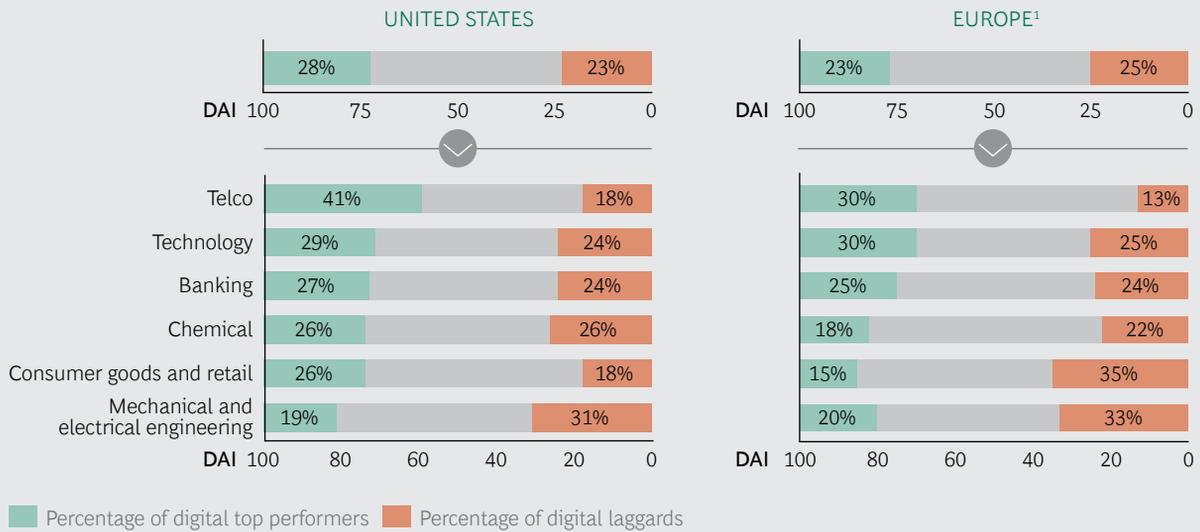
Our survey revealed that the US has 20% more digital top performers than Europe has, putting the US market on a faster track toward digital transformation. Overall, 28% of US companies were digital champions and 23% were laggards. In Europe, 23% were champions and 25% were laggards. (See Exhibit 1.) Much of this edge in performance is due to the stronger technology and telco sec-

tors in the US, which enable other industries' digitization efforts. Among US telcos, 41% are digital champions with their own digital offerings (such as Internet of Things applications) and digital customer journeys, whereas only 30% of European telcos are.

The US top performers excel at reinventing or disrupting their own business models (with an average DAI score of 90 compared with an average of 84 among top performers in Europe), using analytics (for example, collecting machine data in the agriculture industry in order to optimize harvests), and reinventing the customer experience. US companies are also further along than their European counterparts in creating digital acceleration centers to coherently drive innovation (a DAI score of 85 compared with 80) and in extracting financial gains from digital (a DAI score of 78 compared with 72). Both US and European top performers still need to simplify IT and improve prototyping to speed product development.

Laggards on both sides of the Atlantic need to incorporate digital into their manufacturing production lines and processes. Another common trait among low performers is a very low level of ambition for digital transformation (an average DAI score of 43 in the US and 41 in Europe) relative to top performers. Ambi-

EXHIBIT 1 | Digital Top Performers and Laggards in the US and Europe by Industry



Source: BCG analysis.

Note: DAI = Digital Acceleration Index.

¹Europe includes Germany, France, the United Kingdom, and Austria.

tious goals, clear implementation timelines, and confident executive leadership are crucial for transformation and competitiveness.

Digitization Results by Industry

As part of our analysis, we concluded that a company's digital development was more industry specific than country specific, driven by similar starting points and a similar affinity for digitization. Not surprisingly, the telco and technology industries are the most advanced. Companies in these industries have long used experienced software developers to help create digital products and services, and interacted with customers through digital channels. Other industries have yet to learn many of the digital tactics that tech companies and telcos have been deploying for years and that have become integral to their value creation.

The tech universe includes software and internet sectors (which are digital leaders) along with handheld devices, semiconductors, and equipment (which lag in comparison). If we had restricted the tech category to tech software and internet, it would have ranked even higher than telco.

Besides these two leading industries, we took a close look at several more traditional indus-

tries to understand their digital journeys, their specific challenges, and their options for closing the maturity gap. Following are in-depth descriptions of two of those industries: banking and mechanical and electrical equipment manufacturing.

Banking. Banking ranks third in digitization after telcos and technology among the sectors we examined, thanks to a history of strong investment in IT (about 15% to 25% of a typical bank's total cost goes toward IT), long-term experience using online and mobile channels to handle customer interactions, and intensifying competition from financial technology companies.

As a result, some top performers among banks have achieved a step change in digitization. US top performers report high digital maturity in disrupting their own business (a DAI score of 93) and in data-driven marketing (a DAI score of 85). For their part, European banks report higher digitized customer engagement and core offerings, with DAI scores of 87 for new digital service and product offers and 88 for customer experience reinvention.

Banks in both regions still face challenges in connection with transforming the tech function and making the enterprise digital ready, which requires simplifying the IT landscape

to cut complexity and free up monetary and human resources to support the digital transformation. (See Exhibit 2.) For example, by freeing up these resources, banks can begin to scale up agile and DevOps practices that will speed time to market for new products and services. In addition to improving efficiency (with an impact of 15% to 25% on development costs), these changes will improve customer satisfaction and increase overall returns on digital investments.

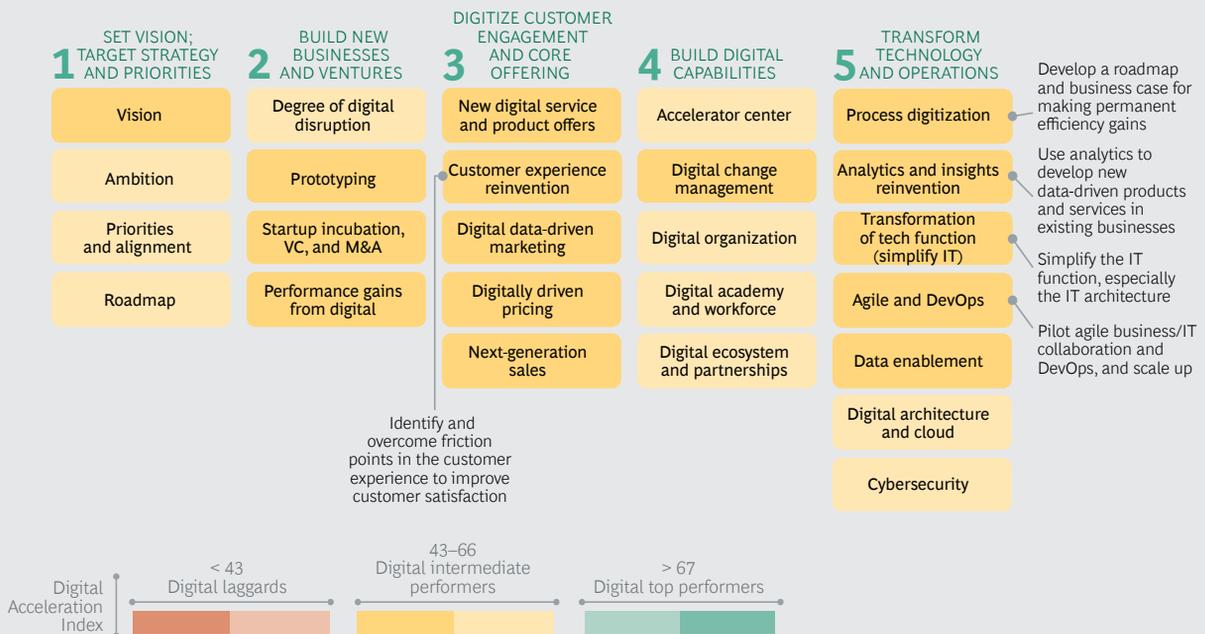
A more digital-ready enterprise can also use advanced analytics to mine its data for relatively precise customer insights, and it can start to apply robotic process automation (RPA) and artificial intelligence to manual tasks in the back office, potentially yielding tremendous efficiencies. Indeed, some banks have accelerated mortgage applications by up to 80% with RPA and customer journey redesign. By combining increasingly personalized customer offerings, efficient back-office processes, and agile IT dedicated to supporting business demands and delivering high-quality products, banks can reinvent the customer journey.

Mechanical and Electrical Equipment Manufacturing. This industry faces digital challenges in both the US and Europe, with a high

share of digital laggards in both regions (31% in the US, and 33% in Europe). M&E includes an inordinate number of laggards largely because of its traditional focus on producing great physical products, which limits IT's role mainly to support for office and back-end systems such as supply chain logistics. Digitization of core processes or products has not been a priority for companies in this sector.

Digital represents a completely different business model for M&E companies, but it introduces exciting new opportunities to sell software-driven offerings, such as predictive maintenance and machine as a service. For example, by placing sensors on industrial cranes, crane vendors could gather data and analyze wear and tear on these machines, and dispatch a service technician prior to a costly failure and idle time. Companies could also offer to store each machine's data in the cloud, giving customers access to the data to analyze it and (potentially) optimize operations. Future crane design might benefit from accumulated data on real-life usage and load situations. To make such digital products and services available, companies must invest more in digital. If they do not, they will be unable to unlock the full value of their machines, and they may lose market share to

EXHIBIT 2 | Average DAI score Ranges for Banks and Recommended Actions for Improvement



Source: BCG analysis.

Note: Data represents average DAI score intervals for banks on the 25 (out of 27 total) digital dimensions of the index that are relevant to banks.

forward-looking competitors that offer a broader range of digital products and services.

The laggards in the industry are behind in certain distinct areas. (See Exhibit 3.) For example, M&E laggards earned a very low DAI score of 22 on reinventing the customer journey and offering new digital services and products, indicating that there is an enormous opportunity for companies to enhance their mostly physical product portfolio with new digital products and services. By rethinking the customer journey, M&E companies can create entirely new business opportunities.

The 2020 Perspective

When we asked survey participants about their priorities between now and 2020, the top performers and the laggards gave markedly different answers.

The digital leaders are focusing on further simplifying their IT to multiply the benefits they’ve already gained by cutting complexity and freeing up resources. They also plan to continue their efforts to digitize manufacturing (Industry 4.0) in order to make processes

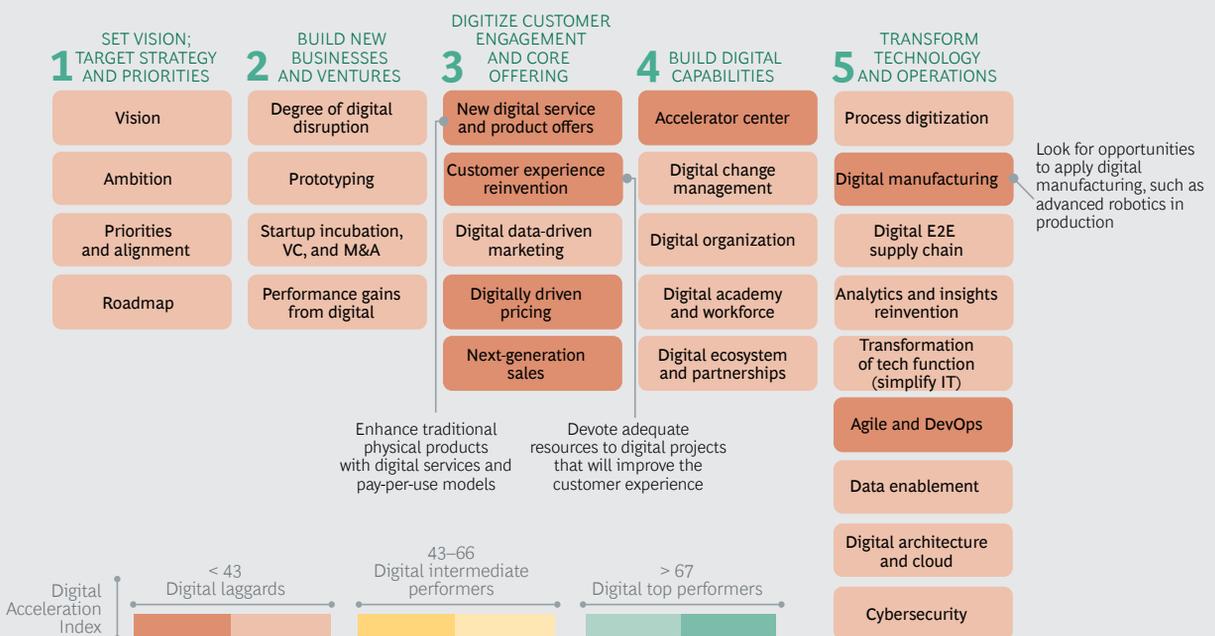
and technologies even more efficient and flexible. Besides pursuing these initiatives to reinforce the core, leaders are focusing on customers—personalizing digital products and services, and implementing next-generation sales approaches.

Although laggards, too, want to satisfy digital customers, they are still working on the basics of setting up the right technological environment (digital architecture and cloud) and making customer data available across the company in order to understand customer needs. Companies in this predicament also emphasized the importance of developing process digitization to overcome legacy IT applications that require frequent manual intervention in the back office. Installing this “digital plumbing” is vital for laggards if they are to compete effectively for digital customers.

Steps for Moving Forward

For top performers, the most pressing question is how to accelerate their digital transformation, cashing in on their previous digital investments and maintaining their edge over competitors. For digital laggards, the chal-

EXHIBIT 3 | Average DAI score Ranges for Laggards in Mechanical and Electrical Equipment Manufacturing and Recommended Actions for Improvement



Source: BCG analysis.

Note: Data represents average DAI score intervals for laggards in mechanical and electrical equipment manufacturing on all 27 digital dimensions of the index.

lenge is to get the basics in place in order to jump-start digital transformation and begin gaining ground. Laggards might want to consider a few specific actions that digital champions have taken to steer their digital journeys in the right direction:

- **In navigating their journey, they look beyond the hype.** To steer their digital investments in the right direction and to retain their competitive edge, champions holistically assess their industry position (compared with best-in-class players and peers). They inquire into how digital attackers are disrupting their industry and what digital trends and opportunities are emerging. And they understand the necessity of setting ambitious goals (their average DAI score on this measure was 84) and setting the right priorities (average DAI score: 83) early on.
- **Leadership is strongly committed to the digital strategy.** Champions know that a digital transformation requires strong commitment from top management, which must integrate the digital strategy into the overall corporate strategy and creatively incentivize change at all levels of the organization. Achieving success depends on having a digital roadmap for holistically translating ambitious goals and priorities into action across the company. Champions show very high maturity in designing the digital roadmap (average DAI score: 85). Leaders understand that individual business units should control their own digital agendas, since they know their customers' needs best and are likely to extract the most value from digital initiatives. Also, when rolling out a new business model that is very different from the company's core offering, leaders typically create a separate organization for the business model and give it significant operational freedom.
- **They continue to deepen their digital organization.** While laggards struggle to lay the digital foundation, champions devote at least 5% of their operating expenses to digital investment. A significant portion of these investments goes toward acquiring digital talent, but

investment alone will not suffice to retain such talent. Champions have also altered their organization's culture to appeal to digital recruits—for example, by adopting new, agile ways of working. They have also built digital acceleration centers to digitize their workforce; now, with those centers fully operational, they can speed up the process.

- **They measure success and build momentum.** For every digital initiative, change must be visible and results must be transparent. To this end, champions define KPIs linked to digital (such as share of sales in digital channels, and profits from digital businesses). Besides being important for measuring digital progress, KPIs help champions build momentum within the organization for other digital initiatives.

OUR survey reveals that digitization is creating a deep divide in the corporate landscape worldwide. This disparity will become more pronounced between now and 2020 as top performers focus on revenue-generating activities such as customer experience reinvention and next-generation sales, while laggards play catch-up. The good news for companies late to digital transformation is that they can take clear steps to catapult themselves ahead of their competitors.

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HOW TO DESIGN AND RUN IT PROJECTS CEOS WILL LOVE

by Benjamin Rehberg and François Stragier

ALARGE NUMBER OF CEOs have lost faith in their IT department. Too many projects go off the rails, plagued by budget overruns and costly delays. Worse, precious few tech projects actually create meaningful value for the business. It's not uncommon for companies to devote millions of dollars to a behemoth, multiyear technology initiative—only to wind up writing it off as a failure. And perhaps that's not so surprising. The failure of IT projects isn't due to a lack of talent or skill. It's systemic.

Most IT departments simply aren't set up to deliver great software. The architects and project managers aren't connected enough to

The failure of IT projects isn't due to a lack of talent or skill. It's systemic.

end users (whether employees or customers), project leaders are skeptical that complex projects can be chunked into potentially shippable increments, and execution therefore focuses on a risky “big bang” release. By embracing a new

approach to IT, teams can design projects that create tremendous value for the business—and deliver results that CEOs will love.

Five Strategies to Transform IT Projects

Although big corporations have begun to embrace agile for their customer-oriented products, large and costly back-office projects—such as enterprise resource planning, human capital management, and supply chain management—are still being managed with the same methods that were popular more than 20 years ago. By changing their approach to such projects, companies have the potential to

save millions of dollars each year and free up resources for new business initiatives. To escape the quagmire of overpromising and underdelivering, IT departments need to completely reinvent the way they manage projects.

Start with empathy. It's in digital startups' DNA to test concepts with users before launch. Teams observe users interacting with digital technologies, identify moments of frustration or delight, and find ways to create a unique and differentiated experience that users will love. This approach is entirely sensible—and shockingly rare in corporations. While many organizations give lip service to the importance of the customer, relatively few continually engage with real-world customers and employees to test concepts and solicit feedback.

To build great products, teams need to start with empathy. Do you know where users are feeling burdened, confused, or frustrated? And where they're feeling excited, engaged, and delighted? One of the best ways to gather this data is through firsthand observation. Consider this: teams create a detailed plan to deliver multimillion-dollar projects that span a multiyear time horizon, but they don't have time to test their assumptions with real-world users?

It should be common practice for executives, IT teams, and others in

the business to observe the habits and preferences of customers and learn how they engage with products and how they weigh tradeoffs when making decisions. It's not enough to rely on business analysts who have conducted a few interviews. The project team needs to engage with potential users through ethnographic research, focus groups, and other techniques and then leverage the insights gained in the design of large-scale IT projects. This kind of deep engagement with customers not only helps companies address pain points but also allows them to better anticipate unmet needs.

formance indicators (as opposed to delivering features over time), with precise metrics used for the coming quarter, less precise metrics for the year, and purely indicative metrics over the long term.

Don't expect a precise business case upfront. In today's digital environment, the encyclopedic business case is entirely counterproductive. While business cases may be crafted with the best intentions, they are completely unreliable and often pointless. But because many executives are not fully comfortable with IT, they believe that the business case is

again in three months to provide more data, user feedback, and customer insights. In essence, the team builds a business case from the ground up, testing, learning, and releasing new features in response to user input. By allocating dedicated teams to a project over an extended period of time, and thereby shifting from fixed budgets to fixed capacity, companies can simplify their finances. Business leaders track the results, observe successes and failures, and continue to evaluate the project as it evolves. If the project fails to deliver on its promise, they can cut it off before too much time and money are lost.

Employees need some freedom and incentive to think creatively about product development.

Start small. Agile development has been a hot topic for several years and numerous companies have embraced its basic principles, but many are still surprisingly hesitant to use it in big projects. This is a shame, since big projects are often the ones that need agile the most. With agile development, cross-functional teams can quickly develop a minimum viable product, test it on real users, and iterate based on what they learn. Oftentimes, IT teams will argue that a project will cost more if it's delivered in smaller pieces, rather than all at once. But the risk of committing to a massive IT project, without testing and learning as it evolves, is enormous.

Rather than developing monolithic projects, it is usually better to divide projects into small, manageable chunks. The chunks will vary in size and can be delivered every few weeks or months, depending on the project. Roadmaps can help focus efforts on improving key per-

formance indicators (as opposed to delivering features over time), with precise metrics used for the coming quarter, less precise metrics for the year, and purely indicative metrics over the long term. As a result, no one admits that the emperor has no clothes.

At the early concept stage, estimates of costs and potential revenue tend to be highly inaccurate. Estimates of projected cost savings over time tend to be more precise, but these metrics are rarely tracked after launch, which means that they carry little weight. Knowing this, teams have a built-in incentive to be overly optimistic about the project's potential benefits (and costs).

To break out of this cycle, executives can request a simple, straightforward, almost back-of-the-napkin tally of immediate and long-term costs and value to the business. The team then goes off to build a mockup or a prototype that can be tested with users, knowing that it will meet with the executives

Think differently. To create unconventional and disruptive products, employees need to think differently. Teams quickly become accustomed to working in conventional ways and requesting products and tools that build incrementally on what has come before. Too often, pain points are only superficially analyzed and root causes are ill-defined. This is not a recipe for breakthrough products.

Employees need some freedom and incentives to think creatively about product development. Software developers often have pet projects that they pursue after hours, in the evenings and on weekends, driven purely by their passion. Companies need to create opportunities for employees of all stripes—senior managers, middle managers, business analysts, designers, IT architects, and software developers—to harness that passion in their product design and development process.

While it may seem counterintuitive, constraints can be used to very good effect. Think of the beautiful simplicity of successful mobile apps, compared with the

overwhelming complexity of many enterprise software tools. The process of overcoming obstacles and limitations often sparks extraordinary creativity and problem solving, which is exactly what's needed to create superior products.

Build a culture of transparency—especially around setbacks. By their very nature, IT projects are often large, complex, and prone to unanticipated setbacks and delays. When we audit such projects for our clients, it is commonplace for team members to acknowledge that they knew the project wouldn't deliver on its promise, but they failed to communicate that to their managers.

This isn't entirely surprising. Project managers are the people most accountable for the project's success—and they know it. If the project begins to falter, they will likely scramble to recover, investing even more resources to make up for lost time, which pushes the project further into the red. In their interactions with management, they may be tempted to project a can-do attitude, highlight the small successes, and gloss over the mounting setbacks, hoping all the while that the project will rebound.

This is no way to run a project. In project management as in politics, the coverup is worse than the crime. It can be okay for a project

to be three months late, but not if management only hears about it one month before the project is scheduled to go live. It's okay for the initial release to receive a tepid response from users, as long as there's an understanding of why and a plan to test, learn, iterate, and improve. Executives cannot praise the “fail fast, fail often” startup culture and then hammer employees when they do fail—and this kind of culture change must be driven from the top. With the right culture, where transparency is rewarded, disappointing results allow companies to make better, more informed decisions at every stage of development.

DIGITAL strategy has become a top priority for CEOs, but most IT projects are highly complex and costly, and CEOs have limited visibility into the details of major decisions. (See “The Digital Imperative,” BCG article, March 2015.) This is an uncomfortable place to be. From the CEO's perspective, the IT department can be more of a black box than just about any other aspect of the business, and most have been disappointed with results more than once. But it's important to note that CEOs have an important role to play, because teams need support from the top as they adopt these new methods. Therefore, it's incumbent upon the CEO to foster an organizational

culture that supports experimentation, tolerates setbacks, and focuses relentlessly on customers' needs. With a supportive organization behind them, IT teams are well positioned to develop products that users will love—and IT projects that CEOs will love.

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DATA-DRIVEN TRANSFORMATION

ACCELERATE AT SCALE NOW

by Antoine Gourévitch, Lars Fæste, Elias Baltassis, and Julien Marx

DATA-DRIVEN TRANSFORMATION IS BECOMING a question of life or death in most industries. But initiatives to embed data in operations throughout a company often fail. This is because companies start by trying to reinvent their core IT systems—a multiyear effort that can run to hundreds of millions of dollars. Sadly, most of this money is wasted, because these massive centralized efforts take far too long. When the rules of business are being rewritten on a quarterly basis, companies need an approach to transformation that is agile, focused on results, and manageable.

Most CEOs recognize the power of data-driven transformation. They certainly would like the 20% to 30% EBITDA gains that their peers are racking up by using fresh, granular data in sales, marketing, supply chain, manufacturing, and R&D. And they may even dream of joining the ranks of data-driven companies that have shoved aside traditional players among the world’s most valuable companies. (See Exhibit 1.)

Yet CEOs are right to wonder how their organizations—where managers and executives already complain about a lack of data skills

EXHIBIT 1 | Data-Driven Companies Have Become the Most Valuable

COMPANY: MARKET CAPITALIZATION

RANK	APRIL 2017	Q4 2011	Q4 2006
1	Apple: 741	Exxon Mobil: 406	Exxon Mobil: 447
2	Alphabet: 585	Apple: 376	General Electric: 384
3	Microsoft: 505	PetroChina: 277	Microsoft: 294
4	Amazon: 432	Royal Dutch Shell: 237	Citigroup: 274
5	Facebook: 408	ICBC: 228	Gazprom: 271
6	Berkshire Hathaway: 404	Microsoft: 218	ICBC: 255
7	Exxon Mobil: 344	IBM: 217	Toyota: 241
8	Johnson & Johnson: 330	Chevron: 212	Bank of America: 240
9	JPMorgan Chase: 303	Walmart: 205	Royal Dutch Shell: 226
10	Alibaba Group: 278	China Mobile: 196	BP: 219

 Data-driven company

Source: S&P Capital IQ, “Top 10 Companies with Highest Market Capitalization Worldwide.”

Note: Market capitalization figures have been rounded and are in \$billions.

and where overburdened IT systems seem unlikely to be able to handle a tenfold increase in company data—can pull off such a transformation. These CEOs want to find a reliable way to move their companies into the data-driven future so that they can set up their companies to survive—and not put them in danger in the process.

There is a better way to approach data transformation. In our experience, these initiatives can succeed only if they are cost-effective, incremental, and sustainable. Transformations should start with pilots that pay off in weeks or months, followed by a plan for tackling high-priority use cases, and finishing with a program for building long-term capabilities. Working with clients across industries, we have developed a three-phase approach to data-driven transformation. It starts with small-scale, rapid digitization efforts that lay the foundation for the broader transformation and generate returns to help fund later phases of the effort. (See Exhibit 2.) In the second and third phases, companies draw on knowledge from their early wins to create a roadmap for companywide transformation, “industrialize” data and analytics, and build systems and capabilities to execute new data-driven strategies and processes.

This three-step approach is faster, less costly, and more likely to succeed than a system-wide overhaul. Using existing data systematically

and combining it with external data (from social networks, for example) for marketing or customer issue resolution can deliver fast results. We have seen companies achieve 15% to 20% of the potential of a full data-driven transformation in six to nine months.

- **Use quick wins to learn and fund the digital journey.** In this first phase, companies identify the low-hanging fruit—discrete, rapid digitization efforts that can deliver quick wins. These projects immediately move the needle on performance in a key area—sales support or supply chain, for example. And rather than taking years, implementation occurs in months and starts paying back almost immediately. The pilot projects show that the company can benefit from digitization, and they provide important lessons in how to roll out digital transformation across the company. Crucially, the extra value that the quick wins create can help pay for longer-term efforts, potentially making the transformation self-funding.
- **Design the companywide transformation.** In the second phase, which can begin while the first initiatives are still underway, the company draws a roadmap for company-wide transformation. This involves building a portfolio of opportunities—identifying and prioritizing functions or units that can benefit most from

EXHIBIT 2 | Data Transformation Involves Three Central Tasks

FUNDING THE JOURNEY

Launch of data use cases for quick wins:

- Resource optimization
- Cost efficiencies
- Capital optimization

Proof of concept and organizational learning
Talent and capability building

DESIGNING A COMPANYWIDE PLAN

Innovation ideation:

- Target operating model
- Data governance
- Analytics organization
- Data infrastructure

Communicating the vision

ORGANIZING FOR SUSTAINED PERFORMANCE

Ways of working:

- “Fail fast”
- Agile development
- Lean end-to-end processes

Talent and capability building:

- Change management
- Data enablement
- Data-driven decision making

Source: BCG analysis.

transformation. It also involves locating and starting to address roadblocks to transformation. During the design phase, companies also invest in framing and communicating the vision for the transformation to build support for needed changes, and they invest in systems to industrialize data analytics—making analytics a resource for every operation.

- **Organize for sustained performance.** With a detailed roadmap in place and with the experience and funding available from the early projects, the company is ready to undertake a full-fledged digital transformation. In this phase, digital and data-driven processes and work methods spread to every corner of the company. Employees learn to work across silos to enable data-driven processes, and leaders make the organizational changes necessary to sustain the new approaches. The company creates a data-driven culture by investing in capabilities to use analytical insights and by launching a change management program to embed new mindsets, behaviors, and ways of working.

Use Quick Wins to Learn and Fund the Digital Journey

Moving a big company in a new direction is a huge challenge for management. The best-conceived and most urgent transformation programs—digital or otherwise—are sometimes no match for organizational inertia. This may explain why 70% of publicly announced transformation programs fail to meet the company’s ambition, its timeline for the transformation, or both.

But large organizations can overcome resistance and build the enthusiasm needed for change to succeed if they approach transformation in the right way. By starting a transformation journey with a small number of quick initiatives that demonstrate what can be achieved by using new approaches, companies greatly increase their chances of eventual success.

Leaders should choose quick-win initiatives carefully, on the basis of several critical criteria: they must have a high chance of success,

a significant and rapid payback, and visibility across the company. A major industrial company, for example, started by digitizing high-profile processes, including inventory management. (See the sidebar “Building Momentum Through Pilots.”)

Start a transformation with a few quick initiatives to show what can be achieved.

Initial projects may be limited in scope, but it is essential that they succeed and serve as a convincing advertisement for the benefits of digital transformation. For this reason, companies should not only choose projects carefully but also be pragmatic about execution. It is best to avoid projects that would require fundamental changes in data handling—projects that would entail building a new data repository, for instance. Companies should use agile methodologies to build any new analytics models, with short sprints and tight timelines for developing a minimum viable product that can be tested and used to define additional requirements and refinements.

Quick-win projects should require no more than four to six months to complete, and their value should be demonstrable within weeks. During the quick-win phase, companies can build their ability to focus and execute swiftly and to work across silos—critical capabilities for pursuing large-scale transformation efforts. Quick wins can also energize and inspire managers and employees who have seen change initiatives bog down in the past.

Design the Companywide Transformation

As soon as it is clear that the early digital transformation projects are off to a solid start, the company can start preparing the roadmap for extending digital transformation across the enterprise. This starts with a high-level vision, which company leaders translate into a portfolio of initiatives (or use cases) to be rolled out in a logical order, on the basis of factors

BUILDING MOMENTUM THROUGH PILOTS

A large industrial company contemplated a massive digital transformation to increase its efficiency and to compete more effectively in markets where producers have limited pricing power. The company did not want to tie up capital in a massive change program and wait years for a payback. To avoid that outcome, the company first identified a few quick-win initiatives that could pay off within a month or a quarter.

The first initiatives it selected were in inventory management and capacity optimization—analyzing output and shifting production to sites that made the most profitable products. For these quick wins, the company used static data and created one-off solutions. But the projects led to significant savings and more sales of high-profit items, which generated immediate value. In nine months, quick wins generated \$20 million in value. Once the

projects based on static data were up and running, the company went back and built the systems it needed to manage these processes and functions continuously, using real-time data flows.

Applying the lessons from its early wins, the company has created a roadmap for ten major data transformation initiatives in areas as varied as demand forecasting and managing the outbound sales force. The company has also made plans for new companywide resources to support data-driven approaches and make them sustainable, including building a data lake. And it has begun identifying new data-driven business models. The overall goal for the transformation is to unleash \$200 million in value over three to five years and to help the company raise its EBITDA margin by 2% to 4%.

such as size of impact and competitive needs or opportunities. Then the company must agree upon some underpinnings of digital operations—analytics, data governance, and data infrastructure. (See Exhibit 3.) Creating a roadmap for use cases and projects to build data infrastructure and other resources needed for data-driven operations can not only make the transformation run more smoothly but also ensure that these investments pay. (See the sidebar “Driving Fast Value from Data Transformation in Logistics.”)

Before attempting to define its vision, a company needs to have a thorough understanding of where it stands in terms of data, digitization, and current capabilities. As a preliminary step, then, the company should quickly and objectively assess its situation and gauge how its capabilities stack up against best practices in its industry. One option in this area is a diagnostic developed by BCG that weighs 21 factors in assessing a company’s starting point in data and analytics capabilities and assets, backing up the assessment with extensive, continually updated benchmarks.

FIVE CRITICAL STEPS FOR A SUCCESSFUL DATA TRANSFORMATION

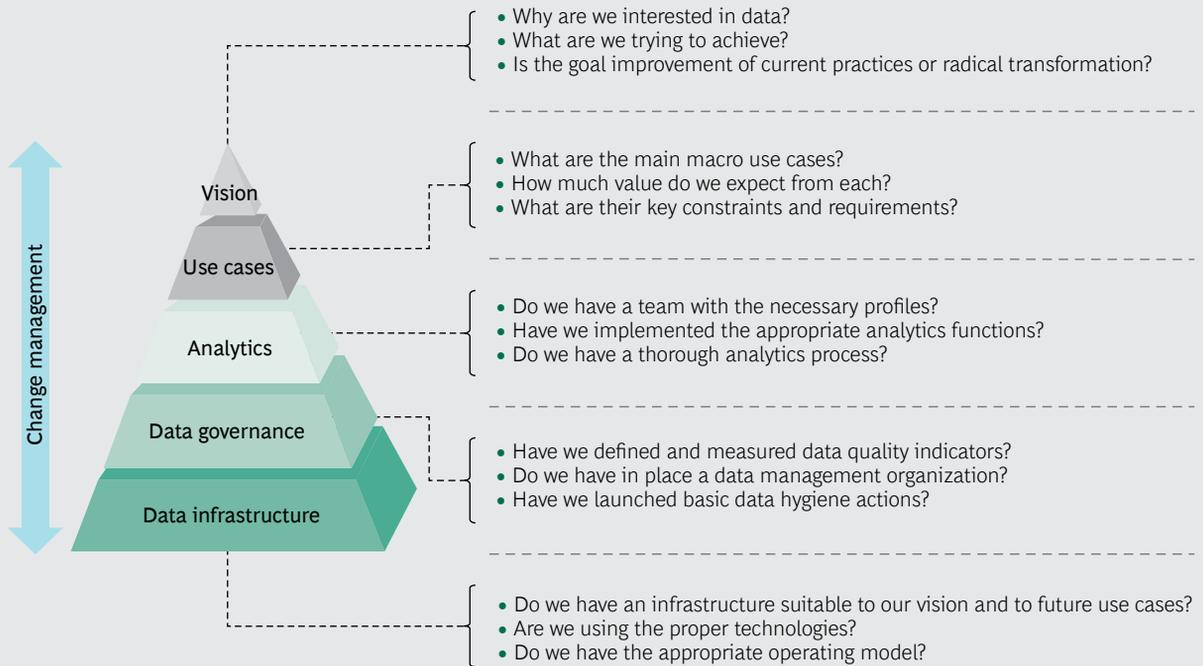
The assessment of data capabilities gives the company the information it needs to carry out five critical steps.

Build a vision. When planning a data-driven transformation, a company must set the appropriate vision for its business. For some companies, the transformation will mostly be about using data to improve operations and to compete more effectively. For others, it might involve building new business models. The visioning exercise should include identifying the macro use cases—the most important projects that the company wants to undertake.

Select the portfolio of initiatives. Using its vision and its list of macro projects for reference, companies can create a full list of transformational initiatives. The company should use a structured ideation process to compile the list, and it should use a rigorous prioritization methodology to set the schedule. Factors such as data availability, regulatory compliance, and technical or modeling

EXHIBIT 3 | Fully Leveraging Data Requires a Comprehensive Model

KEY ISSUES TO ADDRESS (simplified)



Source: BCG analysis.

DRIVING FAST VALUE FROM DATA TRANSFORMATION IN LOGISTICS

For more than 30 years, a major global logistics company led its industry in the use of information technology, and its leaders believed that data was its competitive differentiator. The company took the long-term view and had spent more than five years implementing a new ERP system that cost hundreds of millions of dollars. But after massive investments of time and money, the company could not demonstrate that it had gained any competitive advantage in cost or revenue.

Then the company took a new, agile tack. This time it created a detailed roadmap for transformation based on two primary considerations: an examination of the data needed monthly, weekly, and in real time to optimize functions or operations and to generate the most impact for the company; and an assessment of the systems and data already available to fill the newly

identified business needs. On the basis of this roadmap, the company began a series of pilot projects, using benchmarking data to optimize important cost drivers such as fuel consumption, maintenance, and labor. Another project aimed to improve pricing performance by accessing data such as customer P&L through new analytics.

Over the course of three years, the company systematically completed the list of projects for every major value driver in the business. After dozens of projects in areas such as pricing, fuel consumption, and network, the company went from sitting in the middle of the pack in operating performance to becoming the industry leader on EBIT performance.

difficulty, as well as dollar value, customer benefits, and strategic importance must also be weighed.

Devise an analytics operating model. Before investing in new data analytics capabilities, a company should specify how it wants the data analytics function to work. After analyzing its internal capabilities, it can decide which components of the analytics function to seek in-house and which to outsource.

Establish data governance. To ensure the quality and integrity of the data it will use for business decisions—with and without human intervention—a company must have strict governance rules and a data governance structure. It must also define data quality and establish ways to continually improve it.

The success of a data transformation is measured by sustained results.

Define data infrastructure. A company moving toward data transformation should address the following questions: Can our current infrastructure support our future data value map? Should we make or buy? Should we go to the cloud? Do we need a data lake? What role should our legacy IT systems play in our data transformation? The company should design a data platform (or data lake) that can accommodate its product map and should use that platform to progressively transform its legacy systems.

INDUSTRIALIZE DATA EARLY TO ENSURE FULL TRANSFORMATION AND LONG-LASTING IMPACT

While the company continues to sketch the transformation roadmap—if not sooner—it needs to begin industrializing its data and analytics. This means setting up a way to standardize the creation and management of data-based systems and processes so that the output is replicable, efficient, and reliable. Digital systems are the new means of production, and they need to have all the attributes of industrial machinery, including reliability

and consistency. Above all, the company needs to have a way to guarantee that it generates and harnesses high-quality data and has an efficient data environment.

A centralized or hub-and-spoke operating model can ensure clear, consistent strategy and execution; rationalize investments; and ensure economies of scale. Business units and functions that will rely on new data-driven systems and processes should have input into system design and data quality assurance, but these groups must rely on the core data management organization for data governance.

The second element in industrializing data consists of determining the appropriate architecture to support data analytics across the organization. A flexible open architecture that can be updated continuously and enhanced with emerging technologies is generally the best option. Rather than embracing an end-to-end data architecture, companies should adopt a use-case-driven approach, in which the architecture evolves to meet the requirements of each new initiative. The data governance and analytics functions should collaborate to create a simplified data environment; this will involve defining authorized sources of data and aggressively rationalizing redundant repositories and data flows.

Organize for Sustained Performance

As is the case with any change program, the success of a data transformation is measured by sustained results—and those will not materialize without making the company and its culture data-centric. To prepare its organization for a digitized future, the company needs to move on four fronts: creating new roles and governance processes, instilling a data-centric culture, adopting new ways of working, and cultivating the necessary talent and skills.

Many companies may be capable of managing this change on their own; but if a company faces competitive challenges that require a rapid transition, or if it is far behind in digitization or lacks the resources and capabilities to manage the transformation, it may benefit from adopting a build-operate-transfer model

(which we discuss below). This involves creating a dedicated organization—usually run with the guidance of an outside expert partner—that takes over the organizational change effort.

DEFINE NEW ROLES AND GOVERNANCE RULES

To ensure the sustainability of the benefits it obtains through the adoption of new digital processes, a company needs to make clear who has responsibility for building and running new systems and maintaining specific types of data—and how to manage those people. The changes begin at the top: senior leaders should adopt data-driven objectives and cascade those goals throughout the organization. Top management may want to set up data councils to extend the work to all sectors of the organization and to carry it out more effectively.

A company can adopt many agile tactics and use them in everyday operations.

The company should promote data awareness by using data champions to disseminate data-driven practices. The company can set up a change management function under the chief data officer, too. The data awareness effort should extend to all work, including tasks that the digital transformation does not directly affect. For example, the company might create data-based metrics for functions such as HR, perhaps measuring the number of applications processed per job filled.

BUILD A DATA-FIRST CULTURE

Not everyone needs to become steeped in data analytics or learn to code in order for digital transformation to work. However, everyone does need to adopt a less risk-averse attitude.

To move quickly and to continually find new ways to apply data, companies should behave a bit like software development operations, embracing a test-and-learn culture that encourages experimentation, accepts—even cel-

ebrates—failure, and is always learning. Companies can also encourage the desired cultural change through organizational moves, such as creating internal startup units where employees can focus on experimentation or collocating data labs within operating units. The company can also promote the new culture by using cross-functional teams that share data across silos, thereby encouraging openness and collaboration throughout the organization.

ADOPT AGILE WAYS OF WORKING

The entire organization does not have to become expert in agile, but the company can adopt many of the tactics of the agile method and use them in everyday operations to increase the organization's responsiveness and adaptability. It can establish scrum teams with squads and tribes to tackle specific problems—and accelerate the pace with weekly sprints, rather than months-long efforts. Teams and groups can implement morning standups and weekly demos (reviews) as part of governance. Overall, the new ways of working should emphasize autonomy and reduce hierarchy.

CULTIVATE THE NECESSARY TALENT AND SKILLS

For data-based transformation to work, the company must have talent with the right skills to execute data-driven strategies and manage data-based operations. This presents a workforce planning challenge, starting with assessing current employees and defining future needs. The company should create an inventory of the talents and skills that its employees will need, and it should identify where the gaps are in the current workforce. Companies will need to retrain current employees, hire new talent, or use a partnership to get the right capabilities. To recruit people with digital skills, the company may need to rethink the value proposition it offers—work, opportunity, rewards, career path, and so on—in relation to what tech companies offer.

CONSIDER THE BUILD-OPERATE-TRANSFER MODEL

In some instances, a company may need to adopt bolder steps to accelerate its data-driven transformation. This may be because it is starting from far behind its competitors or

because it lacks the capabilities and resources needed to drive the transformation internally.

In such situations, using the build-operate-transfer model makes sense. Adapted from the construction industry, this model involves creating a stand-alone organization in partnership with an outside vendor that has the expertise to run transformation initiatives. The organization focuses on managing transformation efforts and is staffed by employees from both the firm and the outside partner. It takes responsibility for setting up and running the use case projects and other elements of the transformation. Over time, as projects are completed, the partner withdraws its employees. Eventually it transfers all work and resources back to the company, and the stand-alone organization dissolves.

The promise of data-driven transformation has captured the imagination of leaders throughout the business world and is driving change in the public and social sectors, too. Executives are inspired by the idea of using data to make better decisions and digitizing all sorts of processes to improve performance. They are also motivated by fear that they won't be able to keep up with competitors who are ahead of them in data-driven digital transformation. These forces can encourage companies to try to achieve sweeping, companywide change to go digital—which can lead

to counterproductive overreaching. This contest will not be won by making huge bets. The winners will be agile, pragmatic, and disciplined. They will move fast and capture quick wins, but they will also carefully plan a transformation roadmap to optimize performance in the functions and operations that create the most value, while building the technical capabilities and resources to sustain the transformation.

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BRIDGING THE TRUST GAP

HOW TO BECOME A TRUSTED DATA STEWARD

by John Rose, Alexander Lawrence, and Elias Baltassis

ONLY ABOUT 20% OF consumers say that they trust companies to do the right thing with their personal data, and more than half think that companies aren't honest about their data use. Such mistrust translates into damage to a brand's reputation and a quantifiable decline in revenue; consumers who perceive that a company has misused data will cut or curtail their spending with that company, as the previous articles in this series have shown. (See "The Hidden Landmine in Big Data" and "Why Companies Are Poised to Fail with Big Data.")

Consider the opposite scenario, though. Our research, which included surveys of companies and consumers, found that consumers are more willing to do business with companies they trust to manage their data. It stands to reason that as consumers decrease spending with companies they don't trust, they will increase it with those they do. So, both to avoid the looming downsides of poor data use and to capture the upside potential of optimal data use, companies must be able to prove to consumers that they can manage data well. They must become trusted data stewards.

Few companies have attained that status. To do so, they must establish a set of best practices and work to embed a new mindset about consumer data usage: that companies themselves own the responsibility of ensuring

that consumers and other stakeholders (such as regulators) fully understand the collection and use of consumer data. This article outlines the best practices required to achieve trusted data stewardship—both internally focused practices that define how a company collects, manages, and uses data and externally focused practices that establish how it engages with its stakeholders about its collection and use of data. Further, we will soon introduce a diagnostic that companies can use to assess their progress relative to both competitors and state-of-the-art data stewardship benchmarks. (See the sidebar, "What Is a Trusted Data Steward? Where Does My Company Stand?")

Internally Focused Practices

Becoming a trusted data steward begins at home; companies can establish—or enhance—best practices internally, in several ways.

Ensuring Engagement by Senior Line Executives. Senior line executives should be actively involved in establishing policies and principles. They need to determine overall policy and approve both legal-language and plain-language versions. Plain language matters—consumers would be 56% more likely to do business with companies that offer a short, clear, and easy-to-understand version of their full privacy policies. (See

WHAT IS A TRUSTED DATA STEWARD? WHERE DOES MY COMPANY STAND?

A company that is a trusted data steward manages the collection of consumer data even before the collection occurs: Which data will we gather and why? How will we ensure that consumers understand and approve our data capture? Finely tuned management must continue, as the gathered data is properly stored, secured, and repurposed, always with transparency and adherence to policies and procedures that govern access, notifications, and permissions. A trusted data steward also stands ready to address any real or perceived

misuses of consumer data, and it measures and shares its performance on all fronts.

We will soon make available an online diagnostic, called the Trust and Data Privacy Best-Practice Diagnostic Tool. The tool will allow companies to assess their data stewardship strengths and weaknesses and their performance versus industry peers. Answering a few questions will allow companies to gauge their potential trust risk—and reward.

“Data Misuse and Stewardship by the Numbers,” BCG slideshow, October 2016.)

However, in most companies senior line executives are not substantively engaged in policy and procedure. Instead, responsibility is delegated to the legal and IT teams. (See Exhibit 1.) These teams should be involved, of course; they have the expertise to address legal and regulatory issues and cybersecurity. But the collection and use of consumer data directly affect brand value, market share, and revenue growth through consumer and stakeholder perceptions of these actions. So, these issues require active line guidance and decision making.

Consider the situation Google encountered when the news of Google Maps’ true scope emerged. While Google cars were collecting data for Street View, they were also grabbing data from home Wi-Fi networks, including passwords and e-mails, and creating individually identifiable consumer profiles. Google subsequently admitted that it should have informed consumers that it was collecting their data and using it to profile them—but an even greater shortcoming was revealed: senior executives were not aware of these activities; had they been aware, they likely would not have approved them.

Projects like this need the expertise that rests in multiple functions and at multiple levels of an organization. In this case, in the absence

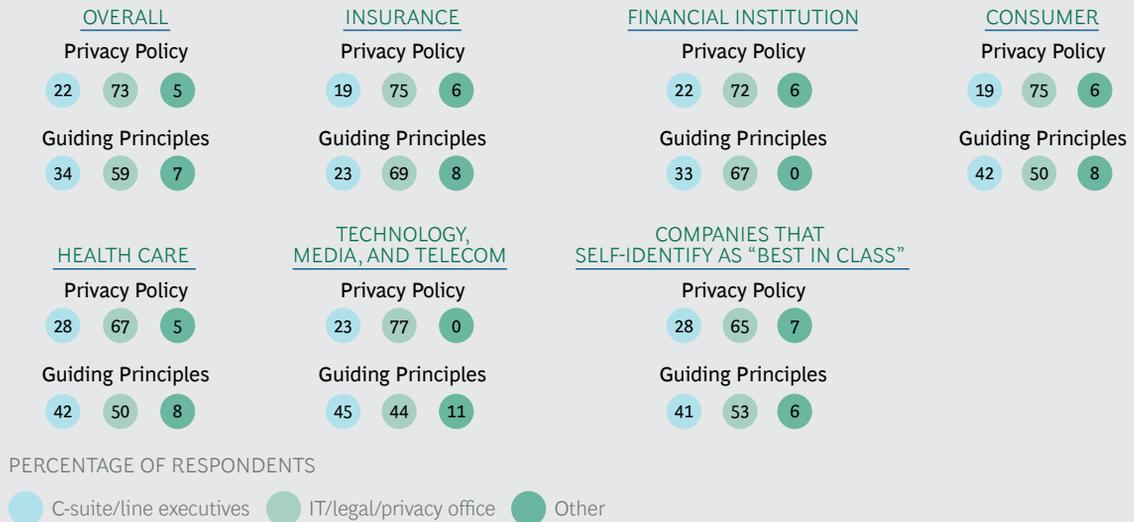
of either clear guidelines about new data collection and use or a decision-making framework that surfaced these new practices to the right, senior line levels, the decision to collect the data and create the profiles was made in isolation by the team doing the work. The backlash was provoked not by the project’s original intent—creating functionality for Google Maps—but by the collection of new data elements for new uses that were not specifically part of Google Maps and that had not been explicitly discussed and approved. Google has since limited its data collection approach, destroyed the profiles, and settled the resulting multistate lawsuit. But the kind of disconnect that led to Google’s issue is not uncommon in large organizations, demonstrating the need for clear guidelines and the active engagement of senior line executives in the governance process.

Creating Robust Protocols for Data Access—and Use. Once a company has established its policies, principles, and governance mechanisms, it must embed them in its approaches to regulating access to the data that it has collected.

The good news is that many companies—71%, according to our survey results—have created protocols that govern access. These protocols establish which individuals have access to which particular types of data—the “who” and “what” aspects of the protocol.

EXHIBIT 1 | Most Companies Don't Put Responsibility for Privacy Policies or Guiding Principles at the Right Level

IF YOUR COMPANY HAS A PRIVACY POLICY OR SET OF GUIDING PRINCIPLES IN PLACE, WHO IS RESPONSIBLE FOR IT?



Source: BCG Big Data and Trust Company Survey, 2015.

But to truly steward data and avoid the pitfalls of unapproved uses, companies must also regulate the “why” aspect: the ways in which individual employees are allowed to use the data they are approved to access. Most companies do not have usage-based controls in place. They need to create protocols that consider “who,” “what,” and “why” in order to achieve a well-rounded, purpose-based approach to data control.

The poster child for the problem of failing to control usage came into public view when Edward Snowden leaked classified information from the National Security Agency’s PRISM electronic-data-mining program. One of the issues that emerged was that people with appropriate access were, in the absence of usage-based controls, misusing data. Whether people agree or disagree with PRISM’s original intent—to defend against terrorism—and its extent, few would argue that the data collected should be used to intrude on a neighbor’s privacy or check up on a significant other.

In another example, from the corporate world, Uber took steps to better manage data after the revelation that its employees could access customer data and track customers’ location and that this data was being used for purposes far beyond providing outstanding

car service. To mitigate such misuse in the future, Uber encrypted and password-protected location data. It also instituted a who-what-why approach to data access and use: the company restricts data access to a small number of employees, who can view and use the data related to drivers and customers only for legitimate business purposes.

Instituting Real-Time Monitoring and Proactive Responses. In a perfect world, everyone would follow the intent of guidelines, and purpose-based access protocols would work flawlessly. In the real world, it is important for companies to ensure that their employees are following the rules and that there are no violations of access or intent.

This requires supplementing access protocols with real-time data monitoring. Monitoring approaches must focus on the same who-what-why elements that access-based protocols must address: the individual accessing the data, the data that he or she can access, and the usage for which the data is being accessed. Currently, though, only one in five companies has any kind of real-time data-monitoring protocol in place, much less one that incorporates usage—meaning that more than 80% of companies are highly vulnerable to data misuse.

By building in ways to respond when employees improperly access and use data, a company can repair inevitable breaches before they do harm to their stakeholders and, in turn, to their own brand and financial performance.

Right now, data misuse (real or perceived) is usually uncovered through consumer or media scrutiny. External rather than internal discovery of misuse has two unfortunate consequences: the misuse continues for longer and has a more significant impact on consumers than if it had been identified and shut down before being built into widely distributed products and services. And when a company uncovers a misuse itself, its response can be managed internally instead of in the context of public scrutiny. As our research suggests, the implications of public reactions to data misuse are highly negative: company revenues fall by 5% to 8% in the first year after a real or perceived data misuse. We believe that the year-one loss could be more severe—10% to 25%—as consumer awareness and concerns increase. (See “The Hidden Landmine in Big Data,” BCG article, June 2016.)

However, it is unlikely that companies will execute perfectly to identify in advance all instances of data collection and usage that will ultimately result in adverse reactions from

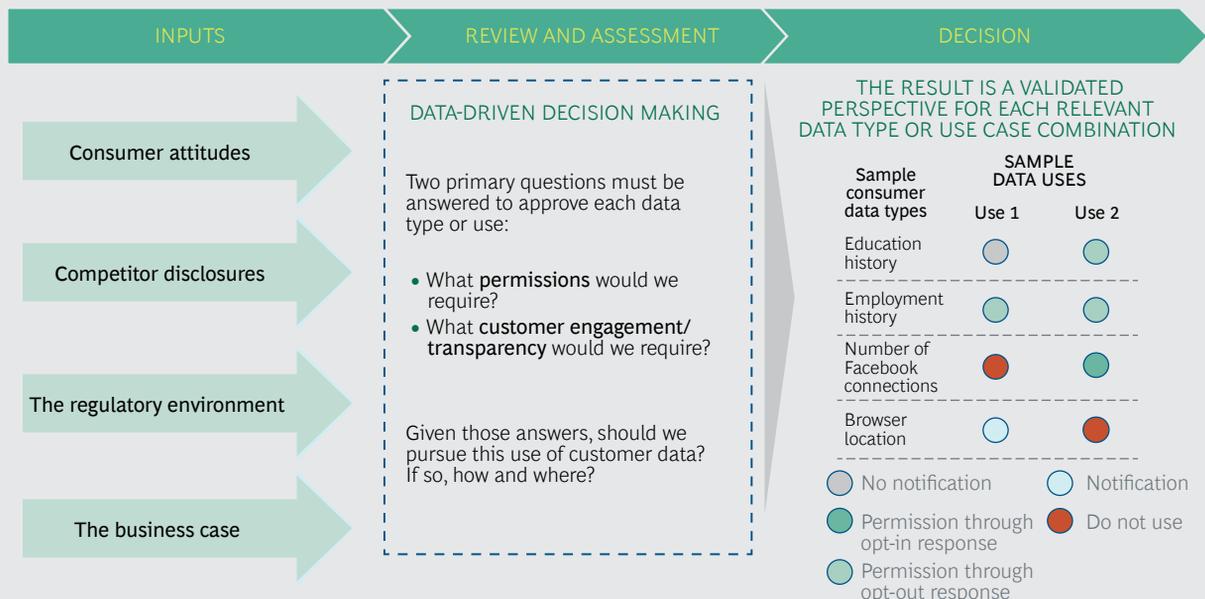
consumers or other stakeholders. So, companies must prepare protocols in advance so that they are ready to address these types of situations. Predefined actions to repair the specific collection and usage issues and to communicate effectively with consumers and other stakeholders will help ensure that companies emerge from these incidents with equal—or greater—trust rather than suffering brand and revenue erosion.

Establishing a Permissible-Use Framework.

Designing new decision-making processes to evaluate and to approve or reject new uses of data is also critical. Best practices can be established by following a permissible-use framework, such as the one shown in Exhibit 2. Such a framework guides those contemplating a new data use to consider four key inputs:

- **Consumer Attitudes.** How will different segments of consumers react upon being made aware of this new use?
- **Competitor Disclosures.** Is this an innovative new use or is it already prevalent in the market?
- **The Regulatory Environment.** Is the new use allowable under current rules and agreements?

EXHIBIT 2 | Example of a Permissible-Use Framework



Source: BCG experience.

- **The Business Case.** What are the direct and indirect benefits to the company of this new use?

These four inputs allow executive teams to make a fully informed decision regarding the risks and value associated with potential new data uses. This perspective can help them to decide not only whether to approve or reject a new use but also how to extend their best practices externally—to determine the best approaches for engaging consumers and other stakeholders.

Externally Focused Practices

In addition to taking internal actions to reduce the potential for adverse reactions, companies must actively engage with consumers and other stakeholders through external best practices. These requirements of good data stewardship are as important as internal best practices—but more elusive. Currently, these are the biggest stumbling blocks and sources of failure for companies attempting to make use of consumer data.

Increasing Transparency. Our survey data is clear: consumers want to know what data companies are collecting and how it will be used. Such transparency is rare, however.

Ensuring a high degree of transparency is, for most companies, a major mindset and cultural shift. It is a shift from “making information available” and “adhering to legal requirements for disclosure” to something much more fundamental: being responsible for ensuring that consumers and all other stakeholders understand what a company is doing with personal data. This is a significant pivot, with inherent challenges—but companies face an additional barrier: the likelihood that the new transparency will engender negative near-term reactions from some consumers who are surprised by the existence of data practices that they perceive as new.

In the medium and long terms, however, the benefits of making this transition will be significant. Consumers are willing to accept a much wider use of their personal data than companies believe—but only if they are fully informed. In failing to understand and inform

consumers, companies are currently being “recklessly conservative” (a behavior whose dangers we describe in the second article in this series, “Why Companies Are Poised to Fail with Big Data,” BCG article, October 2016).

A successful transition from opaque to transparent lies in adopting a new set of engagement practices—moving from “pull” to “push.” Engagement practices today are overwhelmingly oriented toward pull behavior. They are designed to support consumers who will take the initiative to investigate and understand data use practices. (See Exhibit 3.) Unfortunately, few consumers do so, leaving the majority primed for distress when they are unpleasantly surprised by “new” data activities.

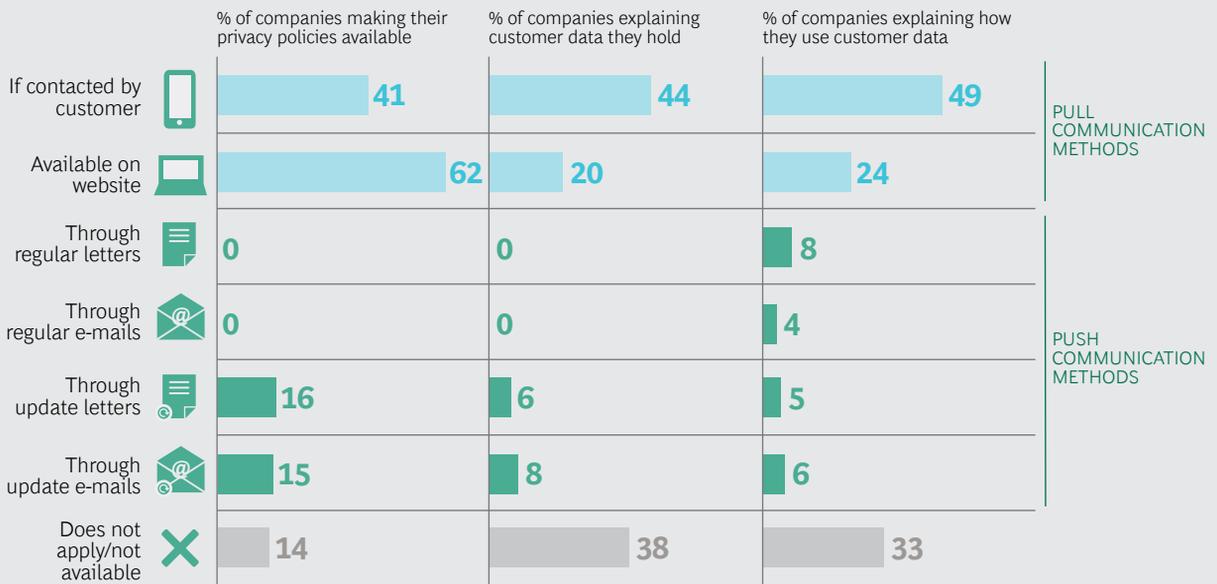
Good pull practices should not be eliminated. Rather, companies should add push-based practices, by which they take the initiative to bring information to consumers’ attention. This requires designing the right communications messages, processes, and distribution formats and vehicles. The appropriate balance of push and pull methods will vary by company, industry, use case, or message. Always, though, a company’s core goal must be to ensure that its data collection and use are fully understood by all relevant consumers—and other stakeholders.

External best practices are as important as internal best practices—but more elusive.

Indeed, transparency is not just a consumer issue. Making data practices clear to a wider set of stakeholders also creates significant benefits. Regulators need to know—in advance—when a company is doing something new so that their actions are not shaped as reactions to consumer and financial press, for instance. Investors, industry associations, and commercial partners will also benefit from such transparency.

Clarity and transparency are good for the entire “data use ecosystem”: when a company is open with regulators about its data practices,

EXHIBIT 3 | Companies Rely Too Much on “Pull” Rather Than “Push” Communication Methods



Source: BCG Big Data and Trust Company Survey 2015.

Note: Survey questions: “With regard to communicating your company’s privacy policies to customers, which of the following statements are true?”, “with regard to engaging with customers about the data your company holds about them, which of the following statements are true?”, and “with regard to engaging with customers about how you use their data, which of the following statements are true?”

for instance, regulators are more likely to view new uses or consumer feedback positively because the transparency will provide them with valuable knowledge and insight into the complex and rapidly changing area of data usage and regulation. For example, we recently recommended that a financial services company implement a quarterly issues-oriented, nontransactional discussion with regulators. The goal is to give regulators a broad understanding of practices and issues on the horizon. Being involved in this way lets companies help drive the conversation instead of simply reacting to it.

Employing Purpose-Specific Notifications and Permissions. For each new use of data, a company should have an explicitly agreed-upon and purpose-specific approach to notification and permissions. In some cases, providing just a notification to consumers is sufficient. In others, an explicit opt-in response (which is not the same as signing a credit card application or clicking on a digital license agreement and thereby agreeing to something covered in the “fine print”) will be needed.

It is clear that companies need to do this more effectively.

For instance, The Global Privacy Enforcement Network surveyed more than 1,200 smartphone apps in 2014 and found that 85% did not disclose data uses and that many requested broad permission for data uses without explaining why or how the data would be used.

Measuring and Publishing Metrics About Consumer Trust. As with all significant change and key operating activities, progress toward becoming a trusted data steward cannot be made without active measurement. And, in the context of transparency, key metrics should be shared with consumers and other stakeholders. Doing so is a way to begin to differentiate a company’s data practices and create a sustainable competitive advantage.

Companies should start by creating metrics so that they can monitor trust, by tracking stakeholder perceptions, regularly and routinely. Metrics should be tailored to a company’s unique dynamics but should generally cover:

- Overall faith in a company’s data stewardship

- Willingness to allow the company to pursue new uses
- Understanding of a company's data practices
- Areas of significant sensitivity and concern

These metrics will serve several functions. They will help determine how consumers are responding to current efforts and which approaches to notifications and permissions work best for particular consumer segments. They can feed into a permissible-use framework by revealing trends among different demographics. For example, trust data might indicate that millennials trust a company more than Generation-Xers do, indicating that opt-out permissions are a better methodology for the former group whereas opt-in permissions are more appropriate for the latter. Because they can deliver such insights, trust metrics can help senior executives set policy direction.

In general, this set of practices is the aspect of data stewardship that companies today are the furthest from mastering. Currently, only 6% of companies have internal consumer trust metrics and actively measure consumer trust, according to our survey, and just 4% publish their trust metrics regularly.

In the absence of these metrics, companies are flying blind. If you don't know how you are being perceived, it is inherently impossible to know what to change. Thus blinded, a company will have little chance of becoming a trusted data steward and is in jeopardy of tripping unforeseen landmines and suffering reputational and performance damage.

The Responsibilities and Rewards of Trust

Companies must choose which direction to take when it comes to managing consumer data and trust.

Failing to establish good stewardship of consumer data puts companies on a vicious cycle, wherein poor management leads to the loss of trust and revenue and a downward trend in financial performance.

Conversely, companies can enter a virtuous cycle by establishing best practices and—crucially—a fundamentally revised mindset about privacy and data stewardship in order to win trust. In this virtuous cycle, managing consumer data well engenders consumer trust, trusting consumers allow more data to be used (our survey showed that consumers are at least five times as likely to share data with companies they trust), and so on.

Companies that choose this track and earn the trust of well-informed consumers will be able to create more value from consumer data. They can access more data for current uses and pursue new uses that are not available to less-trusted competitors. This advantage, we believe, is sustainable, because the capabilities that must be built to achieve it are not easily replicated and because standards will only get higher over time, allowing front-runners to get far ahead of the pack as they establish new marketplace norms.

The choice seems clear, and the time to make it is now.

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WHAT DEEP-TECH STARTUPS WANT FROM CORPORATE PARTNERS

by Nicolas Harlé, Philippe Soussan, and Arnaud de la Tour

AS CISCO'S JOHN CHAMBERS predicted years ago, every company has become a tech company. Affecting aspects of every industry—from the supply chains and processes to customer journeys—digital technologies have revamped virtually every corporate function and activity. But some companies do more than simply apply digital technologies to existing functions or innovative business models that reinvent customer experiences. These innovation leaders seek to develop unique, proprietary, and hard-to-reproduce technological or scientific advances that have the power to create their own markets or disrupt existing industries. Following the past decade of digital innovation, these deep technologies, which will be at the center of the next wave of industrial and information revolution, represent the “next big thing” that venture investors are looking for.

Because of their intense focus on science and technology, deep-tech startups face their own particular set of challenges. An innovation ecosystem has taken root around them, and within this ecosystem, deep-tech companies see large corporations as the partners that can best help their businesses mature and grow.

At the same time, large corporations seeking new sources of innovation are increasingly turning to new-venture vehicles, including

corporate venture capital, accelerators and incubators, and idea labs. (See *Corporate Venturing Shifts Gears: How the Largest Companies Apply a Broad Set of Tools to Speed Innovation*, BCG Focus, April 2016). All these vehicles have soared in number among the biggest companies in multiple industries, as these firms seek new partners and skills that can bring more agility to their R&D operations, disrupt existing business models, provide access to adjacent markets, and help them develop a more entrepreneurial internal mindset. Even though innovation built on deep tech is now a priority, many companies still struggle to work effectively with startups, and the road to productive collaboration is rocky.

BCG and Hello Tomorrow surveyed more than 400 deep-tech startups, inquiring about their needs and their preferred partners. The tech ventures represent ten industries—aerospace, air quality and environmental technology, beauty and well-being, data sciences, energy, food and agriculture, health care, Industry 4.0, transportation and mobility, and water and waste—in more than 50 countries. Our goal was to understand deep-tech startups' needs and challenges and how they interact with other stakeholders in the ecosystem. In addition, we conducted in-depth interviews with other key ecosystem players, including investors, support organizations, and mentors.

Deep-Tech Startups Seek Corporate Partners

Our research revealed that startups have plenty of choices when it comes to partners but that they, like their preferred partners, struggle to make the relationships work. Corporate partnerships offer lots of advantages—more than most other potential partnerships—but it is difficult to secure and make them successful. While 95% of startups wish to develop long-term corporate partnerships, only 57% of them have done so. There are many obstacles, including the following:

- Inadequate preparation on the part of the startup, including lack of a clear value proposition, application, and proof of concept
- Failure of both parties to clearly define the relationship right from the beginning, including agreeing on vision, business, knowledge, and HR objectives
- Misalignment of timing and processes, including complex and slow corporate decision making
- Lack of a clear status and role for the startup within the larger company
- No high-level sponsorship for the startup within the corporation
- Lack of buy-in from the business on the corporate side

Large companies that want to bring deep-tech startups into the fold need to consider carefully the particular needs of these young operations, particularly where the startups stand in their development and what type of bets the bigger companies are making. Both sides also need to work out the fit and structure of the collaboration and specify how the two entities will actually work together.

What Makes Deep Tech Different?

Digital innovation is often about speed to market and scaling up fast to seize first-mover advantage. Deep tech is different in several ways: it involves a strong research base, a challenging business model, and large invest-

ment needs. Given their ambition—and often their complexity—truly disruptive deep technologies can require considerable development time before being brought to market.

For deep-tech startups, a strong research capability is essential since their innovations rely mostly on fundamental and advanced R&D supported by highly developed skills, knowledge, and infrastructure. New materials that demonstrate promising properties in lab conditions need improvements to meet industrial standards. External factors—for example, clinical trials in the health care industry—mean the need for additional resources and can extend the development process for years.

Startups—and their preferred partners—struggle to make the relationships work.

The business models are challenging because deep-tech startups are creating products that are absolutely new. Entrepreneurs must think not only about the technological development of their product but also about how to jump-start nascent or nonexistent markets. This requires the ability to anticipate and understand customer needs that don't yet exist, as well as a detailed strategy that addresses the challenges of industrialization and scaling up production. On top of that, some groundbreaking products are based on advanced materials and newly developed resources, so deep-tech startups need sharply honed business skills to work through such challenges as procurement, manufacturing, and achieving scale. Furthermore, there is always the danger that incumbents, feeling the threat of disruption, will actively seek to slow down, or block, new technologies from entering the mainstream.

Because in many cases, expensive infrastructure is required to support development and deep tech generally takes time to mature and reach the market, substantial funding from understanding and patient investors is essential. (More than 20% of the companies in our survey expect to work three years or more be-

fore getting a product to market, and 50% of startups underestimate the time that they will need.) Early experimentation and prototyping generally require expensive equipment. Testing and scaling is much more costly when it involves purchasing hardware as well as software, which is available and relatively inexpensive from the cloud. Not only is deep-tech capital intensity higher than that of conventional product development, the pay-back periods are also typically further in the future because of the longer time to market. Funding is, therefore, a big and time-consuming challenge.

It Takes an Ecosystem—and a Corporation Can Be a Pillar

For all of these reasons, deep-tech entrepreneurs look to a broad ecosystem of organizations, institutions, and individuals for support. The most common top priority is funding: 80% of the startups we surveyed rank it among their top three needs. But it is far from their only need. Startups look to the supporting ecosystem for help with market access (61%), technical expertise (39%), and business expertise and knowledge (26%). Startups are attracted to particular funders by the specific attributes that they bring to the table. (See Exhibit 1.) Startups’ needs

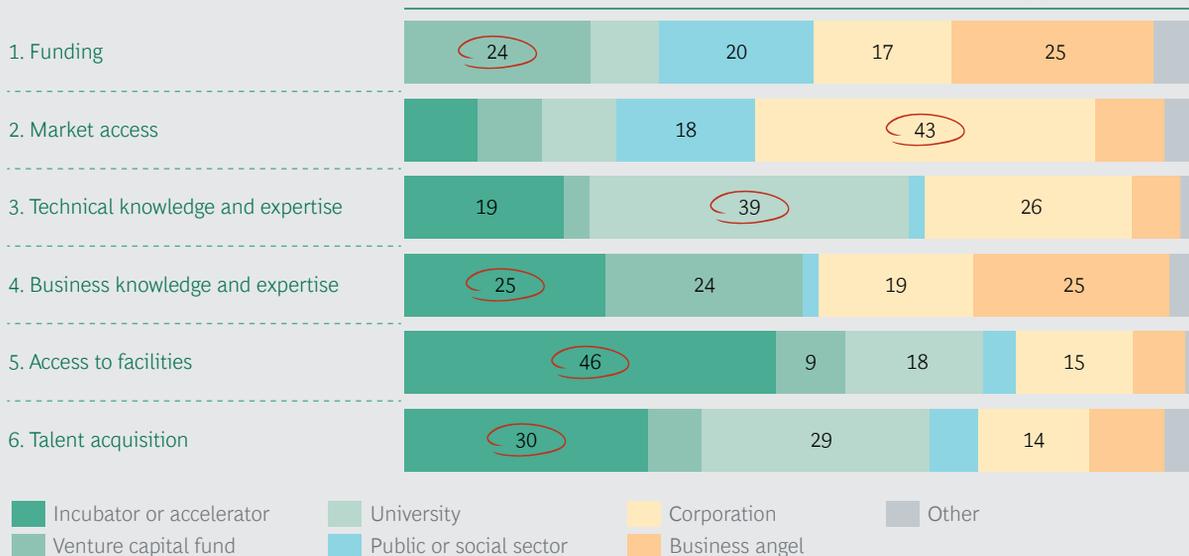
evolve as they and their products move closer to market, and the attractiveness of various types of funding partners shifts as well.

Our survey found that overall, deep-tech startups target venture capital, business angels, corporations, and the public sector in roughly equal measure, with 15% to 25% of respondents indicating a preference for each. (University grants are generally seen as less desirable: they are preferred by only 10% of startups.) A comparison of historical funding sources and startups’ preferred funding channels for the future reveals the evolution of the funding life cycle. It’s not surprising that friends and family most often provide seed capital: 40% of our respondents benefited from such investments. And, on average, 30% of companies accessed the public sector, but we found wide discrepancies among countries and industries. For second-stage funding, deep-tech startups turn toward so-called professional sources—venture capital funds, business angels, and corporations—which, in addition to being able to provide larger sums of cash, can also provide business intelligence, professionalism, network access, and market credibility. Fear of misaligned vision and objectives is a concern, however. Some 35% of startups that had not yet received venture capital funding considered such mis-

EXHIBIT 1 | Startups Seek Different Partners for Different Needs

NEEDS OF DEEP-TECH STARTUPS, RANKED BY IMPORTANCE

PREFERRED PARTNER TO SUPPORT THE NEED (%)



Source: BCG–Hello Tomorrow deep-tech survey.

alignment a critical roadblock. However, only 20% of those that actually had venture capital investors reported any friction.

In addition to funding, startups' preferences for each type of potential partner are shaped substantially by their assessments of their other needs. As a result, corporations are the preferred partners for companies looking to gain access to the market through, for example, access to market and customer data, an existing customer base, or a distribution network. Those that give top priority to technical knowledge and talent acquisition look to universities. Venture capital firms, corporations, and business angels are all seen as desirable for providing business expertise. And it's no surprise that incubators and accelerators rank high among startups seeking access to facilities such as offices, labs, and testing grounds.

When it comes to partner desirability, corporations have a decided advantage over other ecosystem participants. Corporations are the preferred partners for most potential needs: they are differentiated by their ability to provide market access, technical knowledge, and

business expertise, and funding is the icing on the cake. (See Exhibit 2.)

The Evolving Needs of Startups

Large companies looking to partner with deep-tech startups need to segment these up-and-comers according to their maturity and market readiness. Sharpening their understanding of startups' needs and expectations provides a user's guide to what startups are seeking from other participants in the ecosystem. In Exhibit 3, the maturity axis is the level of development of the technology or product itself. The estimation of maturity ranges from early stage (idea, proof of concept) to intermediate stage (prototype, minimally viable product) to late stage (market-ready product). The market readiness axis indicates whether a product or technology will easily find commercial application and customers. It takes into account customer needs and receptiveness, the regulatory environment, and current innovations in the field.

Applying this segmentation analysis to our sample reveals four categories of startup,

EXHIBIT 2 | Startups' Perception of Their Needs and Preferred Partners

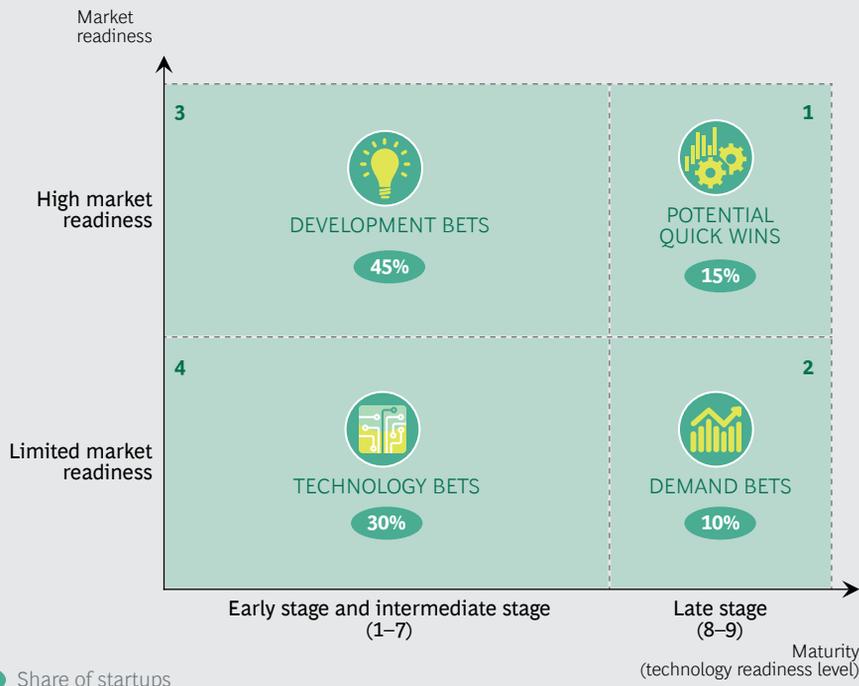
	CORPORATIONS	VENTURE CAPITAL FUNDS	BUSINESS ANGELS	INCUBATORS OR ACCELERATORS	UNIVERSITIES	PUBLIC OR SOCIAL SECTOR	Share of startups with a critical need (%)
Funding	✓	✓	✓			✓	80
Market access	✓					✓	61
Technical expertise	✓			✓	✓		39
Business expertise	✓	✓	✓	✓			26
Access to facilities	✓			✓	✓		23
Talents				✓	✓		22

Corporations are among the partners preferred for supporting the full scope of needs. They are preferred primarily for market access and technical knowledge; although funding is not the leading startup expectation, companies include it in their offer

-  Startup considers stakeholder a preferred partner
-  Startup prefers the stakeholder's support to that of others
-  Startup would like the stakeholder's support

Source: BCG–Hello Tomorrow deep-tech survey.

EXHIBIT 3 | The Four Types of Deep-Tech Startups



Source: BCG–Hello Tomorrow deep-tech survey.

each with its own set of needs: potential quick wins, demand bets, development bets, and technology bets.

Potential Quick Wins. These are startups that have a commercially ready product and a market that is prepared to adopt it. The immediate challenge is to achieve scale (initiate large production volumes, for example, or mount a major public-relations and marketing campaign), and for this, they need fresh funding, market access, and talent. Among startups in this group, 40% consider venture capital funds the preferred channel (compared with 25% overall) because venture capitalists tend to offer more generous levels of funding. To develop the customer base and the distribution network, many startups turn to corporations, although only 25% of them expect to get funding out of these collaborations. One-quarter of them do expect to get visibility, and 20% indicated that they expected to gain credibility, business knowledge, or technical knowledge.

Demand Bets. These are startups with a product that is sufficiently mature to be launched but that still has no broad commer-

cial application. Their main challenge is to identify and create a market for their technologies. The two key roadblocks are the lack of a distribution network (42% of startups in this group mentioned this as a challenge, compared with 16% overall) and market resistance to change (37% of them cited this as a challenge, compared with 20% overall). Other than funding, their most important resource needs are market access (a customer base and a distribution network) and business knowledge, for which the preferred partners are, respectively, corporations and venture capital funds.

Development Bets. These startups have identified a market opportunity and defined a value proposition, and they are developing a technology to respond to the opportunity. They have not yet created a market-ready product. They are focused on gaining access to technical expertise (a critical need for half of these startups, compared with 40% overall) and overcoming technological uncertainty (which 25% of them describe as critical). To obtain the expertise they need, they are willing to consider collaborations with companies and universities, but less than half have

actually established corporate partnerships (compared with 57% overall). Of the collaborations that the development bet startups have established, 60% are research partnerships that share the costs and risks of R&D and accelerate the product development.

Technology Bets. These are startups that have identified a promising (though not fully developed) technology that lacks a market application. Their objective is to develop a viable product that fills a market need. The two chief roadblocks that these startups face are long development time (a major problem for 30%) and technological uncertainty (noted by 25%). Because the attendant uncertainty makes funding risky, their funding is generally from university and public sources. Obtaining access to corporate knowledge and support is relatively difficult for technology bets owing to the risk factors involved. Survey participants from this group express stronger needs for all resources, as they need to turn a technology into a solution to a problem, and they need to develop a marketable product in order to reach the potential-quick-win stage.

FOR large companies with big innovation ambitions, picking the deep technologies to support depends on strategic priorities and a strong market assessment. Choosing the right partner, however, is much like a courtship, especially since the relationship is likely to be a lengthy one. In our experience, these arrangements tend to involve significant commitment from both sides—in terms not just of money but also of management time, organizational expertise, and resources. Understanding what your prospective partner is looking for, as well as how those needs align with your own ambitions and capabilities, raises the chances for success.

This article is the first in a two-part series on how big companies can collaborate with entrepreneurs and startups engaged in “deep technology”—developing technologies that advance scientific and technological frontiers in industries as diverse as agriculture, health care, energy, and transportation—technologies that in many cases address the biggest societal and environmental challenges and shape the way we solve the most pressing global issues. This article looks at young

companies’ needs with respect to other players in the startup ecosystem, particularly large corporations. The second, “A Framework for Deep-Tech Collaboration,” BCG article, April 2017, considers ways that companies can go about setting up collaborations with deep-tech startups. Both articles are based on research conducted by BCG and Hello Tomorrow, a global initiative that connects deep-tech entrepreneurs with corporations and investors. The research involved more than 400 deep-tech startups. BCG and Hello Tomorrow also conducted in-depth interviews with other key ecosystem players, including investors, support organizations, and mentors. The full results are presented in the report From Tech to Deep Tech: Fostering Collaboration Between Corporates and Startups (<http://media-publications.bcg.com/from-tech-to-deep-tech.pdf>).

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Hello Tomorrow is a global organization that gathers together a community of thousands of the world’s brightest talents, who leverage science and deep technologies to create a better future. Hello Tomorrow initiates and propels collaborations between the world’s most promising projects and leading entrepreneurs, executives, and investors to bring breakthrough technology to market. The annual Hello Tomorrow Startup Challenge and Hello Tomorrow Global Summit, as well as numerous international events around the world, provide a unique platform, connecting local deep-tech ecosystems with a global innovation network.

POWERING THE SERVICE ECONOMY WITH RPA AND AI

by Philipp Gerbert, Michael Grebe, Martin Hecker, Olaf Rehse, Fabrice Roghé,
Sabine Döschl, and Sebastian Steinhäuser

ROBOTIC PROCESS AUTOMATION (RPA) and artificial intelligence (AI) have traditionally been viewed as separate and somewhat unequal worlds—RPA proponents consider AI to be impractical, while AI enthusiasts deem RPA primitive—but these two fields are highly complementary. Think of them as the brawn and the brains of performance. Companies can gain quick wins through RPA while strategically introducing AI for sustainable benefits and continual optimization.

Services are especially amenable to this approach. By services, we mean both service industries, such as banking, insurance, and telecommunications, as well as services provided by in-house support functions, such as finance, HR, and IT.

Similar to other technologies, however, RPA and AI are not cure-alls. But, by systematically incorporating both into their processes, service organizations can increase their productivity and boost their ability to generate insights. To succeed, companies should establish clear business objectives and de-

fine the role that RPA and AI will play in their overall optimization efforts.

In addition, companies should introduce these technologies through a clear change management program that addresses their impact on organizational and operational functions as well as on employees, who often feel threatened by robots and other labor-transforming methods.

Automation: Rise of the Robots

In recent years, RPA has gained popularity in service organizations. This tool allows software robots to replace computer activity traditionally performed by humans. These bots can open spreadsheets and databases, copy data between programs, compare entries, and perform other routine tasks. RPA is ideal for repetitive, rules-driven processes that span several IT systems—it's like a macro on steroids.

These bots have several advantages over humans. They work 24-7, rarely make mistakes, accept new assignments, are easy to monitor,

and operate four to five times faster than people. Generally, they pay for themselves within a year and help companies reduce costs by 20% to 80%, depending on the amount and complexity of the manual work they are replacing.

But for better or worse, RPA is a Band-Aid. It can be laid on top of existing IT systems without time-consuming and costly integration. However, it also can lead to a proliferation of similar spot fixes that threaten overall IT architecture and integrity.

So why is RPA a hot topic for many service organizations? First, vendors are offering powerful and intuitive drag-and-drop RPA software. And second, the application landscapes of organizations remain overly complex and still require too many manual steps. To simplify and accelerate their processes, many companies deploy hundreds or even thousands of bots.

For example, a telco started using them to automate what it called “revolving-chair processes,” activities that required humans to move

back and forth among legacy back-office systems. These bots helped to verify contract terms and to manage service staff in the field. RPA paid for itself by a factor of two in the first year and by a factor of three or four in following years.

Despite these benefits, the telco's introduction of bots also presented challenges that the company needed to address. IT systems required that the bots enter an employee number for verification. When worker councils expressed concerns about job losses, the telco re-assigned affected employees and reduced outsourcing.

AI increasingly is embedded in business processes, interactions, and products.

One broader drawback of RPA is that software bots are rule followers. They do not learn or improve. When rules conflict with reality or when unexpected events occur, a human needs to intervene. A leading furniture retailer introduced RPA to schedule deliveries, routing exceptions such as concurrent bookings to call center agents. For these exceptions, the bots provided the agents with full order histories and automated dialing, so the agents were fully prepared to speak with customers.

Although bots are faster than humans, they are still orders of magnitude slower than fully automated processes. For example, bots need to open and log into applications; more deeply automated processes can handle tasks at the system level.

Given the limitations of RPA, companies frequently decide to explore even more ambitious solu-

tions. That is where AI enters the picture.

AI: When Computers Can See, Speak, and Think

AI—the realization of intelligent behavior in computers—has reached new levels of performance and increasingly is embedded in business processes, interactions, and products. These machines process language and retain knowledge, so they can interact deeply and intuitively with people. Because they have also learned to “see,” they can leave the virtual world and join the real one. These capabilities have profound implica-

tions for future competitive advantage. More immediately, AI can improve at least three types of services:

- **Tasks That Are Individually Easy but Collectively Cumbersome for Humans.** Examples include classifying unstructured data, such as extracting information from an invoice, routing incoming emails, and reconciling names and addresses.
- **Tasks That Humans Cannot Easily Perform.** Examples include credit scoring, fraud detection, and high-speed algorithmic securities trading. Humans generally need rules to perform these tasks and the judgment to make exceptions. It's an arduous set of processes that humans perform too slowly. Banks, for example, need to make quick decisions to stop potentially fraudulent transactions. By the time a

human makes a decision, the transaction may have already been processed. Machines, on the other hand, can act in milliseconds and continually learn and improve by processing increasing volumes of information.

- **Tasks That Require Human Interaction, Knowledge, or Both.** Examples range from speaking to customers from a call center to offering legal advice, such as monitoring compliance, by following a set of rules or by first observing and then taking over the research, compliance, and simple advisory tasks of real lawyers.

The grouping of these tasks is imperfect because machines “think” differently than humans, and thus the line between the first two categories, where most activity is concentrated, is blurry. But it helps to lay the groundwork for how companies can use AI in services.

Many companies find AI challenging. Machines learn inductively by processing ever-greater volumes of data, and this learning does not happen on its own. Humans need to train the algorithms. With limited in-house AI capabilities, companies often turn to vendors, and these vendors sometimes oversell their AI capabilities, leading to disappointing AI pilot projects. (See *Reshaping Business with Artificial Intelligence—Closing the Gap Between Ambition and Action*, MIT Sloan Management Review report, September 2017.)

A large insurance company overcame this challenge by seeking vendor-agnostic advice about the most promising automation and AI projects. The insurer evaluated labor and claims costs, the ability to

identify potentially fraudulent or inflated claims, and the strains that pursuing these claims might place on customer relationships. It identified operational and IT requirements, especially the fit between new and legacy systems, and examined a full range of solutions, from rules-based methods to advanced AI algorithms.

Ultimately, the insurer decided to build a team of internal AI experts to develop transparent algorithmic learning solutions for some areas rather than more advanced deep-learning approaches. For many other areas, the company concluded that traditional rules-based automation would work fine.

AI applications are not limited to financial services but apply across the entire industrial landscape. Retailers and consumer companies can microtarget offers to customers, B2B companies can cross-sell more effectively, and industrial

goods companies can offer predictive maintenance services. A broad spectrum of companies can take advantage of AI for uses such as risk and compliance management as well as IT security.

Automation and Intelligence: Working Together

Many service organizations are starting to recognize the benefits of combining RPA and AI. They can achieve both the rapid payback of RPA and the advanced potential of AI. This combination is especially attractive for companies with large legacy systems—such as in the financial services and telecom industries or in HR and finance functions.

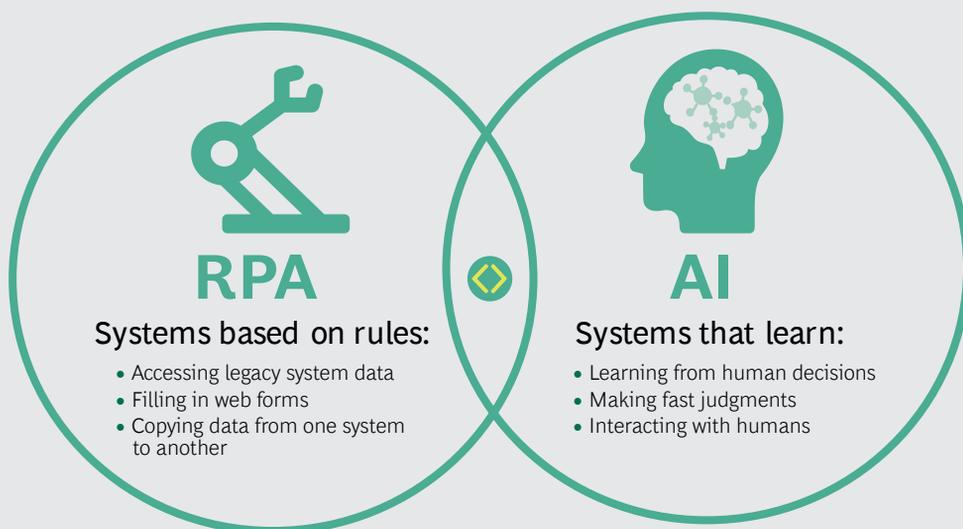
Employees can work together with both RPA and AI to optimize service processes. A natural transition from automation to intelligence occurs when a human

intervenes in a rules-based process. For example, a bot routes text, digitized via optical-character recognition, to a human to classify items such as date, address, and topic. Over time, an AI system can take over this classification. As it improves, the system can gradually replace additional human interactions. (See Exhibit 1.)

An Asian bank took this approach to automation and intelligence in order to provide a better experience to customers, improve risk and compliance, and cut costs. The bank had already reduced head count by digitizing many discrete processes, but it wanted to go further.

To replace human tasks, the bank installed RPA and AI systems that learned on the fly. They routed cases to humans only when the systems were uncertain about what to do. Within four weeks, the AI system had achieved a 50%

EXHIBIT 1 | RPA and AI: The Brawn and Brains of Process Automation



Bots automate easy tasks and make broad data sources accessible to AI.

AI learns to mimic and improve processes based on data handed over from RPA.

Source: BCG analysis.

accuracy rate, and it eventually reached levels superior to those of humans.

By undergoing this automation and intelligence transformation, the bank reduced its costs by 20% and decreased from days to minutes the amount of time that it devoted to certain processes. In addition, the bank amassed a library of automation and AI modules that it can reuse in other contexts.

Fully automating all service processes does not make economic sense. But, even in more complex cases, organizations might be able to preprocess certain activities, reducing the human workload by 80% or more.

Getting Started

Your organization needs to introduce automation and intelligence in an organized and thoughtful way, in order to avoid falling victim to the seductive pitches of ven-

dors and stumbling over common pitfalls. (See Exhibit 2.)

To Create Value, You Need a Strategy. Organizations need both a realistic perception of the risks and rewards of automation and intelligence as well as a clear understanding of the objectives they want to achieve.

The overall RPA and AI strategy and target setting should help advance business priorities and reflect a clear understanding of the current maturity and the disruptive potential of emerging technologies.

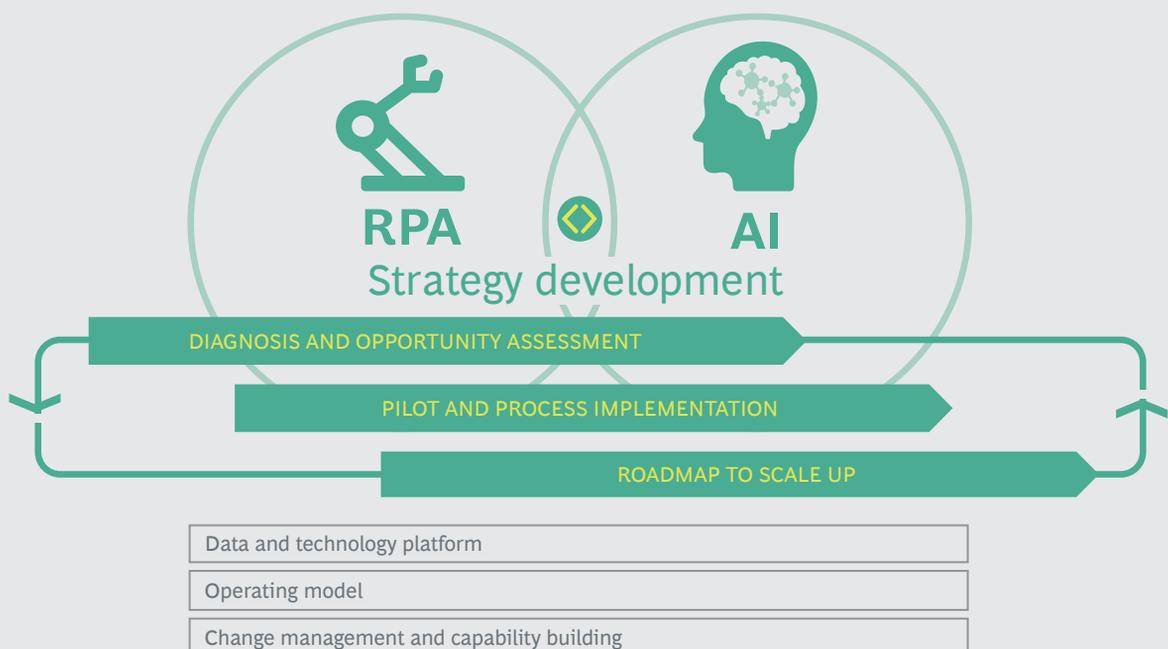
To Move Forward, You Need Priorities. Companies need to objectively assess the current status of RPA and AI projects and identify a comprehensive set of opportunities. They should examine how they can leverage internal and external data sets and exploit the speed and scale of intelligent machines. To avoid myopia, this

analysis should not happen in a vacuum but should be embedded in a wider range of efficiency and optimization efforts under way in the company.

One sensible approach to setting priorities is to create a heat map of RPA and AI opportunities across relevant products and processes, plotting value created against time to implementation. Organizations should identify the improvements with the highest potential payoff and realistically assess the current abilities of various technologies under consideration. They should also take an end-to-end view of implementation. One company, for example, rushed to automate a series of isolated tasks before realizing that this piecemeal approach would not reduce head count or achieve performance increases.

To Fly, You Need Pilots. When designing pilot projects, organizations should remember the saying

EXHIBIT 2 | Bringing RPA and AI to Life in Services



Source: BCG analysis.

“Practice does not make perfect. Perfect practice makes perfect.” By entering into pilots haphazardly, companies risk learning the wrong lessons. One company, for example, did not take an end-to-end view and installed robots in the middle of a value chain that created cumbersome issues at the front and back ends.

To Reach Your Destination, You Need a Roadmap. Companies should combine the insights that they gained from setting priorities and running pilots and should create a comprehensive roadmap of their individual RPA and AI projects. Too often, we see experiments that lack transparency, coordination, and guidance—and unsurprisingly fall short of expectations. Companies need both a timetable and a plan that covers the underlying changes to technology, organization, people, and operations. A sponsor, preferably a C-suite executive, should oversee the transformation. As with all transformations, success starts at the top.

To Win, You Need to Integrate Data and Technology. Simple RPA systems are fairly easy to layer atop legacy systems. But the degree of difficulty rises with the sophistication and scale of the automation and intelligence that companies are introducing. Organizations must ensure that the new systems integrate seamlessly with call centers and other service centers, and they must establish a performance center to manage the overall automation and intelligence activities. And, as companies move into AI, they need access to large internal and external data sets. Vendors vary widely in their ability to support these integrations, however, so organizations need to critically assess vendor capabilities in this area.

To Leverage Automation and AI, You Need New Operating and Governance Models. Automation and intelligence change the nature and economics of work and consequently have significant implications for how companies should organize and deliver their services. Shared-service organizations will remain an important part of the mix, despite claims that automation reduces their relevance. Historically, many of these organizations have been located in low-wage markets to take advantage of labor cost arbitrage. In the future, the role of these organizations will become more strategic, shifting toward the

To Make Automation and AI Successful, You Need to Manage Change and Build Capabilities. Automation and intelligence are not just tools to be introduced in a vacuum. When implementing these new systems, an organization may encounter resistance from employees worried about their paycheck and from executives satisfied with the status quo. Both may discover that they need new skills to take advantage of changing opportunities.

Even if jobs are not in jeopardy, the introduction of robots and AI into an organization of people is

The rise of AI within organizations strains traditional organizational and process setups.

delivery of digital capabilities, customer service, data analytics, and decision support.

More broadly, the rise of AI within organizations strains traditional organizational and process setups. As humans and machines interact in an environment of constant learning, functional and technical teams must collaborate more closely by working in agile ways. AI and agile are inherently iterative. In both, offerings and processes become continuous cycles. Algorithms learn from past outcomes, just as agile teams learn from rapid prototyping and fast feedback.

Ultimately, companies may be headed toward an “automation and intelligence first” imperative, similar to the “mobile first” mantra in multichannel environments. This push for ever-increasing performance and efficiency will free the workforce to devise the next wave of service improvements.

challenging. Managers are generally not trained to oversee a mixed environment of robots and people. They may know how to communicate the changes to their staff but may not be prepared to address employees’ emotional concerns regarding automation.

One underestimated and unexpected challenge to implementation of these technology changes may come from the IT staff. These professionals may be comfortable with the new technologies but not with the collaboration required under agile ways of working. Or they may be uncomfortable with both.

In addition to managing employee reaction to the changes, organizations must also change their capabilities so they can meet two needs. The first, and obvious, need is to find a way to hire employees with modern technology skills at a time when competition for these people is high. To address talent

scarcity, companies should consider managing their AI resources centrally, at least initially. The other, more subtle need is to retrain displaced employees for new roles and responsibilities. Augmented reality can help these employees transition from one job to another with minimal training on newer technologies.

Indian business process outsourcers have already faced these challenges in introducing automation and intelligence. The CEO of one of these companies told us that his organization removes several thousand employees a quarter from their traditional roles and gives them new tasks. His company has also trained more than 100,000 employees in design thinking, a method of devising new ideas that can be used to better serve customers.

THE combination of RPA and AI is both a gift and a riddle. Companies can start benefiting from the gift today with fast-payback initiatives. The riddle they face is figuring out how to use RPA and AI to thrive in a more demanding environment tomorrow. As Lao Tzu said, “The journey of a thousand miles begins with one step.”

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