McKinsey Quarterly

Data culture
Opening the flow
of analytic insight

McKinsey Quarterly

THIS QUARTER

Data is a double-edged sword. It's fueling new business models and transforming how companies organize, operate, manage talent, and create value. It also poses risks: data-security questions, privacy concerns, and uncertainty about ethical boundaries are unavoidable. For leaders, the ability to seize the potential of advanced analytics, while simultaneously avoiding its hazards, is becoming mission critical.

Those leaders shouldn't try to go it alone. Their people and organizations can be powerful allies—or barriers to progress, even sources of trouble. Tools and rules are helpful enablers, but empowering people to make the most of advanced analytics requires something deeper: a corporate culture that's acutely aware of data's growing importance and of the need to be both bold and alert to danger.

"Data culture" is a relatively new concept. This issue's cover story, "Why data culture matters," tackles it through the eyes of six practitioners on the front lines. Representing industries ranging from aerospace and baseball to media, shipping, and banking, those leaders describe how they're democratizing data, making risk management a source of competitive advantage, and cultivating analytics talent with culture in mind. The article also presents seven emerging takeaways on data culture, distilled by our colleagues Alejandro Díaz, Kayvaun Rowshankish, and Tamim Saleh. We hope their reflections represent the start of a useful conversation that carries over to your organization and stimulates fresh ideas on how to harness the power of advanced analytics responsibly.

The organizational context for many of those efforts will be an "agile" one. As more fluid organizational approaches have taken hold across business, a range of second-order questions have begun to emerge. What does it take to

set loose the independent teams that make agile organizations hum? Who manages in an agile organization? And what exactly do those managers do? Our colleagues tackle questions such as these in two articles, "Unleashing the power of small, independent teams" (by Oliver Bossert, Alena Kretzberg, and Jürgen Laartz) and "The agile manager" (by Aaron De Smet).

Keeping the employees we seek to empower healthy and happy is an ongoing priority for leaders—one that has gotten more challenging, according to Stanford professor Jeffrey Pfeffer, as the pace of business life has increased and the intensity of our always-on corporate environment has grown. In "The overlooked essentials of employee well-being," Pfeffer reminds us of two levers—ensuring that individuals feel they have control over their jobs, and providing them with social support—whose importance is supported by reams of academic research; Pfeffer then shows how companies are pulling these levers in creative ways.

The promise is clear: Technology enables organizational innovation. Agile organizations unleash the potential of their people. And those empowered people, in turn, become the backbone of companies that fully exploit—while mitigating the risk associated with—the digital, data- and analytics-driven possibilities before them. As you strive to create this virtuous cycle, pay careful attention to your company's culture, which can clarify the purpose, enhance the effectiveness, and increase the speed of your efforts to stay on the leading edge. ⓠ

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Features

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Leading Edge

Closing View

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Leading Edge

Research, trends, and emerging thinking

TELLING A GOOD INNOVATION STORY

Appealing to people's emotions helps new ideas cut through the clutter.

by Julian Birkinshaw

Among corporate innovators, the travails of James Dyson and the unlikely insight of Art Fry are iconic. Dyson's bagless vacuum cleaner was perfected only after a staggering 5,127 tries. Fry's inspiration, interestingly enough, came during a church service. Pieces of paper he had used to mark hymns kept falling out of his choir book, which led the 3M scientist to think about the materials chemistry that eventually produced Post-it Notes. World-changing products, yes, but also great stories.

Companies today are fixated on innovation, to say the least. Many have reorganized so that ideas can move forward faster and with less internal friction. In an article in this issue of the *Quarterly*, McKinsey authors describe how companies are experimenting with virtual-reality hackathons and "innovation garages" to step up their product-development

hit rate (see "Accelerating product development: The tools you need now," on page 90). We know that much of corporate innovation travels along well-orchestrated pathways—a neat tech breakthrough, a product owner, and an orderly progression through stage-gate and successful launch.

Occasionally, though, it's a "crazy" idea that bubbles up through a lone entrepreneur battling the system, over-coming false starts, and surviving against the odds. While such instances are by their very nature idiosyncratic, one thing many have in common is that good storytelling helps them break through. Storytelling has always been important in business, of course, but in today's environment, with executive and investor attention stretched thin by information overload, the softer stuff is ever more important for getting ideas noticed.

Over the past three years, my colleagues and I have been researching how people frame their innovation stories to create differentiation and attract attention. Our project started with the creation of an innovation award—officially, "The Real Innovation Awards"—at the London Business School in 2016. The award had a number of provocative and unusual categories (see story lines), nominations for which were determined by a mix of expert judges and crowdsourced voting. Over the three years, we have had more than 1,000 nominations[1] from companies or individuals, of which 54 were shortlisted and 26 awarded prizes. Based on our analysis of the stories of all nominees so far, here are three lessons for senior managers as well as entrepreneurs, in organizations large and small, on what makes a compelling and emotional story.

The disconnect between academic labels and good storytelling

"Fast follower" and "self-cannibalization" are terms long-used by academics like me to describe, clinically, what some

Story line: *Best beats first*

☑ **Say this …**
"We did things differently; we saw an opportunity they missed"

☒ **… not this**
"We copied and improved on their idea"

Role models: Facebook, Virgin
Key qualities: Novelty, distinctiveness, tackling a challenge

Story line: *Master of reinvention*

☑ **Say this …**
"We reinvented ourselves for a changing world"

☒ **… not this**
"We cannibalized our old business"

Role models: Amazon, David Bowie
Key qualities: Rediscovery, self-awareness

companies are doing to innovate and reinvent their business models. We had two categories that spoke to these terms, and 20 percent of the nominations fell into either one or the other. Significantly, though, many nominees either refused to accept their nomination in that category or expressed discomfort with the terms. As a result, we recharacterized them as "best beats first" and "master of reinvention."

A "best beats first" innovator takes the measure of a competitor who may be dominating a market with an acceptable product, and then leaps to the front with something even better. It's about winning through cunning, instead of using the conventional playbook of scaling a similar product with heavy investment to maintain share. Many innovators told us that the "fast follower" meme is bereft of emotion: no one ever wins people over by talking about their capacity for imitation. "Best beats first" celebrates doing things in a new way and vanquishes the competitors by seizing

an opportunity they missed. A great example among our award winners is Vivino, which created a leading wine-rating and -recommendation app, based on the use of mobile devices to take a photo of the bottle label.

If employing this story line, make sure to emphasize the points of difference, and downplay the similarities, with the incumbent's offerings. It isn't so important how you got there, but it *is* important to show what makes you distinctive.

The "master of reinvention" story line has a twist. Instead of the innovator taking on the establishment, this one is about the establishment challenging itself. It's the classic tale of transformation or rebirth, where the archetypal protagonist gets into trouble, goes through a near-death experience, and does some soul searching to reinvent himself as a better person. It's a common occurrence in business—take Ørsted, the erstwhile Danish fossil-fuel producer that now gets about 40 percent of its revenues from wind energy—but rarely is it captured

with sufficient emotion. Companies often disrupt themselves by cannibalizing their legacy products before their upstart competitors do so. However, nominees told us that this understates the essence of what they had achieved, and they didn't want to position themselves as aggressively killing off declining product lines (despite the fact that it's often a valid strategy for coping with disruption).

Master reinventors bear in mind that people want to hear about the emergence of the butterfly rather than the demise of the caterpillar. Acknowledge your declining products and the external changes causing you to reevaluate, by all means, but don't linger on the internal struggles you have gone through to kill them. Instead, focus on the forward-looking reinvention story with its new array of potential successes. Investors will relate to this: it suggests you're in touch with both the company's past and its future.

The enduring power of serendipity, perspiration, and underdogs

Approximately 30 percent of the nominations fell into these "classic" innovators categories, which still enjoy broad resonance.

Serendipity involves stumbling over something unusual, and then having the foresight or perspective to capitalize on it. What makes that such an attractive story? It's the juxtaposition of seemingly independent things. In a serendipitous flash, one recent winner, an engineering firm, realized that the gear it designed for scallop trawlers could also be used to

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Story line: *Serendipitous discovery*

> ⊘ **Say this …**
> "We were astute enough to see the opportunity when it happened"

> ⊗ **… not this**
> "We made a lucky discovery"

Role models: Alexander Fleming (penicillin), Art Fry (Post-it Notes)
Key qualities: Surprising connection, curiosity

Story line: *If at first you don't succeed*

> ✓ **Say this …**
> "We undertook a process of discovery; we pivoted cleverly"

> ✕ **… not this**
> "We made a lot of mistakes"

Role models: James Dyson, Thomas Edison
Key qualities: Tenacity, diligence

recover hard-to-get-at material in nuclear-waste pools. Surprising connections such as these set off a chain of events that culminate in a commercial opportunity. So to build this story line, think about the quirky combination of ideas that got you started and remember that serendipity is *not* the same as chance—you were wise enough, when something surprising happened, to see its potential.

The perspiration story theme (or "If at first you don't succeed . . .") is all about hard work and tenacity. Things don't go according to plan, but you conscientiously refine and adapt your idea, and eventually, like Thomas Edison, you wind up with a working lightbulb after a thousand failed attempts. How could this *not* be compelling to investors, customers, or an R&D committee? Just remember that to close the story loop, perseverance needs to show progress. Better not to dwell on mistakes and go around in circles. Emphasize how "learning" and "experimentation" and "pivoting" made the perseverance pay off.

In the underdog, or "the unreasonable person," category, the innovator is fighting the system—the executives and internal procedures that block progress. Unyielding creators such as Steve Jobs and Elon Musk are the role models. They pit themselves against mere incrementalism and me-too products, while rejecting the usual idea-development pathways and timetables. Underdog innovators take on the mantle of the fighter who thrives in battle and relishes proving someone wrong. "Unreasonableness" means not pivoting to get to victory but sticking doggedly to your vision. So you'll need to convince the world how your idea challenges orthodoxy, takes on vested interests, and—after many struggles—has been proved right.

The persuasive power of riding trends

Valuable as all the storytelling approaches above can be, it's worth emphasizing that nearly half (45 percent) of all the nominations were for "the winds of change" award—essentially about harnessing

Story line: *The unreasonable person*

> ✓ **Say this …**
> "She or he had a clear vision and won others over through persistence"

> ✕ **… not this**
> "She or he was incredibly stubborn"

Role models: Steve Jobs, Elon Musk
Key qualities: Vision, stubbornness, resilience

Story line: *The winds of change*

Role models: YouTube, Tencent
Key qualities: Timing, going on a journey

external forces. This notion of riding trends is incredibly powerful, so much so that an award category we created for its polar opposite ("before its time") received so few (weak) nominations that we discontinued it in the second year.

The story line of external forces propelling things forward at a unique point in history typically credits the idea originator for being in the right place at the right time, while deftly navigating the economic or political currents that have combined to make success almost inevitable. YouTube, in the classic example, rode the winds by capitalizing on the emergence of simple video-editing technology and the massive rollout of broadband internet access.

In this story framing, don't tell colleagues and investors you were simply lucky, but instead position yourself as the expert surfer who caught the wave at exactly the right moment: "We were smart enough to see how these trends were coming together, and this is what drove our success." Beware, however, that the story arc of protagonists getting swept up doesn't always point forward. Winds

unpredictably change direction, and ideas crash to the shore. So let everyone know you're aware of how creative destruction can be cruel and that today's disruptive innovation can be tomorrow's outdated technology.

———————

There may be other story lines we haven't thought of, but we're confident the ones highlighted in this article will attract attention because they are enduring and tap a range of emotions. The ability to frame ideas in an attractive way is important for reaching customers and employees, too, but it's particularly so in the world of innovation because of the enormous levels of uncertainty involved in creating something new. Ⓠ

1 There is an increasing amount of interest in using these types of "crowd"-based judgments in social research. For example, see Tara S. Behrend et al., "The viability of crowdsourcing for survey research," *Behavior Research Methods*, September 2011, Volume 43, Number 3, pp. 800–13; and Geoffrey Rockwell, "Crowdsourcing the humanities: Social research and collaboration," in Willard McCarty and Marilyn Deegan, eds., *Collaborative Research in the Digital Humanities*, New York, NY: Routledge, 2012, pp. 135–55.

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ARTIFICIAL INTELLIGENCE: WHY A DIGITAL BASE IS CRITICAL

Early AI adopters are starting to shift industry profit pools. Companies need strong digital capabilities to compete.

by Jacques Bughin and Nicolas van Zeebroeck

The diffusion of a new technology, whether ATMs in banking or radio-frequency identification tags in retailing, typically traces an S-curve. Early on, a few power users bet heavily on the innovation. Then, over time, as more companies rush to embrace the technology and capture the potential gains, the market opportunities for nonadopters dwindle. The cycle draws to a close with slow movers suffering damage.[1]

Our research suggests that a technology race has started along the S-curve for artificial intelligence (AI), a set of new technologies now in the early stages of deployment.[2] It appears that AI adopters can't flourish without a solid base of core and advanced digital technologies. Companies that can assemble this bundle of capabilities are starting to pull away from the pack and will probably be AI's ultimate winners. Executives are becoming aware of what is at stake: our survey research shows that 45 percent of executives who have yet to invest in AI fear falling behind competitively. Our statistical analysis suggests that faced with AI-fueled competitive threats, companies are twice as likely to embrace AI as they were to adopt new technologies in past technology cycles.[3]

AI builds on other technologies

To date, though, only a fraction of companies—about 10 percent—have tried to diffuse AI across the enterprise, and less than half of those companies are power users, diffusing a majority of the ten fundamental AI technologies. An additional quarter of companies have tested AI to a limited extent, while a long tail of two-thirds of companies have yet to adopt any AI technologies at all.[4]

The adoption of AI, we found, is part of a continuum, the latest stage of investment beyond core and advanced digital technologies. To understand the relationship between a company's digital capabilities and its ability to deploy the new tools, we looked at the specific technologies at the heart of AI. Our model tested the extent to which underlying clusters of core digital technologies (cloud computing, mobile, and the web) and of more advanced technologies (big data and advanced analytics) affected the likelihood that a company would adopt AI. As Exhibit 1 shows, companies with a strong base in these core areas were statistically more likely to have adopted each of the AI tools—about 30 percent more likely when the two clusters of

Exhibit 1

Companies with a strong base in core digital technologies and big data analytics are more likely to have adopted an array of AI tools.

Increased probability that a company[1] will adopt given AI tool if it has a foundation in:

■ core digital technologies
■ big data analytics

| | Virtual agents | Natural-language generation | Machine learning | Image recognition | Decision making | Robotic process automation | Natural-language processing | Robotics | Speech recognition |
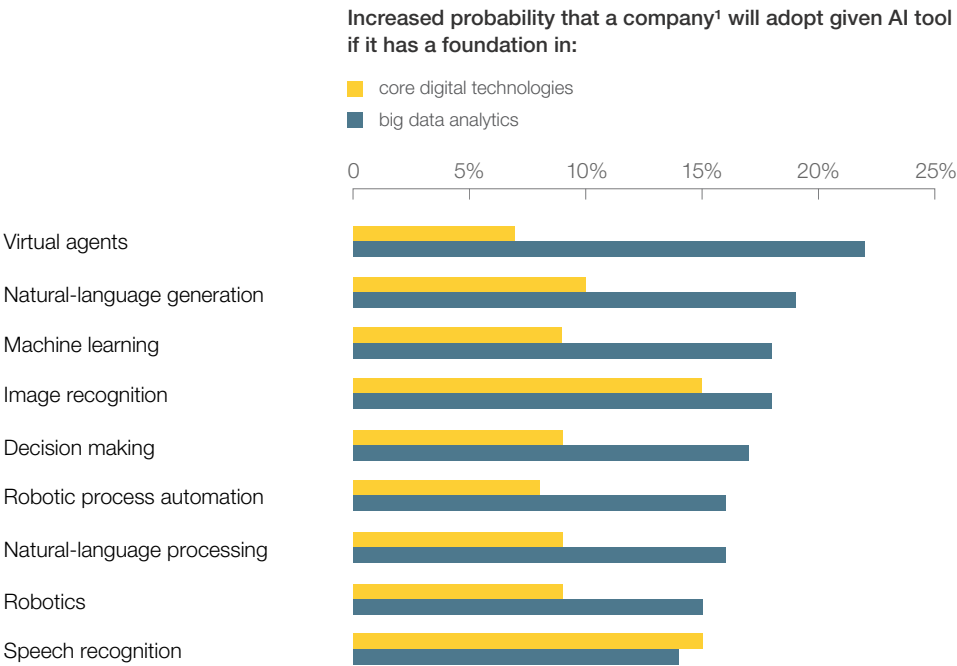
[1] Sample sizes vary by technologies, but each assessment of technology adoption is based on >1,300 survey responses.

Source: 2017 Digital McKinsey survey of 1,760 companies; 2017 Vivatech survey of 3,023 companies

technologies are combined.[5] These companies presumably were better able to integrate AI with existing digital technologies, and that gave them a head start. This result is in keeping with what we have learned from our survey work. Seventy-five percent of the companies that adopted AI depended on knowledge gained from applying and mastering existing digital capabilities to do so.

This digital substructure is still lacking in many companies, and that may be slowing the diffusion of AI. We estimate that only one in three companies had fully diffused the underlying digital technologies and that the biggest gaps

were in more recent tools, such as big data, analytics, and the cloud. This weak base, according to our estimates, has put AI out of reach for a fifth of the companies we studied.

Leaders and laggards

Beyond the capability gap, there's another explanation for the slower adoption of AI among some companies: they may believe that the case for it remains unproved or that it is a moving target and that advances in the offing will give them the chance to leapfrog to leadership positions without a need for early investments.

Our research strongly suggests that waiting carries risks. Early movers appear to be racking up performance gains, and AI investments by first movers are also setting the stage for a second wave of gains. After realizing initial business-model improvements through AI, it seems, companies use the profits to invest in additional AI applications, adding further to their margins.

To provide a more detailed picture of AI leaders and laggards, we examined four levels of internal diffusion of both AI and digital technologies across six industries.[6]

Our analysis suggests that power users of AI with a strong digital base can boost profits by one to five percentage points above industry averages (Exhibit 2). The analysis showed that profits among companies in the bottom two tiers—companies, in each industry, that had yet to diffuse AI and had a weak or no footing in digital technologies—were significantly below industry averages. In finance, where AI and digital technologies are creating greater competitive differentiation, the profit gap is wider than it is in construction, where (so far) AI and digital strategies have been relatively uncommon.

Exhibit 2

Power users that invest in both core and advanced digital technologies see a boost in profits.

Estimated profit margin relative to industry average,[1] percentage points

■ Energy　　■ Automotive　　■ Tech
■ Finance　　■ Telecom　　■ Construction

Companies with …

| … high diffusion of both AI and digital technologies | … lower AI diffusion but relatively strong digital intensity | … no AI diffusion and limited digital intensity | … no diffusion of either AI or digital technologies |
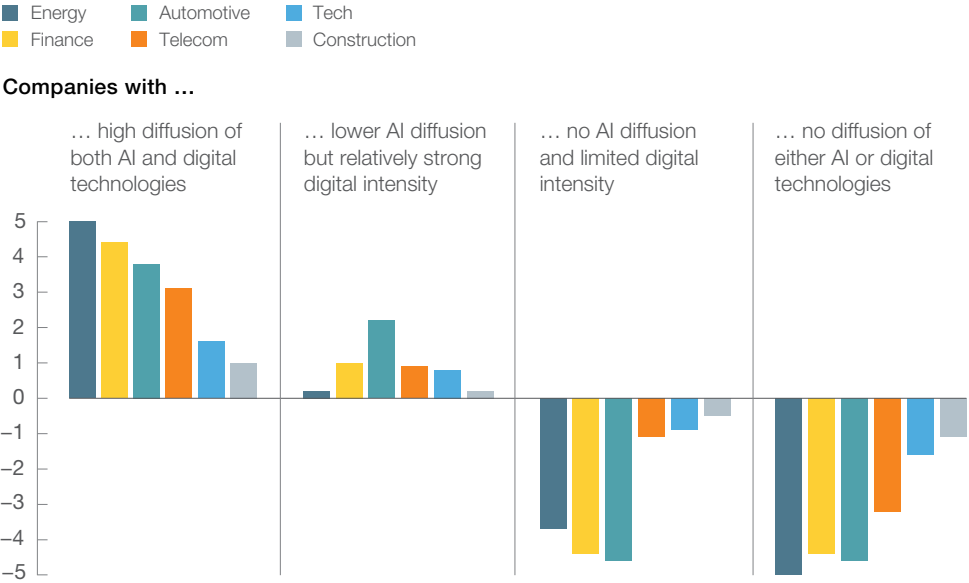
[1] Sample size for each industry reflects >60% of survey responses.

Source: 2017 Digital McKinsey survey of 1,760 companies; 2017 Vivatech survey of 3,023 companies

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Reaching a tipping point?

Interestingly, the downward pressure on margins for the greater number (long tail) of companies in the lower two quadrants is greater than the uplift experienced by the smaller circle of companies that have either broadly adopted AI or are testing it (about 35 percent of our sample). This suggests that AI and digital competition are depressing overall industry margins. Our prior research on core and advanced digital technologies found that industries reach a tipping point once 15 percent of revenues shift to digital attackers and very fast followers.[7] While AI competition isn't in this zone yet, our model indicates that revenue shifts are moving toward it as the diffusion of AI accelerates over the next five years.

The number of companies applying the full range of AI technologies, of course, is still small, and many of the most advanced power users in our research, notably, were digital natives. But the competition is stiffening—fast followers are responding as they see profits drained by attackers. Companies that have a strong base in digital capabilities will benefit, since they can move more quickly to adopt AI. Companies with a less favorable digital foundation will need to line up new talent and rev up their digital-transformation efforts. Ⓠ

[1] See, for example, Lucio Fuentelsaz, Jaime Gómez, and Sergio Palomas, "Intrafirm diffusion of new technologies. A competitive interaction approach," University of Zaragoza, Spain, 2008 (mimeographed); or Tugrul Daim and Pattharaporn Suntharasaj, "Technology diffusion: Forecasting with bibliometric analysis and Bass model," *Foresight*, 2009, Volume 11, Number 3, pp. 45–55.

[2] Our research is based on two samples. The first is a global survey, conducted in 2017, which includes 3,000 executives from companies across ten industries and ten countries. A second, an independent sample of 2,000 firms, is one of McKinsey's global surveys on key management issues. The data we used focused on the digitization of enterprises.

[3] We found a 50 percent probability in the case of AI competition as compared with a 25 percent probability for earlier digital technologies.

[4] For another look at AI diffusion, see *Harvard Business Review* blog, "A survey of 3,000 executives reveals how businesses succeed with AI," blog entry by Jacques Bughin, Brian McCarthy, and Michael Chui, August 28, 2017, hbr.org.

[5] Or three times more likely to be a first mover adopting the entire suite of AI tools than a company with a poor digital base.

[6] We looked at four levels of AI and digital diffusion: high diffusion of AI and digital, with adoption of more than five AI technologies and broad, underlying digital diffusion; low AI diffusion (fewer than five AI technologies) and relatively high digital-technology diffusion; no AI diffusion and low levels of digital diffusion; and no diffusion of both AI and digital technologies. We defined the underlying digital technologies as fixed and mobile web access, enterprise 2.0 communications technologies, cloud computing, the Internet of Things, and big data architecture.

[7] See Jacques Bughin, Laura LaBerge, and Nicolas van Zeebroeck, "When to shift your digital strategy into a higher gear," *McKinsey Quarterly*, August 2017, McKinsey.com.

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HOW AI CAN TURBOCHARGE TODAY'S ANALYTICS

A recent McKinsey Global Institute (MGI) research effort parsed the real-world applications and value potential of artificial intelligence (AI). To get beyond the hype, MGI assessed more than 400 AI use cases across 19 industries. The work showed just how interrelated AI and advanced analytics are, emphasizing the importance of AI to marketing and sales, as well as to supply-chain management and manufacturing, and describing industry-specific variations on those themes. Highlights from the analysis follow. For the full research summary, see "Notes from the AI frontier: Applications and value of deep learning," on McKinsey.com.

Value typically arises at the intersection of AI and other advanced-analytics techniques.

Share of 400 use cases (ie, targeted applications to business challenges) where …

… AI augments value captured by
other analytics techniques

69%

16%

… AI alone
enables value
capture

15%

… full value
can be captured
using non-AI
techniques
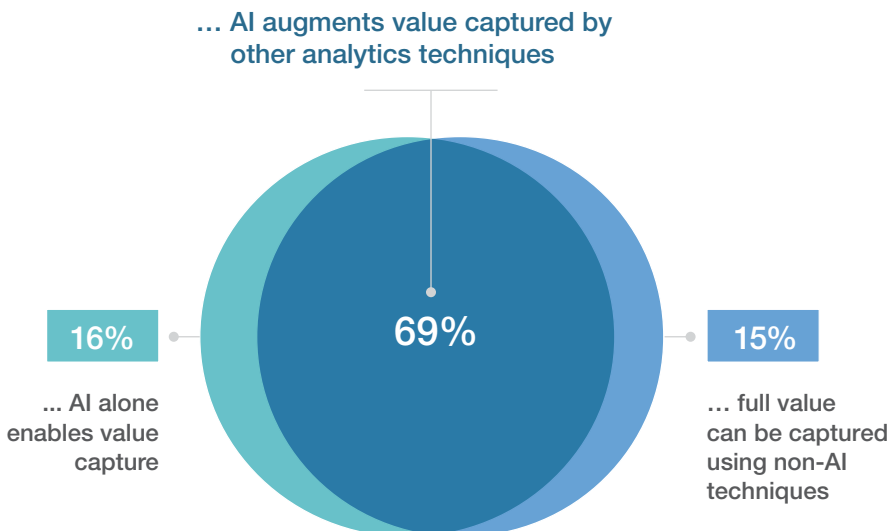
Much of AI's potential value is concentrated in marketing and sales, along with supply-chain management and manufacturing.

Potential AI value across functions in 19 global sectors, $ trillion

Marketing and sales
1.4–2.6

Supply-chain management and manufacturing
1.4–2.0

Risk
0.2

Service operations
0.2

Other operations
0.2–0.4

HR
0.1

0.1
Finance and IT

0.1
Product development

<0.1
Strategy, corporate finance
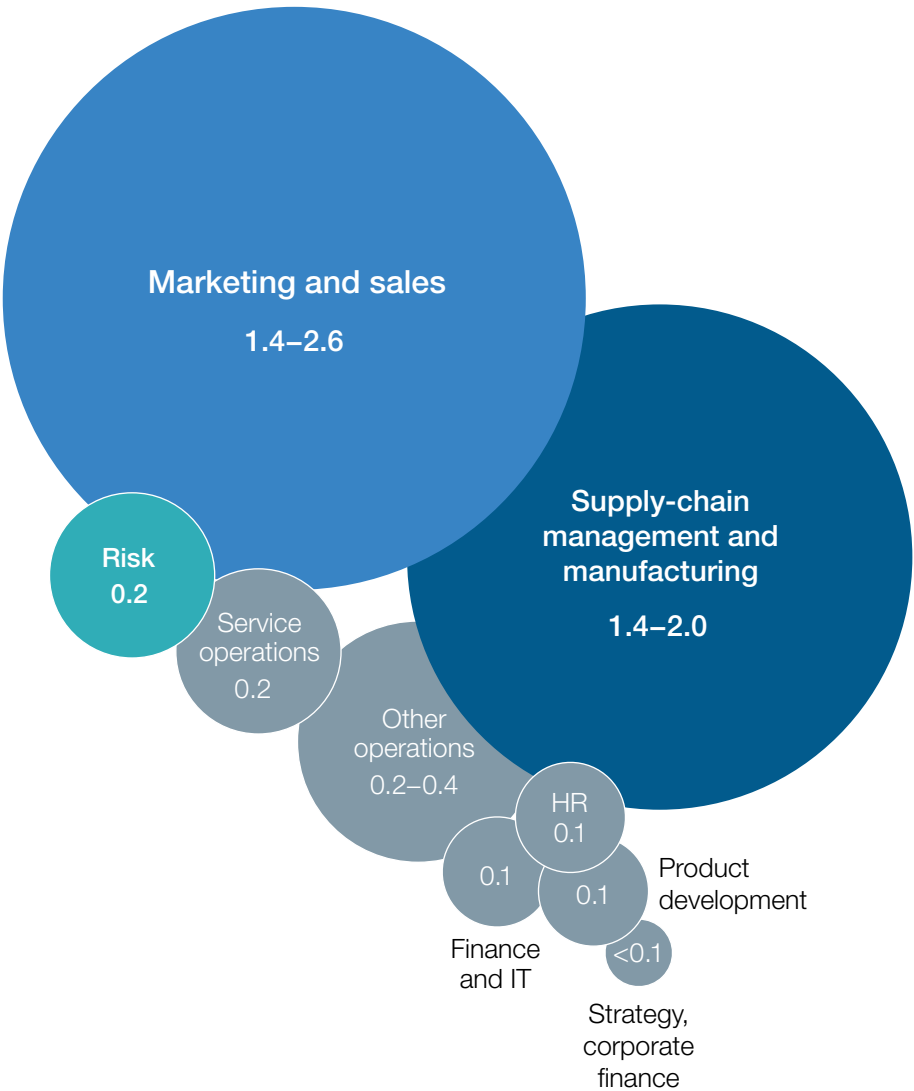
For individual industries, those broad opportunities and the use cases associated with them help define the size of the overall prize.

Three industry examples

Potential AI value by selected functions, $ billion

● Marketing and sales
● Supply-chain management and manufacturing
● Risk
○ Industry, overall

Retail

400–800

300–500
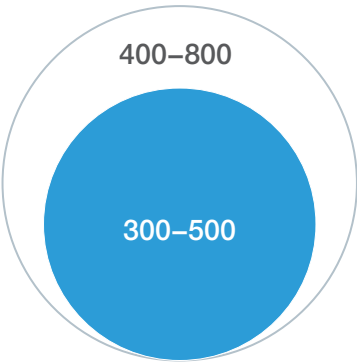
Selected use cases

Pricing and promotion	100–200
Customer-service management	~100
Customer acquisition/generation	<100
Next product to buy	<50

Consumer packaged goods

200–500

200–300
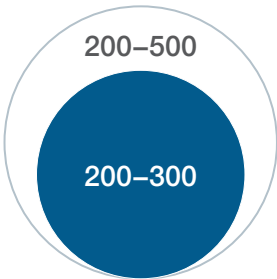
Selected use cases

Predictive maintenance	~100
Inventory/parts optimization	~100
Yield optimization	<100
Sales/demand forecasting	<50

Banking

200–300

100–200
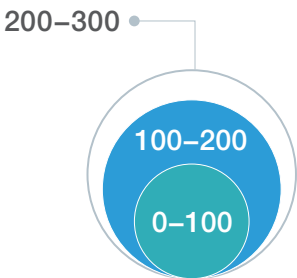
0–100

Selected use cases

Channel management	~100
Customer-service management	0–100
Fraud/debt analysis	0–100
Analytics-driven finance and IT	<50

UNLOCKING THE ECONOMIC POTENTIAL OF DRONES

The benefits to business and society should soar if companies and governments can overcome safety, structural, and other hurdles.

by Pamela Cohn, Alastair Green, and Meredith Langstaff

Most people still think of drones as a hobbyist's tool for capturing cool aerial photos, or as a sophisticated and stealthy technology for the military. But drones, also known as unmanned aerial systems (UAS), are steadily powering their way into corporate and consumer markets. Even more sophisticated UAS are in development.

More than 300 drone start-ups have emerged since 2000, attracting over $3 billion in funding. We estimate that by 2026, drones could represent $31 billion to $46 billion in US economic activity. The most mature UAS applications involve short-range surveillance, but there are many others (exhibit). Some, for instance, facilitate difficult or dangerous operational tasks, such as the inspection of infra-structure assets. Drones for long-range surveillance may be available in a few years, as may UAS that provide multimedia bandwidth to remote areas by emitting signals. The development timelines are much longer for applications with the greatest potential to transform society: full scaling of delivery drones and air taxis.

Industry and government leaders, meanwhile, will need to reassure the public about safety and other concerns. The goal of business should be to develop more applications that inspire enthusiasm for drone technology and create value for customers—by delivering medications to patients in remote locations, for example. But there are even more important issues relating to technology, regulation, and infrastructure. Innovators still need to address shortcomings in areas such as battery performance and navigation, while governments have yet to draw up robust guidelines in those areas. As for infrastructure, unmanned traffic-management systems are among assets that stakeholders will have to build. Q

→ This article is an edited extract from "Commercial drones are here: The future of unmanned aerial systems," available on McKinsey.com.

Exhibit

Some drone capabilities are fully developed, but the most transformative applications are on the horizon.

Economic impact[1]

   High
   Medium
   Low

Estimated time to maturity[2]

Transportation of people	10–15 years
Delivery of objects	5–10 years
Long-range surveillance[3]	2–5 years
Signal emission for remote broadband	1–3 years
Short-range[3] surveillance	
Operations (labor-intensive, difficult tasks)	Already mature in 2018
Photo/video	
Entertainment, advertising	
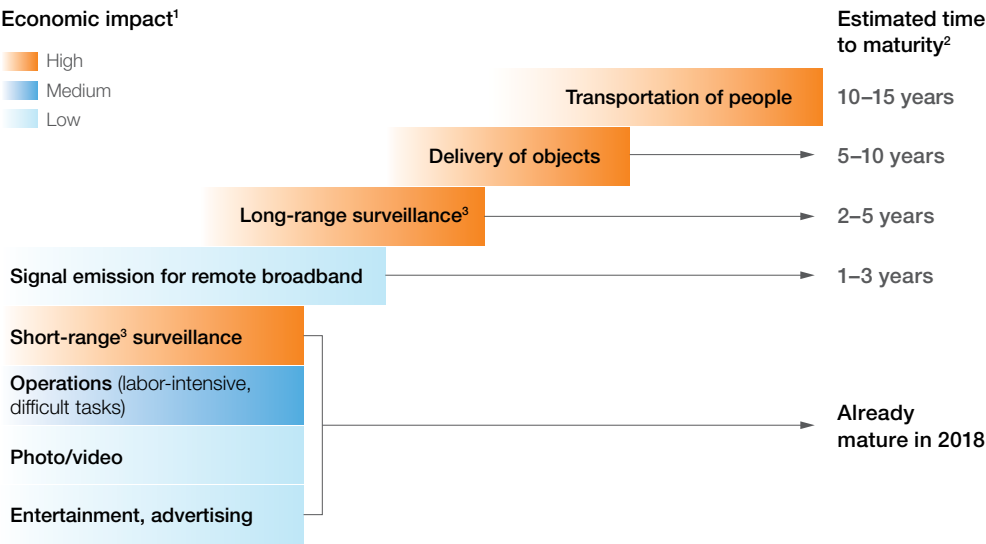
[1] Refers to relative magnitude of economic effect on an industry.
[2] Maturity defined as point when public acceptance, economic drivers, technological advances, regulation, and infrastructure enable majority of uses.
[3] Both short- and long-range surveillance include image capture and analytics; short range is defined as within visual line of sight.

Source: Interviews with industry experts; McKinsey analysis

SHAKING UP THE VALUE CHAIN

In pharma, mining, and energy, data is redefining how value is created.

WILL DIGITAL PLATFORMS TRANSFORM PHARMACEUTICALS?

Start-up companies are combining genetic information and new therapies to transform drug discovery and development—at greater speed and scale.

by Olivier Leclerc and Jeff Smith

Product innovation is at the heart of the pharmaceutical industry's value chain. Long, capital-intensive development cycles and legacy processes, though, have made it difficult to exploit the full potential of emerging digital technologies to deliver faster, more agile approaches to discover and develop new drugs. Indeed, McKinsey research shows that the industry's digital maturity lags that of most other industries.

A new current is forming in one area of the industry: start-up companies that are creating biomolecular platforms around cellular, genetic, and other advanced therapies.[1] The platforms marshal vast amounts of data on the genetics of diseases, such as cancer, and combine that with patients' genetic profiles and related data. They zero in on key points along the information chain—for example, where there are linkages between DNA and proteins, and then cells—to "design" new drugs. Much like software

developers, the platforms engineer disease therapies built upon the "code-like" DNA and RNA sequences within cells (Exhibit 1). These techniques have significant implications for the treatment of many life-threatening illnesses that are outside the reach of standard therapeutic approaches. They could also disrupt the industry's value chain as they speed up drug discovery and development, with the potential for a single platform to scale rapidly across a range of diseases (Exhibit 2).

In one example of a biomolecular platform, for a disease that results from a mutation in DNA that codes for a needed enzyme, the platform models the disease from medical and genetic data to arrive at an enzyme "optimized" to correct for the mutation. The platform then designs a sequence of genetic material to treat the disease, as well as a delivery vehicle to get it to the target cells. In another example, for CAR-T[2] therapies, the platform modifies a patient's T cells

Exhibit 1

Biomolecular platforms marshal **vast amounts of data …**

Database

Disease biology ○
Patients' genetics ○
Historical outcomes ○
Genetics of various cancers ○
Similar disease pathways ○

Advanced algorithms and analytics
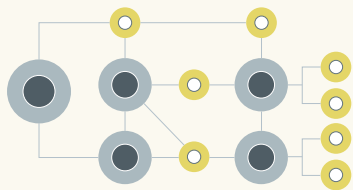
… pinpointing links between DNA, proteins, and cells to **design new drugs.**

1 Gene sequencing

Data analysis **identifies genes** that encode proteins in tumors and **isolates mutant proteins** that might generate an immune response
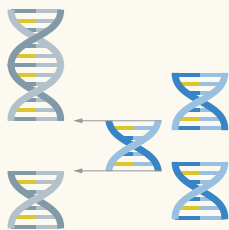
2 Gene synthesis and testing

"Design" labs **synthesize genetic code** and run viability tests using advanced modeling and simulation techniques

These digital capabilities **speed up preclinical and clinical development …**

- **Faster synthesis of initial versions of treatment** for preclinical and clinical trials
- **Accelerated review by Food and Drug Administration (FDA)** and other authorities

… and automate manufacturing, including **personalized therapy.**

CAR-T therapy example

1

Blood collected from patient

2

Algorithms used to predict effects of mutations identified in patient's cancer

3

Automation used to reengineer genetic material that stimulates patient's immune response to cancer cells

4

Personalized therapy with reprogrammed cells injected into patient

23

Exhibit 2

Biomolecular platforms have the potential to increase the speed and scalability of drug discovery and development.

Drug-development process: illustrated timelines[1]

Speed

Drug R&D platforms

First in-human trial

Proof of concept

Regulatory approval

Traditional	Drug discovery	Preclinical	Clinical

Source of acceleration

Routinized process is built on common product-design elements

Applicability of data across products reduces data-collection needs

Clinical-development pathways are expedited

Biomolecular	Drug discovery	Preclinical	Clinical

Scalability

Traditional — Drug discovery | Preclinical | Clinical — **Product A**

Development of product A and B proceed with limited interdependencies

Drug discovery | Preclinical | Clinical — **Product B**

Biomolecular — Drug discovery | Preclinical | Clinical — **Product A**

Addressing the platform and clinical risks of an initial therapy allows rapid scaling across related diseases

Discovery | Preclinical | Clinical — **Product B**
Discovery | Preclinical | Clinical — **Product C**
Discovery | Preclinical | Clinical — **Product D**
Discovery | Preclinical | Clinical — **Product E**

[1] In traditional drug development, discovery typically takes 4 years; preclinical, 1 year; and clinical, 8 years. Timelines shown are not to scale.

(an immune-system cell), which are then deployed to attack a cancer.

A new competitive landscape

Optimized biomolecular platforms have the potential to accelerate the early stages of R&D significantly. For example, it can take as little as weeks or months to go from concept to drug versus what's often many months, if not years, of trial and error under conventional discovery methods. This is achieved by routinizing key steps (such as preparing a drug for preclinical testing) and using common underlying elements in the design of the drug (such as drug-delivery vehicles that are similar). In the past five years or so, a number of start-ups have formulated dozens of drugs that are in clinical trials and, in some cases, drugs that have already been approved. The large infor-mation base behind therapies helps identify the right targets for preclinical and clinical trials.

Digital technologies also enable the fast, replicable, and systematic application of a platform's data and analytics capabilities to treat a whole range of related ailments. Initially, a platform organization may discover drugs limited to one or a small number of diseases. Then, if successful in early tests, it can expand the therapies rapidly to a broader range of diseases, building scale economies. Financial valuations of platform companies often swing dramatically on these early readouts and reflect the fact that early-stage platform companies implicitly carry an option to develop a broad pipeline. At the same time, the platforms encourage collaborative drug discovery—and even new pharmaceutical ecosystems—since research institutes and other partners can work together on a therapy concept that can be rapidly translated into a drug.

The road ahead

Biomolecular platforms face obstacles. They require significant up-front investment to build, and the variability and complexity of the diseases they target is staggering, even using high-powered information systems in the discovery process. Yet once platforms are locked in on a design and validated with a therapy

Optimized biomolecular platforms have the potential to accelerate the early stages of R&D significantly.

(such as a vaccine or an intracellular treatment), their speed and ability to scale rapidly across a range of related diseases make them a potent force. The advances may catalyze new partnerships and M&A activity as larger companies seek to establish their own platform expertise and capabilities. Indeed, as the benefits of digital prove themselves, both biotech pioneers and larger pharma companies are increasingly positioning themselves to harness the potential of biomolecular platforms. That's a recipe for progress and change in an already innovative industry. Q

[1] These include, for example, DNA- and RNA-based gene therapies, gene editing, microbiome therapies, as well as stem-cell and other cell-based therapies.

[2] Chimeric antigen receptor: a genetically modified receptor that binds to a protein on cancer cells.

Olivier Leclerc is a senior partner in McKinsey's Southern California office, and **Jeff Smith** is a partner in the Boston office.

→ For additional insights, see "How new biomolecular platforms and digital technologies are transforming research and development," on McKinsey.com.

COULD YOUR SUPPLIER BECOME TOO POWERFUL?

In the digital age, companies must balance the advantage of outsourcing a segment of the value chain to suppliers with the risk of foreclosing their strategic options.

by Calin Buia, Christiaan Heyning, and Fiona Lander

Armed with data and the capabilities to analyze them, suppliers are offering their services in ever greater chunks of the value chains of energy and materials companies. Customers could find the offer tempting given the promise of quick efficiency improvements. But they also risk handing over the keys to the business if they don't tread carefully.

Outsourcing is not new to the sector. Big companies have long outsourced low-value functions such as payroll, but most higher-value ones deemed central to the business, such as exploration and operations, have been kept in-house. Digital, however, is forcing a rethink. In a data-rich world, suppliers might be able to outperform their customers, so why not harness their capabilities? A fair question in this new, more porous environment, which is requiring companies to re-evaluate which data and digital capabilities are at the heart of their business.

A global manufacturer of turbines, for example, will have more data on their performance than even the largest customer and so could, potentially, maintain them better. It might make sense, therefore, for the customer to outsource

their supply and maintenance rather than purchase them. Some mineral companies already use technology specialists to track and improve productivity in their processing plants using the Internet of Things, and a company like Amazon could perhaps transfer its logistical might to the energy industry. In theory, a miner could eventually outsource its entire operations—blasting, extraction, haulage, processing, freight, and marketing—to contractors who had the data and accompanying expertise to drive down costs and raise productivity and safety.

With technology shifting so quickly and value chains so fragile, it's unwise to predict the future. Ultimately, energy and materials companies may need to redefine what constitutes a core business function (exhibit). But in the meantime, some ground rules will help them capture the short-term gains of outsourcing without limiting future strategic options, or walking away from the many classic truths about supplier management that still apply.

• *Flexibility is more important than ever.* Make sure you can exit a contract or change the terms without fierce penalties. Cost reductions might be

In a data-rich world, even those functions once thought critical to the business might be candidates for outsourcing.

Some examples for energy and materials companies

Criticality to the business
- Importance to strategic objectives
- Competitive advantage

High

Insource, for now	Potentially outsource
Integrated planning Reservoir management Integrated logistics	3-D seismic Marketing Ore haulage and handling Subsea drilling and equipment
Potentially outsource Raw-material transport Inventory management	**Outsource** Back-office functions such as payroll

Low

Low ———————————————————→ High

Supplier's performance advantage
- Data and technology
- Digital talent

today's agreed-upon goal in a contract to outsource logistics, for example, but the overnight delivery of spare parts could become more important to you once predictive-maintenance technology is implemented. Or you may decide you only want a stopgap partnership—perhaps to supply and operate a drone to interpret the images, or to leapfrog your radio-frequency-identification capabilities—while you build your own know-how. That's likely to be a wise course, given how logistics could be profoundly disrupted as technologies evolve.

- *Your data are your most valuable asset.* Share them carefully, but don't give them away. You will find it harder to build your own advanced-analytics skills if, for example, the data generated from your machinery are owned by a supplier. And all the while the supplier could be using the data to strengthen its own market position or, worse still, your competitors if the data are used to train models sold to others.

- *Don't cede control of your IT and data architecture.* It can lock you out of new technology solutions offered by other vendors.

- *Maximize competitive tension.* In theory, the more closely a company works with a supplier, the better for both. But some efficiencies, such as the costs saved and lessons learned from deep collaboration

with a single supplier, may have to be sacrificed to avoid lock-in. A network of suppliers might be a safer choice.

Make no mistake. Outsourcing more of the business to suppliers could have a big upside thanks to the power of their data-driven insights. And every company will need to participate in the digital eco-systems that are forming around every industry. Still, companies also need to be alert to new wrinkles—value-chain trade-offs beyond the data-rich outsourcing we have described. Location-agnostic robots, for example, hold the promise of markedly reducing labor costs for many industries, allowing incumbents to shift production away from low-cost venues or to bring some activities in-house.

For most companies, keeping the entire value chain intact won't be a winning approach. But outsource with your eyes wide open, avoiding irreversible choices while chasing short-term gains. Ⓠ

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POWERING THE DIGITAL ECONOMY

As cheaper storage bends the electricity cost curve and gives a boost to electric-vehicle charging stations, utilities are raising their digital game.

SHOULD BATTERY STORAGE BE ON YOUR STRATEGIC RADAR?

Many commercial and industrial users can already save money.

by Jesse Noffsinger, Matt Rogers, and Amy Wagner

The use of stationary batteries to store energy on commercial and industrial sites is rising because costs have been falling—from $1,000 per kilowatt-hour in 2010 to $230 in 2016, according to McKinsey research[1]—and are heading even lower (toward $100) by 2020. In light of this, we believe the market for distributed battery installations in the United States is set to expand rapidly—as much as 50 percent a year. To date, such installations have been few and far between, mostly limited to specific applications in places such as California with expensive "demand charges" (the monthly payment based on peak demand). Because the whole year's payments are tied to the highest hours of energy usage, there is a natural incentive for users to lower their costs by smoothing out demand.

That is where the newer batteries come in: they can cost effectively store more energy when prices are low and then release it when they are high. Many commercial users in energy-intensive industries can already save money

through storage (exhibit), particularly those in high-cost states. Improved back-up reliability and resilience are other benefits. The aggregation of distributed batteries into virtual power plants could even allow business customers to sell power back to the grid.

In short, as costs of storage fall, the economics of how to manage consumption could profoundly change. Businesses that get the timing right—investing in storage when the costs are less than the average demand charges—should improve their operations, cut their energy use, and score a competitive advantage. Ⓠ

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1 David Frankel and Amy Wagner, "Battery storage: The next disruptive technology in the power sector," June 2017, McKinsey.com.

Jesse Noffsinger is a specialist in McKinsey's Seattle office; **Matt Rogers** is a senior partner in the San Francisco office, where **Amy Wagner** is a senior expert.

→ For more information on battery storage, see "Why the future of commercial battery storage is bright," on McKinsey.com.

Exhibit

On average, 43 percent of commercial and industrial customers could use battery storage to reduce their electricity costs.

% of customers by county who would benefit

0   20   40   60   80   100

CHARGING UP THE ELECTRIC-VEHICLE MARKET

The economics of EV charging stations are often hobbled by high charges for connections to the power grid; more powerful, lower-cost battery storage could provide relief.

by Stefan Knupfer, Jesse Noffsinger, and Shivika Sahdev

It's a chicken-or-egg situation. Consumers will be reluctant to buy an electric vehicle (EV) if they worry it will run out of power. But unless more EVs are sold, not enough charging infrastructure will be built. As of 2015, there were seven times as many gas stations as public charging stations in the United States, and few of the latter were fast-charging.

Battery storage can help resolve this conundrum by reducing the "demand charges" paid by charging stations. These fees are based on the highest rate, measured in kilowatts (kW), at which electricity is drawn during any 15- to 30-minute interval in the monthly billing period. In a high-cost state, they can be as high as $3,000 to $4,500 a month—far too much to be spread over the few EVs lining up on the forecourt today.

On-site batteries, however, can charge and discharge using direct current (DC) and connect to the grid using a large inverter. The batteries can be charged from the grid at times when costs are lower, store the power, and release it when demand is higher. A battery with a 300 kW hour (kWh) capacity can manage peak demand through several two-vehicle charges and recharge in between. By managing the load profile this way, the on-site battery-storage system can reduce demand charges to a minimum (exhibit). This greatly improves the economics of charging. It also helps that the costs of battery storage are falling fast, with forecasts for the near future as low as $100 per kWh, according to McKinsey research. Ⓠ

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→ For more on EVs and battery storage, see "How battery storage can help charge the electric-vehicle market," on McKinsey.com.

Exhibit

On-site battery storage can help electric-vehicle charging stations to reduce costly demand charges.

Theoretical load profile at a US charging station, kW[1]

Without storage,
peak = 100 kW

With storage,
peak = 27 kW

100

80

60

40

20

0

4:00 a.m.　　　　Noon　　　　7:00 p.m.
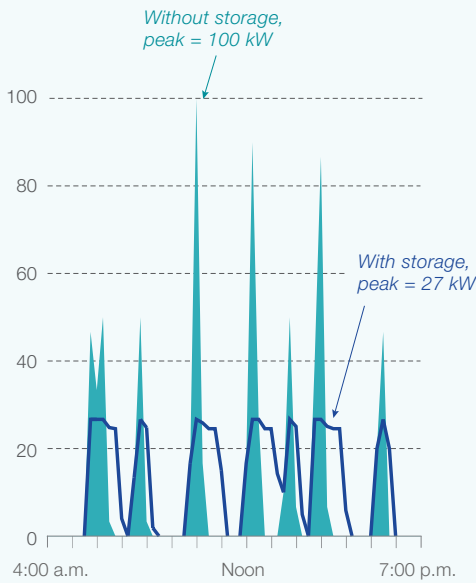
Example: using storage to reduce monthly demand charge[2] in a high-cost state

$3,000

−73%

$810

Without
storage

With
storage
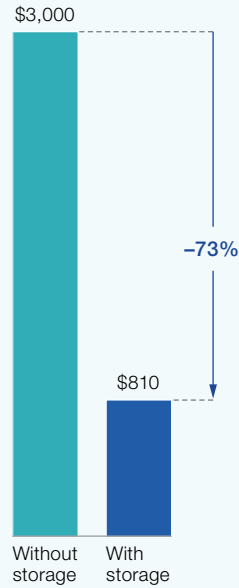
[1] kW = kilowatts. Load-profile assumptions are: station has 4 direct-current fast-charging 50 kW chargers; 11 charging sessions occur during time period profiled (4:00 a.m. to 7:00 p.m.); in at least 1 instance, 2 cars charge simultaneously; demand-charge rate is $30 per kW; and battery-storage system is 150 kWh and can discharge at up to 75 kW.

[2] Demand charge: fee based on highest rate at which electricity is drawn during any 15- to 30-minute interval in monthly billing period, separate from any charge paid for actual energy consumed.

THE POWER INDUSTRY'S DIGITAL FUTURE

Digital technologies offer utilities an opportunity to deliver greater value as market and regulatory conditions shift.

by Adrian Booth, Eelco de Jong, and Peter Peters

In recent years, despite apparent barriers to entry such as tough regulation and high capital costs, utility companies have felt the growing impact of digital-age dynamics. New, digitally enabled players have entered power markets, intelligent apps have given customers both large and small more control over their energy usage, and low-cost batteries and renewables have altered demand patterns. Yet digital technology is also opening a new horizon for incumbent utilities to adapt and create value. Our work suggests that transforming operations and systems with digital technologies can create substantial value—a reduction in operating expenses of up to 25 percent, which can translate into lower revenue requirements (to cope with uncertain demand) or higher profits.

The benefits of digital initiatives are evident across the value chain (exhibit). In generation and transmission-and-distribution operations, predictive-maintenance algorithms help avoid excess work and premature asset replacements while better preventing power failures and other asset breakdowns. When fieldworkers make service calls, mobile applications provide real-time information about site conditions that lets workers safely complete inspections and repairs. Utilities can also borrow the sophisticated customer-service tools of digital-native companies, such as virtual agents that

help ratepayers quickly resolve concerns. This is an important challenge given that industry deregulation in Europe and elsewhere has pushed customer-churn rates as high as 25 percent.

Digital priorities will vary among companies, whose potential performance gains can range from 20 to 40 percent in areas such as customer satisfaction, regulatory compliance, and safety. Fully integrated utilities in regulated markets, for instance, might first look for operational-expense savings as well as higher productivity and network reliability. In general, utilities will readily find 15 to 20 customer journeys and business processes that will be strong candidates for digital reinvention. We have seen that the initial wave of a transformation can generate enough cost savings to pay for itself so that a utility can roll any subsequent savings into further investments in digital initiatives. Over time, the adaptability and efficiency created by digital technologies will give utilities a stronger basis to compete. ⓠ

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→ For more information on the role of digital technology in the power industry, see "Accelerating digital transformations: A playbook for utilities," on McKinsey.com.

Digitization can create benefits for utilities across the value chain.

**Potential savings in operating
and maintenance costs,**
% of respective spending

■ Process automation (eg, asset management)
■ Digital enablement (eg, customer-journey optimization)
■ Advanced analytics (eg, predictive maintenance)
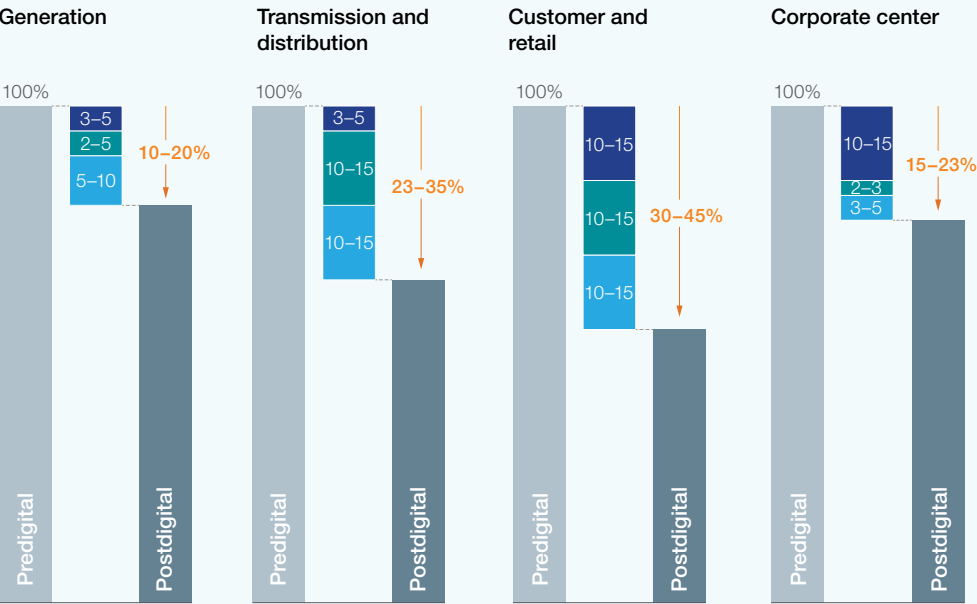
Generation

100%

3–5
2–5
5–10

10–20%

Predigital   Postdigital

Transmission and distribution

100%

3–5

10–15

10–15

23–35%

Predigital   Postdigital

Customer and retail

100%

10–15

10–15

10–15

30–45%

Predigital   Postdigital

Corporate center

100%

10–15
2–3
3–5

15–23%

Predigital   Postdigital

DATA CULTURE

OPENING THE FLOW OF ANALYTIC INSIGHT

Why data culture matters

Organizational culture can accelerate the application of analytics,
amplify its power, and steer companies away from risky outcomes.
Here are seven principles that underpin a healthy data culture.

by Alejandro Díaz, Kayvaun Rowshankish, and Tamim Saleh

Revolutions, it's been remarked, never go backward. Nor do they advance
at a constant rate. Consider the immense transformation unleashed by data
analytics. By now, it's clear the data revolution is changing businesses and
industries in profound and unalterable ways.

But the changes are neither uniform nor linear, and companies' data-analytics
efforts are all over the map. McKinsey research suggests that the gap between
leaders and laggards in adopting analytics, within and among industry sectors,
is growing. We're seeing the same thing on the ground. Some companies are
doing amazing things; some are still struggling with the basics; and some are
feeling downright overwhelmed, with executives and members of the rank
and file questioning the return on data initiatives.

For leading and lagging companies alike, the emergence of data analytics as
an omnipresent reality of modern organizational life means that a healthy
data culture is becoming increasingly important. With that in mind, we've
spent the past few months talking with analytics leaders at companies from
a wide range of industries and geographies, drilling down on the organizing
principles, motivations, and approaches that undergird their data efforts.
We're struck by themes that recur over and again, including the benefits of

data, and the risks; the skepticism from employees before they buy in, and the excitement once they do; the need for flexibility, and the insistence on common frameworks and tools. And, especially: the competitive advantage unleashed by a culture that brings data talent, tools, and decision making together.

The experience of these leaders, and our own, suggests that you can't import data culture and you can't impose it. Most of all, you can't segregate it. You develop a data culture by moving beyond specialists and skunkworks, with the goal of achieving deep business engagement, creating employee pull, and cultivating a sense of purpose, so that data can support your operations instead of the other way around.

In this article, we present seven of the most prominent takeaways from conversations we've had with these and other executives who are at the data-culture fore. None of these leaders thinks they've got data culture "solved," nor do they think that there's a finish line. But they do convey a palpable sense of momentum. When you make progress on data culture, they tell us, you'll strengthen the nuts and bolts of your analytics enterprise.

That will not only advance your data revolution even further but can also help you avoid the pitfalls that often trip up analytics efforts. We've described these at length in another article and have included, with three of the seven takeaways here, short sidebars on related "red flags" whose presence suggests you may be in trouble—along with rapid responses that can mitigate these issues. Taken together, we hope the ideas presented here will inspire you to build a culture that clarifies the purpose, enhances the effectiveness, and increases the speed of your analytics efforts.

1. DATA CULTURE IS DECISION CULTURE

The takeaway: *Don't approach data analysis as a cool "science experiment" or an exercise in amassing data for data's sake. The fundamental objective in collecting, analyzing, and deploying data is to make better decisions.*

Rob Casper, chief data officer, JPMorgan Chase: The best advice I have for senior leaders trying to develop and implement a data culture is to stay very true to the business problem: What is it and how can you solve

it? If you simply rely on having huge quantities of data in a data lake, you're kidding yourself. Volume is not a viable data strategy. The most important objective is to find those business problems and then dedicate your data-management efforts toward them. Solving business problems must be a part of your data strategy.

Ibrahim Gokcen, chief digital officer, A.P. Moller – Maersk: The inclination, sometimes, when people have lots of data is to say, "OK, I have lots of data and this must mean something, right? What can I extract from data? What kind of insights? What does it mean?" But I'm personally completely against that mind-set. There is no shortage of data, and there is even more data coming in.

Focus on the outcomes and the business objectives. Say, "OK, for this outcome, first let's look at the landscape of data and what kind of analytics and what kind of insights I need." Then act on it rapidly and deliver that back to the team or the customer. This is the digital feedback loop: use the insights, ideas, and innovation generated by the team or your customer as an accelerator for improving the capability and product and service that you already have.

Cameron Davies, head of corporate decision sciences, NBCUniversal (NBCU): It's not about the data itself. It's not just about the analytics—any more than taking a vitamin is only so you can claim you successfully took a pill every morning. When it comes to analytics, we have to keep in mind the end goal is to help make better decisions more often. What we try to do first and foremost is look at places where people are already making decisions. We review the processes they use and try to identify either the gaps in the available data or the amount of time and effort it takes to procure data necessary to make an evaluation, insight, or decision. Sometimes we simply start by attempting to remove the friction from the existing process.

Jeff Luhnow, general manager, Houston Astros: We were able to start with a fresh piece of paper and say, "OK, given what we think is going to happen in the industry for the next five years, how would we set up a department?" That's where we started: "OK, are we going to call it analytics or are we going to call it something else?" We decided to name it "decision sciences." Because really what it was about for us is: How we are going to capture the information and develop models that are going to help the decision makers, whether it's the general manager, the farm director who runs the minor-league system, or the scouting director who makes the draft decisions on draft day. How are we going to provide them with the information that they need to do a better job?

2. DATA CULTURE, C-SUITE IMPERATIVES, AND THE BOARD

The takeaway: *Commitment from the CEO and the board is essential. But that commitment must be manifested by more than occasional high-level pronouncements; there must be an ongoing, informed conversation with top decision makers and those who lead data initiatives throughout the organization.*

Cameron Davies, NBCU: You can talk about being CEO-mandated. It only goes so far. Our CEO [Steve Burke] is very engaged. He's willing to listen and share feedback. We try to be thoughtful of his time and not waste it. A CEO, especially for a company of size, is thinking about billion-dollar decisions. He's thinking big, as you would expect. So we try to focus on the larger things. We have a mantra: even if you have nothing to communicate, communicate that. We have a cadence with Steve that happens on a quarterly basis, where we say, "Here's what we're doing. Here's what the challenges are and here is how we're spending the funding you gave us. Most importantly, here is the value we're seeing. Here is our adoption."

Our CEO also provides encouragement to the team when he sees it. For a data scientist—if you're an analyst or a manager—to get the opportunity to go sit with the CEO of a company and then have him look at you and say, "That's really cool. That's awesome. Well done," that goes further to retention

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RED FLAG

The executive team lacks a clear vision for its advanced-analytics programs.

In our experience, lack of C-suite vision often stems from executives lacking a solid understanding of the difference between traditional analytics (that is, business intelligence and reporting) and advanced analytics (powerful predictive and prescriptive tools such as machine learning).

To illustrate, one organization had built a centralized capability in advanced analytics, with heavy investment in data scientists, data engineers, and other key digital roles. The CEO regularly mentioned that the company was using AI techniques, but never with any specificity.

In practice, the company ran a lot of pilot AI programs, but not a single one was adopted by the business at scale. The fundamental reason? Top management

than almost anything else you can do. And he's willing to go do that from a culture perspective, because he understands the value of it as well.

Takehiko ("Tak") Nagumo, managing executive officer, Mitsubishi UFJ Research and Consulting (MURC); formerly executive officer and general manager, corporate data management, Mitsubishi UFJ Financial Group (MUFG): Just like any other important matters, we need the board's backing on data. Data's existed for a long time, of course, but at the same time, this is a relatively new area. So a clear understanding among the board is the starting point of everything. We provide our board educational sessions, our directors ask questions, and all that further deepens their understanding. And it's good news, too, that directors are not necessarily internal. They bring external knowledge, which lets us blend the external and the internal into a knowledge base that's MUFG-specific. Having those discussions with the board and hearing their insights is an important exercise and, increasingly, a key part of our data culture.

Rob Casper, JPMorgan Chase: Senior management now realizes that data is the lifeblood of organizations. And it's not just financial services. As more and more people digitize all that they do, it all comes down to having transparency and access to that data in a way that's going to deliver value. Senior leaders need to promote transparency on every level. Whether it's the budget, what you're spending your time on, or your project inventory, transparency is paramount. As Louis Brandeis said, "Sunlight is the best

didn't really grasp the concept of advanced analytics. They struggled to define valuable problems for the analytics team to solve, and they failed to invest in building the right skills. As a result, they failed to get traction with their AI pilots. The analytics team they had assembled wasn't working on the right problems and wasn't able to use the latest tools and techniques. The company halted the initiative after a year as skepticism grew.

First response: The CEO, CAO, or CDO—or whoever is tasked with leading the company's analytics initiatives—should set up a series of workshops for the executive team to coach its members in the key tenets of advanced analytics and to undo any lingering misconceptions. These workshops can form the foundation of in-house "academies" that continually teach key analytics concepts to a broader management audience.

disinfectant." If everybody sees what everybody else is doing, then the great ideas tend to rise to the top and the bad ideas tend to fall away.

3. THE DEMOCRATIZATION OF DATA

The takeaway: *Get data in front of people and they get excited. But building cool experiments or imposing tools top-down doesn't cut it. To create a competitive advantage, stimulate demand for data from the grass roots.*

Tak Nagumo, MURC: For MUFG, data culture is a part of our value system. Like eating rice or bread—if you don't eat it, you miss the day. Ultimately, everyone in the organization has to adopt a mind-set of data culture, but it doesn't happen overnight. Creating a cross-cutting data set across the organization is a key for success.

Cameron Davies, NBCU: Just getting the people the data gets them excited. I've never met anybody in all my time at NBCU, or in my past 20 years at another very highly creative company, where I had someone look at me and

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RED FLAG

Analytics capabilities are isolated from the business, resulting in an ineffective analytics organizational structure.

We have observed that organizations with successful analytics initiatives embed analytics capabilities into their core businesses. Those organizations struggling to create value through analytics tend to develop analytics capabilities in isolation, either centralized and far removed from the business or in sporadic pockets of poorly coordinated silos. Neither organizational model is effective. Overcentralization creates bottlenecks and leads to a lack of business buy-in. And decentralization brings with it the risk of different data models that don't connect.

A definite red flag that the current organizational model is not working is the complaint from a data scientist that his or her work has little or no impact and that the business keeps doing what it has been doing. Executives must keep an ear to the ground for those kinds of complaints.

say, "No, please don't give me any information to help me make a better product." At the same time, I don't believe in the *Field of Dreams* philosophy that seems to be inculcated through a lot of data analysis, which is, if you just build it, build something cool, it'll come. I've never seen that work.

Ted Colbert, CIO, Boeing: You have to figure out how to really democratize the data-analytics capability, which means you have to have a platform through which people can easily access data. That helps people to believe in it and to deliver solutions that don't require an expensive data scientist. When people begin to believe in the data, it's a game changer: They begin to change their behaviors, based on a new understanding of all the richness trapped beneath the surface of our systems and processes.

Ibrahim Gokcen, Maersk: Data has to flow across the organization seamlessly. Now that our data is democratized, thousands of people can access it for their daily work. We see a lot of energy. We see a lot of oxygen in the organization, a lot of excitement about what is possible and the innovation that's possible. Because data, applied to a business problem, creates innovation. And our people now have the ability to act on their innovative ideas and create value.

First response: The C-suite should consider a hybrid organizational model in which agile teams combine talented professionals from both the business side and the analytics side. A hybrid model will retain some centralized capabilities and decision rights (particularly around data governance and other standards), but the analytics teams are still embedded in the business and accountable for delivering impact.

For many companies, the degree of centralization may change over time. Early in a company's analytics journey, it might make sense to work more centrally, since it's easier to build and run a central team and ensure the quality of the team's outputs. But over time, as the business becomes more proficient, it may be possible for the center to step back to more of a facilitation role, allowing the businesses more autonomy.

4. DATA CULTURE AND RISK

The takeaway: *An effective data culture puts risk at its core—a "yin and yang" of your value proposition. Although companies must identify their "red lines" and honor them, risk management should operate as a smart accelerator, by introducing analytics into key processes and interactions in a responsible manner.*

Ted Colbert, Boeing: For Boeing, safety always comes first. There's no "sort of" in it. Always comes first. The certification requirements for software embedded on our products are tremendous, for example. Data about how people use a system can help us understand exactly what they're doing, so that productivity and safety go hand in hand.

Cameron Davies, NBCU: There are things we demand about our data and how we treat and consume it. For example, we take PII[1] very seriously. It's a written rule: "This is what you can and can't do." We have policies that are allowed and things that are not allowed. And going against those policies will probably end up in you losing your job. There are expectations that if I do get the data, I treat it safely and effectively. If I transform it or I move it, it's in a place where most people can get to it with the controls in place.

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[1] Personally identifiable information.

No one is intensely focused on identifying potential ethical, social, and regulatory implications of analytics initiatives.

It is important to be able to anticipate how digital use cases will acquire and consume data and to understand whether there are any compromises to the regulatory requirements or any ethical issues.

One large industrial manufacturer ran afoul of regulators when it developed an algorithm to predict absenteeism. The company meant well; it sought to understand the correlation between job conditions and absenteeism so it could rethink the work processes that were apt to lead to injuries or illnesses. Unfortunately, the algorithms were able to cluster employees based on their ethnicity, region, and gender, even though such data fields were switched off, and it flagged correlations between race and absenteeism.

There also is the risk of getting [analytics] wrong. Solutions now are starting to help us understand what's happening inside the box. And it's important to understand that as you build up these capabilities, there is a support cost you're going to have to take on. You should have people monitoring to make sure it makes sense. You should build alerts into place. Sometimes the data goes south, which I've seen happen, and nobody realizes it. I won't throw anybody under the bus, but we had a vendor that couldn't recognize an ampersand. But that's how somebody decided to title one of our shows. We think that issue cost us tens of millions in potential revenue—an ampersand!

We used to think we could build these systems and hand them to people, and they'd be sophisticated enough to run them. We found very quickly that wasn't always the case. We ended up actually staffing to help run it or assist them with it.

Tak Nagumo, MURC: It's almost like a yin and yang, or a dark side and a sunny side. Introduction of the data-management policy documents, procedures, data catalog, data dictionary—the fundamental setting is common for the [financial] industry. And the mind-set necessitated to this area is more of "rule orientation." The other side, the sunny side, I would say, is more Silicon Valley–oriented, more of the data usage, data science, data analytics, innovation, growth. Housing those two ideas into one location is so important.

Luckily, the company was able to pinpoint and preempt the problem before it affected employee relations and led to a significant regulatory fine. The takeaway: working with data, particularly personnel data, introduces a host of risks from algorithmic bias. Significant supervision, risk-management, and mitigation efforts are required to apply the appropriate human judgment to the analytics realm.

First response: As part of a well-run broader risk-management program, the CDO should take the lead, working with the CHRO and the company's business-ethics experts and legal counsel to set up resiliency-testing services that can quickly expose and interpret the secondary effects of the company's analytics programs. "Translators" will also be crucial to this effort.

Rob Casper
Chief data officer
JPMorgan Chase

Ted Colbert
CIO
Boeing

Cameron Davies
Head of corporate decision sciences, NBCUniversal

Ibrahim Gokcen
Chief digital officer
A.P. Moller – Maersk

Jeff Luhnow
General manager
Houston Astros

Takehiko ("Tak") Nagumo
Managing executive officer, Mitsubishi UFJ Research and Consulting (MURC); formerly executive officer and general manager, corporate data management, Mitsubishi UFJ Financial Group (MUFG)

→ Video highlights of the interviews can be viewed on McKinsey.com.

If you don't have a solid foundation, you can't use the data. If you have a solid foundation but are not using the data creatively, you're not growing. This mixing of those two is a key challenge for our entire industry. You have to combine both, that's the bottom line.

Ibrahim Gokcen, Maersk: Every company has constraints. Even the Silicon Valley companies have a lot of constraints. Clearly, we are regulated. We have to comply with lots of rules and regulations across the globe. We are a global company. But failing fast and cheap doesn't mean making bad decisions. It means complying within the constraints that you have, and learning how do you go faster or how do you test things faster. And then implementing the decisions properly. So I think it's really all about the culture of using data, experimenting, building stuff, doing all that as fast as you can—and delivering that to the front line, of course with the right mechanisms.

5. CULTURE CATALYSTS

The takeaway: *The board and the CEO raise the data clarion, and the people on the front lines take up the call. But to really ensure buy-in, someone's got to lead the charge. That requires people who can bridge both worlds—data science and on-the-ground operations. And usually, the most effective change agents are not digital natives.*

Cameron Davies, NBCU: You can talk about a CEO-mandated thing. It only goes so far. People work, breathe their business every day. Nobody knows it as well as they do.

We had a business unit that needed to produce forecasts on an annual basis. There are a lot of players in that process. We went into the organization and found one of the key researchers, who seemed the most open, and we said, "Hey, what do you think? Let's bring you in and you work with us." He became our point person. He interfaced with all his peers throughout this process. Anything we needed to do, this person was the interpreter.

Then we built a set of algorithms, largely machine-learning-driven, with a lot of different features that proved to be fairly accurate. We surfaced them into a tool. And this evangelist on the team was the first to adopt it. He then went out and trained other people how to use it. He brought feedback to us, and through that process took on ownership. Now it's, "This is my
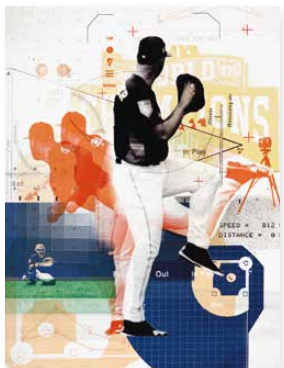
During the early days of Jeff Luhnow's efforts to amp up the Houston Astros's data-analytics efforts, he hired former college players who also had statistical skills to serve as translators for the organization's minor-league baseball players. A full description appears in "How the Houston Astros are winning through advanced analytics," on page 54.

project. I'm responsible for making sure this happens." Nice for us! I don't have to have a product manager now that's meeting with seven different people every month. They've fully taken it on and adopted the process.

Tak Nagumo, MURC: A key role for us is middle management. They're a kind of knowledge crew, conceptualizing and really justifying ideas from upper management, and also leading implementation throughout the entire organization. So that's up, middle, and down. We've also found that "expats" are really well-suited to blend different elements, particularly as we become more globalized. Understand that we have people who work in, among other places, Tokyo, London, New York, or Singapore. No one can communicate better in Tokyo, for example, the needs of employees in the United States than someone who has actually lived and worked in the United States.

6. SHARING DATA BEYOND COMPANY WALLS? NOT SO FAST
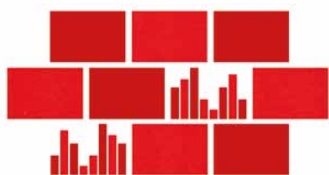
The takeaway: *There's increasing buzz about a coming shift to ecosystems, with the assumption that far greater value will be delivered to customers by assembling a breadth of the best data and analytics assets available in the market rather than by creating everything in-house. Yet data leaders are building cultures that see data as the "crown jewel" asset, and data analytics is treated as both proprietary and a source of competitive advantage in a more interconnected world. (For more on the potential and perils of data sharing, see "Could your supplier become too powerful?" on page 27.)*

Jeff Luhnow, Houston Astros: There was a trend in the past of using external companies to house data like scouting reports or statistics. Most of that has now come in-house. When I was with the Cardinals [2003–11], we used an outside provider, and when I got to the Astros they were using an outside provider, but the response time and the customization was lacking. Most important, when you come up with a way of looking at the world and you want the external provider to build the model for you, you don't want them to share it with the other 29 clubs. It's difficult to have the confidence that it's not going to be shared in some way, shape, or form. I think that's led to most clubs believing that their way of handling data and information is a competitive advantage. It therefore becomes critical to have control over that in-house.

Ibrahim Gokcen, Maersk: We announced a collaboration to develop a shipping-information pipeline—a form of utility that brings standards

across the entire ecosystem. And that will require us to build an ecosystem of participants across the industry—freight forwarders, BCOs, shippers, carriers, truckers, terminal operators, and governments. In that case, it really is all about sharing and collaboration. You have to be incentivized. Maersk plans to participate on the same terms as all other participants. So unless everybody contributes into this ecosystem and platform, the value that everyone else gets is not there, right?

But for some other cases, clearly we can create unique insights and machine learning and AI algorithms and applications and software products for our teams. We can transform our operations and serve our customers much better. So those things, obviously, we want to keep to ourselves. We also don't want to create a situation where we have hundreds and thousands of different companies working for us. We want to be able to insource key talent as much as possible. And that's the journey we're on today. We are building those capabilities in-house, which means we'll rely less on contractors.

Cameron Davies, NBCU: You've got to get people within the organization to understand that first-party data is really important. I'll give you an example. We had a business unit that signed a contract with a data vendor to do some marketing-analytics work. It was fine; we couldn't take it on at the time. We agreed to help support it. However, they didn't ask us to review the contract. When we did get the contract, later on, we learned two things that were a little disconcerting to us.

Number one, there was nothing in the contract that said the vendor had to give us back any of the transformed or enriched data. Well, that's a lot of work to go do; plus, we provided the data in the first place. And not to get any of that back? And then the second disconcerting thing—and the most disconcerting thing in the contract—is that it gave the vendor the right to keep that data and use it in their syndicated sources for their further products. Now, I don't blame the vendor. If I could get away with that contract, I would write it that way, too.

So we've gone on a little bit of an education tour. We put together a package and we did a little road show. "This is an asset. Here's how we use it. You should think about it as something valuable, not just something you just read over in the contract and give up." I think as people see the value, they're getting more excited—like, "OK, not only can I use *my* first-party data but I can bring in other data, enrich it, and create value across the organization."

Ted Colbert, Boeing: I approve every single project that goes into the cloud; it's very helpful that we have a process in place to do that. Our cybersecurity consciousness also has caused us to put a bunch of infrastructure in place to protect the company. It's natural to worry about whether this slows down our ability to innovate or to deliver new capabilities and leverage cool technology. But my first mission is to protect the company.

7. MARRYING TALENT AND CULTURE

The takeaway: *The competition for data talent is unrelenting. But there's another element at play: integrating the right talent for your data culture. That calls for striking the appropriate balance for your institution between injecting new employees and transforming existing ones. Take a broader view in sourcing and a sharper look at the skills your data team requires (exhibit).*

Ibrahim Gokcen, Maersk: This is a company that manages close to 20 percent of global container-trade capacity. Think of the impact to populations. The passion and the purpose are there, and that helps us a lot in attracting the right people globally. We focus on those talents that we need, that we can embed into our business, who can help us execute as soon as possible, but also the pipeline that will be our future leadership team.

I think we have seen that you don't need to have a PhD in computer science, for instance. We actually have a lot of astrophysicists who are amazingly good at working with data and creating value from data. For the skills that we are hiring, industry is not a big differentiator, because we are more interested in functional skill sets. For example, we try to hire an amazing software developer, regardless of which industry he or she worked in before, because we know that an amazing software developer can create a disproportionate amount of value for the company.

Cameron Davies, NBCU: I find it interesting because "culture" itself is a bit of an ethereal term. I used to have a boss at Disney who would say to me, "If you only hire people within your industry, you'll never be smarter than anybody else in your industry." That has always stuck with me. As these data-science programs have evolved, the demand [for talent] has grown. Unfortunately, what we see is the skill set necessarily hasn't followed. People now know how to use some of these tools, but they don't really understand

Defining roles is an important first step in sourcing and integrating the right talent for your data culture.

Business skills

1 Business leaders
2 Delivery managers
6 Data architects
7 Analytics translators
5 Data engineers
8 Data scientists
3 Workflow integrators
4 Visualization analysts

Technology skills   Analytics skills

1 **Business leaders** lead analytics transformation across organization

2 **Delivery managers** deliver data- and analytics-driven insights and interface with end users

3 **Workflow integrators** build interactive decision-support tools and implement solutions

4 **Visualization analysts** visualize data and build reports and dashboards

5 **Data engineers** collect, structure, and analyze data

6 **Data architects** ensure quality and consistency of present and future data flows

7 **Analytics translators** ensure analytics solve critical business problems

8 **Data scientists** develop statistical models and algorithms

"It's not about the data itself. It's not just about the analytics—any more than taking a vitamin is only so you can claim you successfully took a pill every morning. When it comes to analytics, we have to keep in mind the end goal is to help make better decisions more often."

—**Cameron Davies,** NBCUniversal

the basic concepts behind the tools, the math that they're using. If you put the math aside for a moment and focus on their ability to learn the business, manage products, interact with clients, then often you can find people you can pair together and have them become very successful.

We've had a lot of luck hiring from nontraditional areas. One example may be our guy who runs all of our predictive analytics; he actually has a PhD in political science and worked for the Mexican government. Nobody would have picked up his résumé and said, "Yeah, this is a guy who I should go hire to go build forecasting models and interface with a bunch of media creatives on predictive models to tell them how good their show's going to do." Yet he's done a brilliant job of it.

Rob Casper, JPMorgan Chase: The people who succeed in this business are the ones, obviously, who are smart and have high integrity. Those are table stakes. Next, I look for some subject-matter expertise. But you want to have people who bring different things to the table. If you have a team that's very similar in nature, you're not going to get that necessary healthy tension. You want somebody who's strong with technology. You want somebody who's strong with business process. You want somebody who's strong with risk and regulatory. You want people who can communicate effectively, both in

writing and verbally. If you have that, then you have the healthy tension that makes for a good team.

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Culture can be a compounding problem or a compounding solution. When an organization's data mission is detached from business strategy and core operations, it should come as no surprise that the results of analytics initiatives may fail to meet expectations. But when excitement about data analytics infuses the entire organization, it becomes a source of energy and momentum. The technology, after all, is amazing. Imagine how far it can go with a culture to match. Ⓠ

Alejandro Díaz is a senior partner in McKinsey's Dallas office, **Kayvaun Rowshankish** is a partner in the New York office, and **Tamim Saleh** is a senior partner in the London office.

TEN RED FLAGS

The red flags highlighted in this article represent three of the ten challenges identified in "Ten red flags signaling your analytics program will fail," by Oliver Fleming, Tim Fountaine, Nicolaus Henke, and Tamim Saleh, available on McKinsey.com.
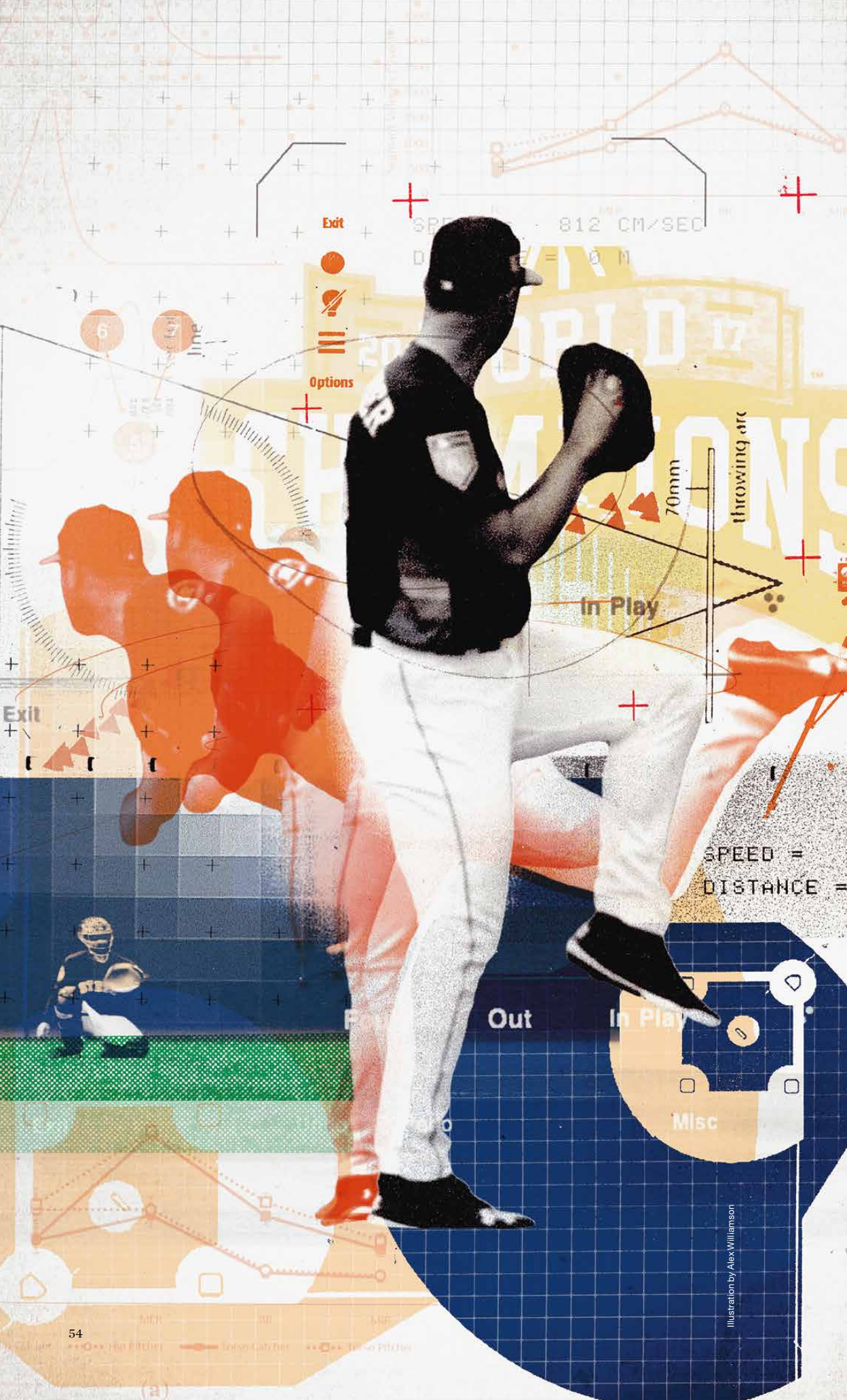
Illustration by Alex Williamson

How the Houston Astros are winning through advanced analytics

Jeff Luhnow, the architect of last year's World Series champions, shares how analytics, organization, and culture combine to create competitive advantage in a zero-sum industry.

When the Houston Astros won the seventh and deciding game of last year's World Series, it marked the end of a long and challenging road. The team not only became the champion of Major League Baseball for the first time in its 56-year history but also did so after losing a staggering 111 (out of 162) games just four short years before. And the Astros didn't simply spend their way to victory. Their Opening Day payroll ranked 18th of 30 major-league teams—and almost 50 percent (approximately $118 million) less than the World Series runner-up, and highest-spending team, the Los Angeles Dodgers.

Winning was a process, years in the making, and resting to a large extent on advanced data analytics. Houston Astros general manager Jeff Luhnow, a McKinsey alumnus and former vice president of the St. Louis Cardinals, began undertaking a data-driven transformation of the baseball operations for the Astros from the moment he was hired in 2011. Analytic insight fueled both player selection and on-the-field decision making, such as where to position players in game situations. As with any big change effort, this was far more than a numbers game. Luhnow and his team had to build an organization and culture that embraced data, translate it into ideas that mattered for players and coaches, and break down silos that were hampering the realization of data's full potential.

In February 2018, Luhnow took a break from spring training to sit down with McKinsey's Aaron De Smet and Allen Webb and discuss his views on both how the Astros used data to move from last to first and what it will take to continue winning as more and more baseball teams join an analytics arms race that has already gone far beyond statistics and data mining and is starting to integrate artificial intelligence.

The *Quarterly*: *What were the analytics strengths and weaknesses for the Astros when you joined them in 2011?*

Jeff Luhnow: There really was not any focus on analytics at all. It was a traditional scouting organization. The Astros had done a nice job of scouting and developing some really good players—players like Dallas Keuchel, George Springer, and José Altuve, who were in the system when I took over. But in terms of the analytic capabilities of the organization, if I were to rank it, Houston would have been in the bottom five for sure.

The *Quarterly*: *Were the existing personnel receptive to your changes?*

Jeff Luhnow: No. There are hundreds of people that work in a baseball organization, including coaches, scouts, and hundreds of players that are signed at any one point in time. They did not accept it right away. For certain elements of the analytics, we had to wait and be patient. Because if you can't get the coaches and the players to buy into it, it's not going to happen.

The *Quarterly*: *How did you get the organization to buy in?*

Jeff Luhnow: The first part was getting the decision makers on the scouting side who are making player-acquisition decisions, either through trades or through the draft, to use the information to make the right decisions. The harder part was changing the behavior of the coaches and the players that were either on our big-league team or in the minor-league system on their way up—getting them to change their behavior and use the information to help make decisions, whether it's game-day decisions or lineups or defensive configuration or recommendations on promoting players. That was harder, and took three or four years to get to a point that we felt good about it. I was fortunate that my boss, the owner of the team, was willing to support us and, quite frankly, help us double down on the strategy. There are other teams in other sports—in football, in basketball, in soccer—that have started a strategy like this and peeled off after two or three years because they couldn't stand the heat in the kitchen.

Jeff Luhnow: I'll give you a great example. The pitcher's on the mound; he throws a pitch. The ball gets hit to where, for the pitcher's entire career, there's been a shortstop right behind him. But all of a sudden, the shortstop's not there, because the analytics would tell us the shortstop should be on the other side of the base. So, to that pitcher, that's a massive failure—that ball should've been an out, and instead, that ball turned into a base hit and maybe a run that's going to go on his personal record.

People always remember the negatives. It's harder for a pitcher to remember the ball that got hit up the middle that, in years past, would've been a single, but this year, it just so happened the second baseman was right there, stepped on the base, and got a double play. We get a little less credit for those, though, than we get dinged on the negative ones.

It's hard to convince the pitchers that this was the right thing to do. Because it was so different. It felt wrong. The defense wasn't standing in the positions that they've been standing in since these guys were in Little League. Pitchers would therefore glare into the dugout and glare at the coaches that asked infielders to move, or glare at the infielders themselves. And over time, everybody would go back to their traditional positions. That was the first year.

The second year—this was 2013—we were a little bit more forceful about wanting to shift, and our coaches did a nice job of doing it for the first couple of months. But again, infielders started to complain: they're not used to

This image and the ones that follow in this article were captured from video shot at the Astros's spring-training facility, in West Palm Beach, Florida, on the day of the *Quarterly*'s interview with Jeff Luhnow.

turning double plays from that spot. The pitchers started to complain. And so we went from being the highest-shift team in the first couple months of the season to one of the middle of the pack by the end, because our coaches just lost the desire to continue to do it and push back against the players.

The next spring training, 2014, we brought all of our major-league pitchers and infielders into a room and decided to share the data with them, which is a little risky because players leave and they go to other organizations. But we figured, if we're asking them to truly change their behavior, they need to understand why this is beneficial to them and where it comes from.

There was an incredible moment where one of our younger pitchers who really wasn't quite getting it kept complaining, "Well, what about this? What about that?" One of the veteran pitchers who had come around turned to the younger pitcher and said, "Look, this is going to help you have a better ERA [earned run average][1] and have a better chance to have a better career, so you should really take this seriously." Once you start getting players to advocate for the use of these tools, it changes the whole equation. Because then you're no longer pushing; it's starting to pull. Once that happens, the sky's the limit in terms of the impact that these technologies and analytics can have on the players.

The *Quarterly*: *Amazing story. And it brings to mind one of the themes that comes up a lot in business contexts: the need to have "translators," people who get the analytics and can bring it to the front line.*

Jeff Luhnow: Absolutely. We decided that in the minor leagues, we would hire an extra coach at each level. The requirements for that coach were that he had to be able to hit a fungo, throw batting practice, and program in SQL.[2] It's a hard universe to find where those intersect, but we were able to find enough of them—players that had played in college that maybe played one year in the minors that had a technical background and could understand analytics.

What ended up happening was, we had people at each level who were in uniform, who the players began to trust, who could sit with them at the computer after the game or before the game and show them the break charts of their pitches or their swing mechanics and really explain to them in a lot more detail why we're asking you to raise your hand before you start

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[1] The average number of runs that a pitcher allows over every nine innings pitched.

[2] A fungo is a ball hit in the air to give players fielding practice. Batting practice involves swinging at multiple balls thrown in fairly rapid succession by a human pitcher or machine. SQL, a programming language, stands for Structured Query Language.

swinging or why we're asking you to change your position on the rubber or how you deliver the ball. Once we got someone in uniform to be part of the team, ride the buses with them, eat the meals with them, and stay in the motels they have in Single A, it began to build trust. They were real people, there to help them.

That was great, and that transition period worked for about two years until the point where we realized that we no longer needed that, because our hitting coaches and our pitching coaches and our managers are now fully technology enabled. They can do the translation. And they're actually real baseball people who have had careers in coaching and playing.

The translators have essentially become the coaches themselves, and we bring them into Houston every year. We have a hitting meeting; it lasts three days where we're talking about hitting and we present all the analytics and all the new things. Same thing on the pitching side, same thing on defense, same thing for the managers. And then our medical staff spends a whole week in Houston. Really, it's a continuing-education program, a way to sort out the pushback we get the preceding year in the field from our players. How can we tailor the program this year to make it easier on them? It's worked very well for us.

The *Quarterly*: *Is that a source of competitive advantage?*

Jeff Luhnow: We're in a zero-sum industry. And I know a lot of industries feel that way—where any advantage you gain has to, by definition, come at someone else's disadvantage. For us, we win a game, someone else loses. For us, the competitive arena moved to being able to implement analytics

insights into the field. And again, that's the most difficult thing to do as an organization. Because, at least at the start, the players aren't going to want to do it. The coaching staff's not going to want to do it. You've got 150 people working in baseball operations, 200 players in a system, some of them have no high-school education. Some don't speak English. You're dealing with a very difficult population to implement new things that are not normal to them. And then you add on top of that the criticism of the media and other organizations and traditional baseball people who, any time they see something different, the first reaction is, "This is bad."

The program of sending the people out and eventually changing over a large part of our hitting and pitching coaches and managers, quite frankly, to be a bit more open-minded, progressive group is when our implementation started to take root. And it's going to provide us an advantage for the next five to ten years. To be able to change people's behavior on the field and how they assess new information and use new technologies is very, very difficult to do. It's been painful, and it's taken a long time, but it's going to be hard for other clubs to copy that.

The *Quarterly*: *What other organizational changes have you made?*

Jeff Luhnow: Traditionally, there are silos in baseball. You've got your player-development silo with all your minor-league teams and your staffing and farm director who helps manage the flow of players and coaches through that pipeline. You've got your scouting department, which is focused on the amateur world of high-school players and college players. You have your international department, which has a lot of scouting and a little bit of player

JEFF LUHNOW

Vital statistics
Born in 1966 in
Mexico City, Mexico

Married, with 3 children

Education
Graduated with dual BSs in
economics and engineering
from the University of
Pennsylvania

Earned an MBA from
the Kellogg School
of Management at
Northwestern University

Career highlights
Houston Astros
(2011–present)
General manager

St. Louis Cardinals
(2007–11)
Vice president of scouting
and player development

(2005–07)
Vice president of player
procurement

(2003–05)
Vice president of baseball
development

McKinsey & Company
(1993–99)
Consultant

development. Then you have your pro scouting department, which looks at other pro players that you might want to trade for. All of these silos are baseball functions. But now you've got an ever-growing sports-medicine group, and a front-office group, which has some economics in there—sort of the general-management group.

Those functions have to work together seamlessly, and there was a lot of cross-functional reorganization that we really had to think through. And every year, we continue to struggle with that to a certain extent. But we've gotten to the point where we have a collaborative senior-management group, all of whom have different areas of responsibility but who work very collaboratively together. Structurally, we've changed the way we're organized at the top and how it flows all the way down to the affiliates and down to the players.

Now, there's a group that covers international player acquisition, domestic player acquisition, and pro player acquisition, so our acquisition philosophy permeates and is led by the same person for all those areas. There's a development group that not only works on the development of a 16-year-old kid in our academy in the Dominican Republic, but also works on the development of Justin Verlander or Dallas Keuchel at the big-league level, because there

are similarities between what we're asking some of them to do and the technologies we're using. What we're doing shouldn't be based on level, it should be based on opportunity to improve. Then there's a sports-medicine-and-performance group, which includes not only the essential medical areas but now gets into mental-skills training and how we develop the mental skills of our athletes, the conditioning aspect of it, and strength building. There's a lot of technology around all the medical areas that are changing the game very rapidly.

The *Quarterly*: *What major changes do you see on the horizon?*

Jeff Luhnow: Big data combined with artificial intelligence is the next big wave in baseball, and I think we're just starting to scratch the surface. It's an area that I consider to be highly proprietary, so I don't discuss it in front of my competition. But we're making a big investment in this area. I think other clubs are as well. There's so much being captured. There's radar and video at every facility in baseball now, not just the major leagues but the minor leagues, colleges, starting to go into high schools.

We know what every person is doing on the field at all times. We know what the bat and the ball are doing on the field at all times. We now have information we didn't dream we'd have a few years back. Developing models from all that information is going to be critical to the success of teams going forward. They can gain an edge—and an edge in terms of not only being first to use that technology but being able to implement it more quickly than the other teams. Because any edge we get, we know it's just a matter of time before the other clubs catch up.

The *Quarterly*: *So how can you stay ahead?*

Jeff Luhnow: It's speed and speed of evaluation and implementation. Those are the key success factors for us. We talk internally about being on the "bleeding edge." We know we're going to have some cuts, some nicks, some bruises—because if we're not, it's similar to base running. If you have a player on first, and he never gets thrown out at third on a single to right field, he's not being aggressive enough. If you don't ever get thrown out at third, you're leaving runs on the table. I consider it the same way in terms of how quickly we implement new technologies and try and squeeze out a competitive advantage. If we're not making some mistakes along the way, we're not being aggressive enough.

"We now have information we didn't dream we'd have a few years back. Developing models from all that information is going to be critical to the success of teams going forward."

If you wait for it to be obvious, it's going to be too late. You have to be first. You have to create an advantage for yourself. If you're not looking at what's coming down the road—and technology and data are so important—somebody else is going to. Then you're going to think to yourself, "That should've been us. That should've been our company out there first. We should've figured it out." Being a fast follower maybe works in some cases, but you've either got to be the first one in or a fast follower in order to really capture the benefits of it. Waiting can only be harmful. All you'd be doing is catching up to the leaders.

The *Quarterly*: *Do you try to combine the analytics, the head, and the heart within the organization to make better decisions?*

Jeff Luhnow: There's always going to be a place for experience and judgment and wisdom in baseball in terms of evaluating players. There are so many soft components to what makes players great—leadership, desire, will, ability to overcome obstacles—a lot of things that you can sort of put a science around it in the mental-skills area, but it's hard, and we are always going to rely on our coaches and our scouts and our human beings who are out with these players to give us their opinion, because their opinion really does matter. And we've proven that when you combine the information from the technology and analytics with the human opinion, you get the best possible result. Either one separately gives you suboptimal results.

The key is how do you combine them? That's much easier said than done. We give expert opinion more weight with high-school players because we don't have the analytics and the information or the track-record part of the information for high-school players that we would for a player who's been three years in the SEC [Southeastern Conference] and played two summers

on the Cape.[3] We have a lot of data that tells us what type of player that player is going to become.

Combining those in a systematic way is important. So is communicating how we're using the information. We want to help folks understand why we actually used their recommendation, and it did nudge this player up the draft board a little, but the player didn't get nudged enough for us to want to take him over some other player. We want a lot of feedback loops going back the other way to the humans that are doing the work for us, and over time, exposing them to more and more of the process and the results.

The *Quarterly*: *So the process generates high-quality results.*

Jeff Luhnow: The right answer is to continue to measure the things that really matter. What are the drivers of success for you in the future, and are those things tracking the way they should be, and is there a way to accelerate those? If you're going to make fast decisions, you need to make sure you understand what the roadblocks are going to be, what the obstacles are going to be, how you're going to overcome them. It's about having the right people and making sure that you have all the dissenting points of view presented together in order to make a decision.

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[3] The SEC is a group of 14 universities, primarily in the southern United States, and is a leader in college athletics, including baseball. The Cape refers to the Cape Cod Baseball League, a summer baseball league in Cape Cod, Massachusetts, in which top collegiate baseball players are selected to compete.

That also means being able to stop doing things that were in the pipeline that are no longer valuable. That's just as important because they use up resources, and as soon as that project is no longer as valuable as one of the ones that's being proposed, you have to make that decision. Just because something has been worked on in the past doesn't mean it should in the future. Frequent communications among people making the decision, with all the right information, helps speed up the decision. And as our people see that the decision that the organization did make was actually better than the decision they would've made had they been in charge, that's when you start to build up confidence that the system, as a whole, is working. ⓠ

Jeff Luhnow is the general manager of the Houston Astros. This interview was conducted by Aaron De Smet, a senior partner in McKinsey's Houston office, and Allen Webb, editor in chief of *McKinsey Quarterly*, who is based in the Seattle office.

This interview is the first of a two-part series with Jeff Luhnow. Part two, "A view from the front lines of baseball's data-analytics revolution," available on McKinsey.com, is aimed at baseball fans, whose ability to grasp the modern game depends on understanding of analytics' growing role.

"We now have so much technology around the ballpark and information about the trajectory of the ball, the physics of the bat swing, the physics and the biomechanics of the pitcher's delivery—so many components that it's, quite frankly, overwhelming to figure out how to analyze all that information, work through it, and come up with the takeaways that will allow you to make better predictions about what players are going to do in the future on the field."

MAKING SMALL TEAMS WORK

Unleashing the power of small, independent teams

Small, independent teams are the lifeblood of the agile organization. Top executives can unleash them by driving ambition, removing red tape, and helping managers adjust to the new norms.

by Oliver Bossert, Alena Kretzberg, and Jürgen Laartz

What does it take to set loose the independent teams that make agile organizations hum? These teams are the organizational units through which agile, project-based work gets done. The typical agile company has several such teams, most composed of a small number of people who have many or all of the skills the team needs to carry out its mission. (Amazon CEO Jeff Bezos contends that a team is too big when it needs more than two pizza pies for lunch.) This multidisciplinary way of composing teams has implications for nearly every business function. Take IT management. Instead of concentrating technology professionals in a central department, agile companies embed software designers and engineers in independent teams, where they can work continually on high-value projects.

While much depends on the actions of the individual team members, senior executives must thoughtfully create the environment in which teams and their managers can thrive. In a nutshell, senior executives must move the company—and themselves—away from outmoded command-and-control behaviors and structures that are ill-suited to today's rapid digital world. They must redouble efforts to overcome resource inertia and break down silos, because independent teams can't overcome these bureaucratic challenges on their own. They must direct teams to the best opportunities, arm them

with the best people, give them the tools they need to move fast, and oversee their work with a light but consistent touch. These ideas may sound straightforward, but they go overlooked by too many leaders who've grown up in more traditional organizations.

This article explores how senior leaders can unleash their companies' full potential by empowering small teams and supporting their managers, whose roles have been redefined by agile thinking (exhibit). Let's start with a glimpse of what that looks like in action.

HOW INDEPENDENT TEAMS WORK

Several years ago, financial regulators in Europe decided to let banks verify customers' identities remotely through digital video chats instead of relying solely on face-to-face appointments at bank branches. When the news reached one established bank, the team in charge of its know-your-customer (KYC) process recognized that the regulatory change could help the bank win new accounts. It quickly sprang into action to create the needed service. The very existence of this KYC team was a credit to the bank's leaders, who had previously put small, independent teams to work—improving the performance of many of the bank's functions by giving them the diverse capabilities needed to address market opportunities like this one. The bank had simultaneously made a series of complementary reforms to remove cumbersome approval, budgeting, and governance processes. Without these institutional refinements, the KYC team's time to market would have been far less competitive.

Critically, senior executives had endowed small, focused groups like the KYC team with the authority and the resources to carry out projects without first seeking corporate approval. When it came to paying for the development of the digital KYC service, the team was spared the trouble of making a formal budget request and enduring a months-long holding period while the corporate planning committee took up the request as part of its regular planning process. Instead, the team drew on a tranche of funding that it had already been given, funding tied to the team's contribution to outcomes such as higher customer-conversion rates.

The bank also loosened or completely unhitched its product teams' dependence on internal support functions. New accommodations in the bank's HR processes, for example, allowed the KYC team to quickly line up outside contractors for help with front- and back-end development, without waiting for those contractors to be vetted. The IT function had streamlined the

bank's technology systems and operations, too, building a modern architecture platform to more easily connect new customer-facing services with legacy back-end systems. The bank had also eliminated its traditional waterfall-development process, as well as a no-compromises protocol for testing new products before launch. Previously, a central IT group would have had to integrate the digital KYC service with core systems, a drawn-out process that could have stalled the KYC team for months. But now the KYC team could integrate testing with work flows, roll out new services as soon as they were viable, and make incremental improvements over multiple cycles. Together, these reforms allowed the KYC team to develop the new digital services in a matter of weeks, rather than the months it would have taken before the reorganization.

Senior company executives had an integral place in this process, despite the independence they had accorded teams like KYC. They evaluated progress and allocated resources according to whether teams deliver against well-defined measures of performance. But they only intervened in the team's ongoing work from time to time, and then only to remove roadblocks and provide support. By creating a supportive structure and managing it with a light touch, senior bank executives fostered this kind of innovative spirit in teams all across the institution.

Exhibit

The effectiveness of small teams requires change in both the corporate environment and managers' interactions with the teams.

The **empowering** executive	The **independent** team	The **enabling** manager
Focuses small teams in customer-facing areas	Is authorized to conduct activities without first seeking approval	Defines outcomes for teams to pursue as they see fit
Stacks small teams with top performers	Has minimal dependencies on internal functions	Acts as a steward rather than a superior
Gives teams a clear, direct view of customers	Builds and launches digital solutions on its own	Prioritizes problem solving over decision making
Allocates resources up front, then holds teams accountable	Draws on preassigned funding with no formal budget request	Spends more time than usual on coaching and learning

HOW EXECUTIVES EMPOWER INDEPENDENT TEAMS

The challenge for senior executives in an agile organization is clear but difficult: empower small teams with great independence and resources while retaining accountability. As our colleagues have written,[1] an agile organization speeds up decision making by allowing teams that are closer to customers to make day-to-day, small-stakes decisions on their own, and only escalating decisions that could have significant consequences or that can only be made effectively with input and sign-off from multiple parts of the organization. Executives further empower teams by lessening their dependence on support functions such as finance, planning, and human resources. Yet executives still must ensure that teams operate with proper governance, that company resources are aligned in pursuit of strategic priorities, and that midlevel managers get the coaching they need to become better versed in agile ways of working. Our experience helping companies with the transition to agile ways of working suggests emphasizing the following actions:

Unleash independent teams in meaningful areas

We've argued that autonomy is especially beneficial to teams working on processes and capabilities that directly affect the customer experience. When executives begin to give their small teams more independence, they should look first at teams that are responsible for features that matter greatly to customers. This way, executives can demonstrate how independence helps teams generate more value. (Skeptics may challenge this approach on the grounds that a new, untested way of managing teams is too risky to try in significant customer-facing areas. In practice, independent teams create less business risk, because they make incremental changes that can be rolled back with ease if they don't work out.) It's also important that executives choose teams of people who represent different capabilities. When multiple domains of the company take part in independent teams, executives and managers can test the limits of the decision-making authority that these domains extend to teams, and demonstrate that autonomous teams can be trusted to exercise good judgment.

Put strong performers on independent teams, especially at the outset

Executives can be reluctant to place their best-performing employees on independent teams that aren't mission critical, because they would rather keep them engaged in "more important" activities. We hold the opposite view: that independent teams are too important to the company's future for

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[1] See Aaron De Smet, Gerald Lackey, and Leigh M. Weiss, "Untangling your organization's decision making," *McKinsey Quarterly*, June 2017, McKinsey.com.

top performers to be deployed elsewhere. Executives whose companies have been through agile transformations say much the same thing. In an interview with McKinsey,[2] Scott Richardson, chief data officer at Fannie Mae, said, "Creating a new team is probably the most important thing managers can do, so make sure you get it right. When we created our initial agile teams, I was personally involved with structuring them and selecting team members. It might sound crazy to get so involved in this level of detail, but it is critical that the early teams become true beacons for success." Choosing high-caliber people not only sets up the teams to be successful but also teaches managers how to build more independent teams. "By the fourth or fifth team," Richardson continued, "my direct reports knew what questions to ask and how to structure a proper team, and they could scale up on their own from that point forward."

Provide teams with a clear view of their customer

At digital-native companies and agile incumbents, an unwavering focus on improving customer experiences provides each independent team, regardless of its area of responsibility, with a consistent understanding of business priorities. Each team's job is simple: to generate small but frequent improvements in the quality of the customer's experience. Executives foster this shared sense of purpose by making sure that every team has a clear, unobstructed view of customers.

In the offices of one international retailer, real-time data on the customer experience is on display almost everywhere you go. Walk through the dining hall: oversized screens on the walls bear the latest conversion rates for each of the company's sales channels. Visit an independent team's workspace: screens are lit up with measures of customer behavior and satisfaction that relate to the team's responsibilities, such as revising the script that call centers follow or tinkering with the layout of the web storefront. At any moment during the workday, a product manager might drop by a team room to see what the team is working on, ask how customers are responding, and offer to help.

So that each independent team can track the customer experience in ways that are relevant to its work, companies might need to loosen their governance of data. A "canonical data model" that standardizes the classification of data across the entire company can cause inadvertent delays because all teams have to agree on changes to the model that are required to capture new

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2 See "How to go agile enterprise-wide: An interview with Scott Richardson," August 2017, McKinsey.com.

kinds of data or reclassify existing data. To avoid these complications, independent teams are ideally allowed to work with and define data within their business context.

Allocate resources up front, then hold teams accountable

At most companies, teams that work on customer-facing products and services will almost always find a way to obtain the approvals, funds, information, and staff they need for new projects. Scarcity isn't the main problem—slowness is. To eliminate delays in the work of independent teams, executives should assign them all the resources they need to do their work up front: the authority to make key decisions, the ability to quickly hire new talent or secure contractors without going through standard human-resources or procurement processes, the money to cover operating expenses, and so on. These resources should include tools for building and launching whatever digital solutions might be needed to streamline customer journeys or business processes. This kind of self-service approach to application development also requires modular, lightly connected IT architectures, which allow companies to continually develop new applications in a flexible way—an approach one might call "perpetual evolution."[3]

The less dependent on other stakeholders small teams are, the more quickly they can get things done. And since teams invariably encounter unforeseen obstacles, such as a blanket policy preventing them from using public-cloud services, executives have to be there to help. Executives who sponsor the independent teams and make time to hear about their progress and understand their difficulties can push for additional reforms that will keep all independent teams on the fast track.

Once executives have given independent teams more resources and more authority, they need to make sure that those teams are consistently advancing the business's broader strategic priorities. As we'll discuss below, one role for managers in an agile organization is to help independent teams choose the outcomes they will pursue and measure their achievements in precise, meaningful terms. It's the job of top executives to hold teams accountable for delivering those outcomes—and to quickly allocate resources away from disappointing endeavors and toward successful ones. McKinsey research[4] has found that tying budgets to strategic plans is more closely correlated

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[3] See Oliver Bossert and Jürgen Laartz, "Perpetual evolution—the management approach required for digital transformation," June 2017, McKinsey.com.

[4] See "The finer points of linking resource allocation to value creation," March 2017, McKinsey.com.

with higher growth and profitability than any other budget-allocation practice that is linked to superior performance.

HOW EXECUTIVES CAN EMPOWER THE AGILE MANAGER

If the company's squads are going to operate at maximum speed, midlevel managers must learn and practice behaviors that let those units operate in a genuinely agile manner. (See the companion article, "The agile manager," on page 76.) But if these managers are going to encourage and enable team members, they themselves have to be become well versed, and comfortable, with agility. This won't be an easy task for managers accustomed to the more predictable set of tasks they performed in a command-and-control hierarchy. Senior executives must ensure that these managers learn and embrace new ways of interacting with teams. Here are three behaviors that executives should try to encourage in managers working with small teams:

Define outcomes, then let teams chart their own path toward them

Corporate leaders at agile companies put teams in charge of product features or components of their customer's journey and give them the freedom to decide the specific improvements that should be made. An effective manager in this context will determine what the business outcomes should be, based on the company's overall priorities, and will spell it out for the team using real-world measures of business performance such as conversion rates or audience engagement. Then, rather than dictating the steps a team should take toward those outcomes, the manager must allow the team to chart its own process, intervening only when the team discovers a problem or a need that it can't address on its own.

One retailer greatly increased the pace at which it enhances customer-facing services by giving more authority to a group of small, independent teams. The retailer made the desired business outcome crystal clear: improve conversion rates by 30 percent. But the specifics of how to make that happen were left to the teams. One team responsible for the company's email campaigns decided to test whether targeting smaller groups of customers with highly specialized product offers and sales announcements would lead to more conversions. The team decided to run a trial of the new campaign against a traditional one, and the results were good. That was all the proof it needed to adopt the new approach. No formal proposals or budget discussions or senior-management approvals were required—in fact, any of those steps could have slowed down or derailed the process altogether.

Step inside independent teams to enable their success

Independent teams typically hold a daily "stand-up" meeting of around 20 minutes to review their activities, plans, and difficulties. Then they spend most of their day on productive tasks, rather than administrative ones such as writing formal progress updates.

This manner of working can require major adjustments from managers. They may find their skills in areas like planning and decision making are less needed, while other capabilities, such as communication and problem solving, must be exercised more frequently. Not every manager will welcome the pressure to adapt. Some might start updating their résumés.

Top leaders should encourage these cautious managers to step inside their independent teams. They should join the daily stand-up meetings to hear what the team is doing or try to troubleshoot situations in real time over agile-friendly platforms such as Jira and Slack. Most managers who actively engage in this way come to appreciate the agile approach. An agile organization largely relieves managers of tasks like allocating staff and resources and mapping out projects. Instead, it can spend more time on higher-value activities: applying expertise to long-term matters, coaching team members and peers, and helping teams work around obstacles.

A top-performing software developer at a rather traditional company that was still engaged in the waterfall style of software development passed up several promotions that would have put him in charge of development teams. He preferred grappling with technical challenges and writing code to managing people. But after the company reorganized its customer-facing functions into independent teams, his prospects changed considerably. He continues to work as a developer, but he also leads a network of coaches who teach the company's independent teams to follow agile ways of working. The new job combines technical assignments with the responsibility to share his expertise in agile development—and has none of the traditional management tasks that he had long avoided.

Commit to retraining managers for their redefined roles

Outside the IT function, managers who understand agile ways of working can be hard to find at traditional companies. To fit in with highly independent teams, most managers will need some help to learn how to organize their thinking around products rather than processes; to direct teams with performance goals instead of work plans; and to position themselves as stewards, not superiors. Executives can, and should, make sure that their

managers have opportunities to develop these behaviors and habits of mind. They can see that managers are taught to use new tools, from collaboration software to analytics engines. They can encourage managers to rotate through assignments with various independent teams, which promotes constant learning. They should pair them with fellow managers who have more experience working with independent teams and let them see how these peers behave. And they can change the way they evaluate managers' performance, placing more emphasis on measurable outcomes and gauging their impact through 360-degree reviews.

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Alfred Chandler, the renowned business historian, famously observed that structure follows strategy: companies set their strategies, then organize themselves in a way that lets them carry out their strategies to full effect. But pressure from fast-moving digital natives and digitally transformed incumbents means that traditional businesses no longer have time to rethink their strategies and reorganize themselves every few years. To promote enterprise agility, more companies are choosing to make small teams their basic organizational unit. Problems occur, however, when companies don't give their small teams enough autonomy to work at the speed required by the digital economy. Executives can change this by giving the teams the resources they need, by eliminating red tape, and by encouraging managers to learn, adopt, and enact the more flexible governance methods of agile organizational approaches. Those who do will see their small teams become more independent, and more capable of producing innovations and performance gains that keep their businesses ahead of the competition. Ⓠ

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The agile manager

Who manages in an agile organization? And what exactly
do they do?

Aaron De Smet

The agile workplace is becoming increasingly common. In a McKinsey
survey of more than 2,500 people across company sizes, functional specialties,
industries, regions, and tenures, 37 percent of respondents said their
organizations are carrying out company-wide agile transformations, and
another 4 percent said their companies have fully implemented such
transformations. The shift is driven by proof that small, multidisciplinary
teams of agile organizations can respond swiftly and promptly to rapidly
changing market opportunities and customer demands. Indeed, more than
80 percent of respondents in agile units report that overall performance
increased moderately or significantly since their transformations began.

These small teams, often called "squads," have a great deal of autonomy.
Typically composed of eight to ten individuals, they have end-to-end
accountability for specific outcomes and make their own decisions about
how to achieve their goals. This raises an obvious and seemingly mystifying
question for people who have worked in more traditional, hierarchical
companies: Who manages in an agile organization? And what exactly does an
agile manager do?

LAY OF THE LAND
The answers become clear once you understand that the typical agile
company employs a dynamic matrix structure with two types of reporting

lines: a capability line and a value-creation line. Nearly all employees have both a functional reporting line, which is their long-term home in the company, and a value-creation reporting line, which sets the objectives and business needs they take on in squads.

In agile parlance, the capability reporting lines are often called "chapters" and are similar in some ways to functions in traditional organizations (you might have a "web developers" chapter, say, or a "research" chapter). Each chapter is responsible for building a capability: hiring, firing, and developing talent; shepherding people along their career paths; evaluating and promoting people; and building standard tools, methods, and ways of working. The chapters also must deploy their talented people to the appropriate squads, based on their expertise and demonstrated competence. In essence, chapters are responsible for the "how" of a company's work. However, once talent is deployed to an agile team, the chapters do not tell people what to work on, nor do they set priorities, assign work or tasks, or supervise the day-to-day.

The value-creation reporting lines are often called "tribes." They focus on making money and delivering value to customers (you might have a "mortgage services" tribe or a "mobile products" tribe). Tribes are similar to business units or product lines in traditional organizations. Tribes essentially "rent" most of their resources from the chapters. If chapters are responsible for the "how," tribes are responsible for the "what." They set priorities and objectives and provide marching orders to the functional resources deployed to them.

MANAGEMENT ROLES

In this world, the work of a traditional midlevel manager is reallocated to three different roles: the chapter leader, the tribe leader, and the squad leader. Let's examine the responsibilities of each and the challenges they pose for traditional managers looking to become agile managers.

The chapter leader

Every functional reporting line has a leader. This chapter leader must build up the right capabilities and people, equip them with the skills, tools, and standard approaches to deliver functional excellence, and ensure that they are deployed to value-creation opportunities—sometimes in long-term roles supporting the business, but more often to the small, independent squads. The chapter leader must evaluate, promote, coach, and develop his or her people, but without traditional direct oversight. Chapter leaders are not

involved in the day-to-day work of squads; they don't check on or approve the work of their chapter members, and they certainly don't micromanage or provide daily oversight. Instead, regular feedback from tribe leaders, team members, and other colleagues inform their evaluations and the kind of coaching they provide. Since they're not providing direct oversight, their span of control can expand greatly, a fact that can eliminate several layers of management. In fact, chapter leaders often free up enough time to tackle "real work" on business opportunities as well.

The most difficult challenges facing new chapter leaders are letting go of the day-to-day focus, and shifting attention to building the right capabilities and helping match talent to the right roles and value-creation opportunities. Traditional managers are accustomed to closer oversight of their people. But if they can let go, they will find themselves in jobs that call on more of their leadership and creative talents. Not only can they join squads occasionally, but they can optimize their chapter-leader role in interesting ways. For example, if a company reconfigures squads frequently, reallocating talent to different roles or teams, the chapter leader might create and manage a backlog of "nice to have" functional work that his talent can help with in between their deployments.

The tribe leader

Since these value-creation leaders borrow or rent most of their resources from the chapters, they no longer bear the burden of building up their own functional capabilities. Instead, tribe leaders act as true general managers, mini-CEOs focused on value creation, growth, and serving customers. They must develop the right strategies and tactics to deliver desired business outcomes and to determine what work needs to get done, how much to invest in which efforts, and how to prioritize opportunities. They work with chapter leaders to match the right people to the right squads.

Like chapter leaders, tribe leaders manage less and lead more. Since they have profit-and-loss accountability, they must develop a strategic perspective on their business and their customers, a cross-functional view of the core capabilities of the broader organization (so they can efficiently secure the resources they need from chapters), and an integrated perspective of the company as a whole and how their part of the business fits in with the larger enterprise. Those who succeed will develop more of a general-manager skill set and an enterprise mind-set that can break down silos, enable collab-

oration across organizational boundaries, and empower product owners to provide day-to-day guidance on objectives, priorities, and tasks.

The most difficult challenges for traditional managers tackling the tribe-leader role are letting go of the need to fully "own" all the people working for them, as well as shifting attention from micromanaging the day-to-day work to developing the right business strategies, setting the right objectives and priorities, and making the right business decisions. Tribe leaders must also wrestle with their reliance on getting their talent from chapters. They must resist the urge to build their own set of resources and create shadow functions so they never lack what they need when they need it. That end-around scuttles the agile matrix, which relies on healthy tensions and constructive conflict to get the right capabilities to the right opportunities at the right time.

The squad leader

Team leaders, or "squad" leaders, serve a crucial purpose in the agile matrix. They aren't the "boss" of the people on their team. They help plan and orchestrate execution of the work, and they strive to build a cohesive team. They also provide inspiration, coaching, and feedback to team members, report back on progress to tribe leaders, and give input on people development and performance to relevant chapter leaders. Think of squad leaders as individual contributors who have developed leadership skills or at least developed an interest in learning these skills. The squad-leader role can be more or less formal and can even change over time depending on what the team is working on. Once again, the challenge for someone from a more traditional company is to lead without exerting onerous control. But the rewards can be great. Some squad leaders will grow into tribe leaders, while others will continue as individual contributors with the additional skill of agile leadership.

SOMETHING OLD, SOMETHING NEW

The idea of autonomous teams is not new; it's been around for decades. For instance, in the quality movement that took hold in manufacturing and continuous improvement 50 years ago, quality circles and high-performance work systems often relied on an autonomous self-managed team with an informal team leader who was not technically a boss. More recently, companies such as W. L. Gore (in materials science) and Haier (the Chinese appliance manufacturer) have emphasized the empowerment of small teams, even if they don't use the language we associate with agility—or focus those teams on software development, where agile has made some of its most prominent marks.

Today's agile organizations are building on these ideas (for more on the shift underway, see sidebar, "The agile revolution"). The squad leader is now a part of an agile matrix, where the value-creation, or tribe, leaders provide constant direction and prioritization around where the value is, and the capability, or chapter, leaders focus on ensuring deep functional expertise, common tools and competencies, and economies of scale

THE AGILE REVOLUTION

Conceiving of the organization as an organism rather than a machine lies at the heart of the gathering trend toward more agile companies. But what does this look like? In a collaborative effort comprising a series of agile "sprints," 50 McKinsey experts from the firm's digital, operations, marketing, and organization practices recently spelled out the nature of these changes—both the overall paradigm shift, as well as five critical shifts that "traditional" organizations must encourage in the mind-sets of their people. A thumbnail sketch appears below, and the full report, "The five trademarks of agile organizations," is available on McKinsey.com.

The agile organization is dawning as the new dominant organizational paradigm.

Rather than organization as machine,
the agile organization is a **living organism**

From organizations as "machines" ...

Top-down hierarchy

Bureaucracy

Detailed instruction   Silos
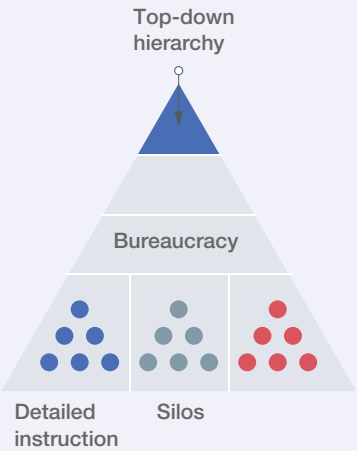
... to organizations as "organisms"

"Boxes and lines" less important, focus on action

Quick changes, flexible resources

Leadership shows direction and enables action

Teams built around end-to-end accountability
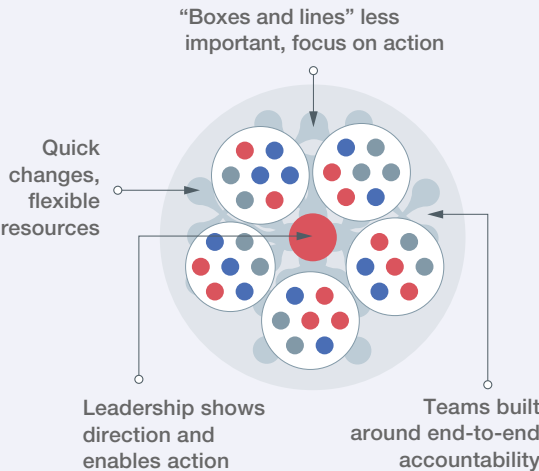
and skill. If these leaders can become effective, nonintrusive managers, the agile company will enjoy the best of both worlds: the benefits of size and scale typically realized in large organizations, as well as the benefits of speed and nimbleness often associated with small entrepreneurial start-ups. Ⓠ

Aaron De Smet is a senior partner in McKinsey's Houston office.

Mind-set shift 1: A strategic North Star embodied across the organization

From	To
In an environment of scarcity, we succeed by capturing value from competitors, customers, and suppliers for our shareholders.	Recognizing the abundance of opportunities and resources available to us, we succeed by cocreating value with and for all of our stakeholders.

Mind-set shift 2: A network of empowered teams

From	To
People need to be directed and managed, otherwise they won't know what to do—and they'll just look out for themselves. There will be chaos.	When given clear responsibility and authority, people will be highly engaged, will take care of each other, will figure out ingenious solutions, and will deliver exceptional results.

Mind-set shift 3: Rapid decision and learning cycles

From	To
To deliver the right outcome, the most senior and experienced individuals must define where we're going, the detailed plans needed to get there, and how to minimize risk along the way.	We live in a constantly evolving environment and cannot know exactly what the future holds. The best way to minimize risk and succeed is to embrace uncertainty and be the quickest and most productive in trying new things.

Mind-set shift 4: A dynamic people model that ignites passion

From	To
To achieve desired outcomes, leaders need to control and direct work by constantly specifying tasks and steering the work of employees.	Effective leaders empower employees to take full ownership, confident they will drive the organization toward fulfilling its purpose and vision.

Mind-set shift 5: Technology as enabler

From	To
Technology is a supporting capability that delivers specific services, platforms, or tools to the rest of the organization as defined by priorities, resourcing, and budget.	Technology is seamlessly integrated and core to every aspect of the organization as a means to unlock value and enable quick reactions to business and stakeholder needs.
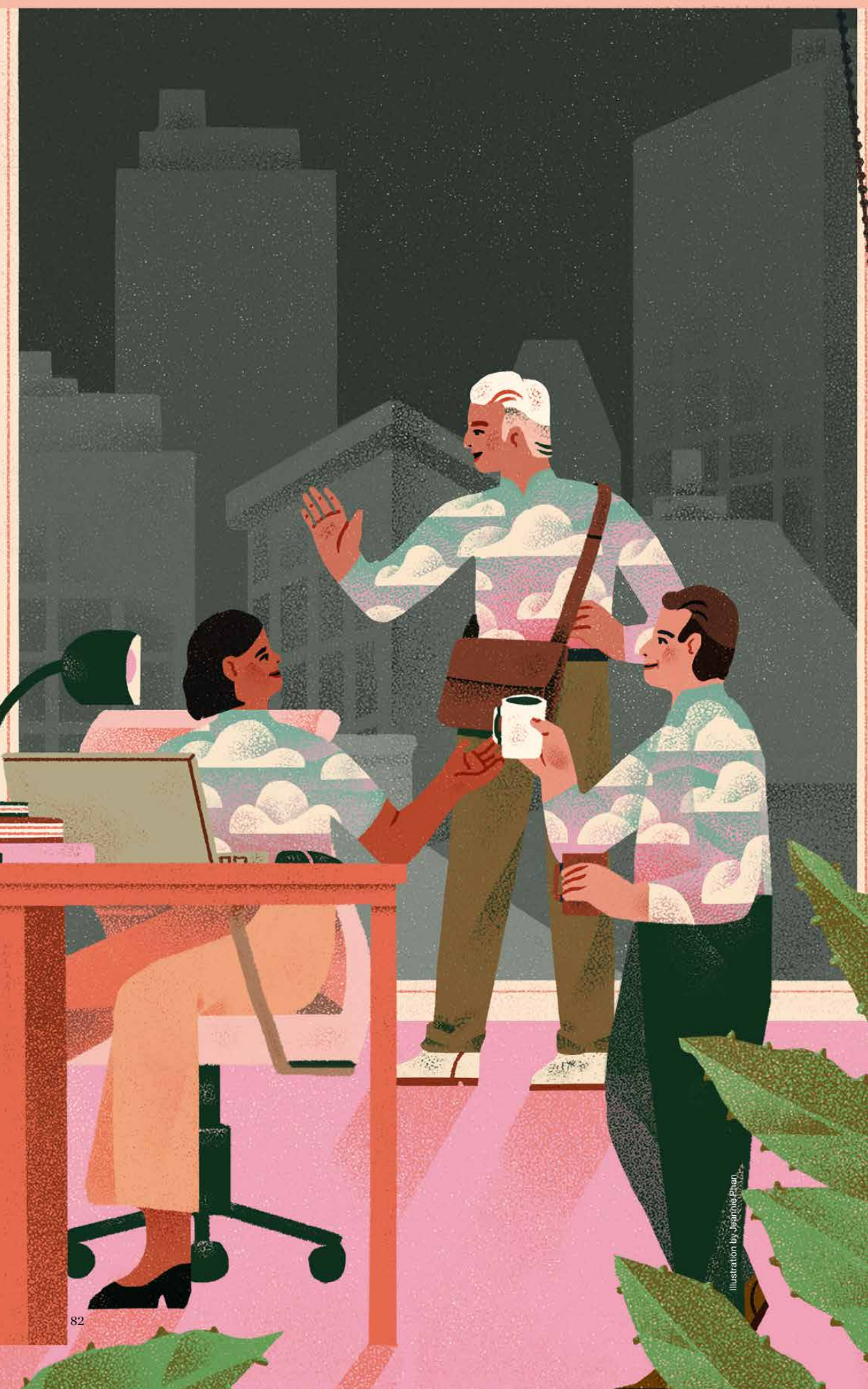
The overlooked essentials of employee well-being

If you really want to increase employees' health and well-being, focus on job control and social support.

by Jeffrey Pfeffer

Workplace stress is exacting an ever-higher physical and psychological toll. It adversely affects productivity, drives up voluntary turnover, and costs US employers nearly $200 billion every year in healthcare costs. Many companies are aware of these negative effects, and some have gotten busy devising ways to counteract them. Efforts range from initiatives to encourage sleep, exercise, and meditation to perks such as nap pods and snack bars.

In the midst of all this activity, it's easy to overlook something fundamental: the work environment, starting with the work itself. For many years, a number of researchers, including myself, have touted the benefits of better work practices for performance and productivity. In my new book, *Dying for a Paycheck* (HarperCollins, 2018), I've tried to show how two critical contributors to employee engagement—job control and social support—also improve employee health, potentially reducing healthcare costs and strengthening the case for them as a top management priority.

In this article, I'll explore the research that connects these two elements to employee health, and describe some examples of organizations that *are* succeeding at providing the autonomy, control, social connections, and support that foster physical and mental well-being. Any company, in any industry, can pull these levers without breaking the bank. Today, though, too few do.

JOB CONTROL

Studies going back decades have shown that job control—the amount of discretion employees have to determine what they do and how they do it—has a major impact on their physical health. Recent research also indicates that limited job control has ill effects that extend beyond the physical, imposing a burden on employees' mental health, too. Organizations can guard against these dangers by creating roles with more fluidity and autonomy, and by erecting barriers to micromanagement.

Physical and mental health

One of the most notable research efforts in this area was the Whitehall Studies, conducted by British epidemiologist Michael Marmot and his team, which examined employees within the British Civil Service. Marmot's team discovered that the higher someone's rank, the lower the incidence of, and mortality from, cardiovascular disease. Controlling for other factors, it turned out that differences in job control, which were correlated with job rank, most accounted for this phenomenon. Higher-ranked British employees, like higher-ranked employees in most organizations, enjoyed more control over their jobs and had more discretion over what they did, how they did it, and when—even though they often faced greater job demands.

Additional Whitehall data related work stress, measured as the co-occurrence of high job demands and low job control, to the presence of metabolic syndrome, a cluster of risk factors that predict the likelihood of getting heart disease and type 2 diabetes. Employees who faced chronic stress at work were more than twice as likely to have metabolic syndrome compared with those without work stress.

Other research has also found a relationship between measures of job control and health. A study of 8,500 white-collar workers in Sweden who had gone through reorganizations found that the people who had a higher level of influence and task control in the reorganization process had lower levels of illness symptoms for 11 out of 12 health indicators, were absent less frequently, and experienced less depression. And that's far from the only example of job control affecting mental- as well as physical-health outcomes. For example, a study of individuals at 72 diverse organizations in the northeastern United States reported statistically significant, negative relationships between job control and self-reported anxiety and depression.[1]

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[1] Chester S. Spell and Todd Arnold, "An appraisal perspective of justice, structure, and job control as antecedents of psychological distress," *Journal of Organizational Behavior*, August 2007, Volume 28, Number 6, pp. 729–51.

Learning, motivation, and performance

During my research, peoples' stories painted a vivid picture of how low job control is all too common in many offices today. I heard much about the ever-evolving performance-evaluation criteria that made it tough to know how to succeed; the business trips rearranged without explanation; and even about a workplace "scout" who had to discern the boss's mood and alert the others.

The picture isn't pretty, and it can be costly. A chaotic workplace environment of frequent, uncontrollable events adversely affects people's motivation, their cognition and learning, and their emotional state. If, through their actions, people cannot predictably and significantly affect what happens to them, they are going to stop trying. Why expend effort when the results of that effort are uncontrollable, rendering the effort fruitless?

That's why research shows that severing the connection between actions and their consequences—leaving people with little or no control over what happens to them at work—decreases motivation and effort. It significantly hampers learning on the job, too. People's ability to learn by observing the connection between actions and their consequences normally permits them to attain some degree of mastery over their environment—an understanding of what they must do to achieve the desired results. In a condition of low job control, on the other hand, people have less responsibility and discretion, which undermines their feelings of competence and accomplishment and ultimately contributes to stress, anxiety, and depression.

Simple steps toward control and autonomy

When you're a child, the people in your life—teachers, parents—tell you what to do. As you get older, you begin to make your own life choices. And then one day, you get a job. Depending on your boss, your employer, and the design of your work, your choices about what to do and how to do it, at least while at work, can disappear—leaving you more stressed, more vulnerable to ill health, and, sometimes, less than yourself. There are some straightforward actions companies can take to avoid creating such an environment.

Guard against micromanagement. Micromanaging is all too common at work, simply because many managers are poor at coaching and facilitating others to do their jobs better. When managers micromanage their subordinates, those individuals lose their autonomy and sense of control to the bosses who won't delegate.

Work doesn't have to be this way. The founder of Patagonia, Yvon Chouinard, thought of the company as a place where "everyone kind of knows the

role that they need to do, and does that work independent of extreme management." He leads using a principle he calls "management by absence." The company reduces the risk of micromanagement by having a flat organizational structure, with more people than any manager could possibly micromanage even if he or she wanted to. Similarly, at Zillow, as a learning-and-development person there put it, "the manager's role is to support the team and be there to help remove roadblocks, not to be the dictator." The head of human resources at Landmark Health agreed, saying, "If somebody feels like the work that they're doing is not valued, if they personally don't feel like they have a voice at the table, if they feel like they're dictated to or micromanaged, they're going to feel less fulfilled and more tired."

Incorporate more autonomy and fluidity into every role. People often believe that providing job control is possible only for some jobs, and for some people. But that is not the case—all people can be given more decision-making discretion in their jobs and latitude to control their work. San Francisco–based Collective Health designed the jobs of its "patient advocates"—who answer the phones to resolve customer issues that aren't readily solved—with a simple goal in mind: create a more empowered, highly skilled call-center staff, drawing graduates from top universities. As Andrew Halpert, senior director of clinical and network solutions, explains, "The typical profile is someone who majored in human biology and maybe wants to pursue a medical career, but meanwhile wants a job and to work for an interesting start-up. Then you say, 'How are you going to keep smart people engaged and happy and not burnt out and dissatisfied?'"

Collective Health trains its hires thoroughly on key technical tools, while regularly rotating their physical locations and assigned tasks: one week they may be coordinating benefit issues, and the next solving larger issues outside their department, giving them an overall picture of how everything works. They are continually empowered to solve problems on the floor as they discover them, connecting with other teams in the company. The system has not only increased employee retention by providing people with more interesting and impactful work, it has also proven more efficient at resolving problems. Halpert says the benefits outweigh the extra costs for the company and the customer: "On the 'how much did I pay?' criterion, it looks more expensive. . . . The Collective Health call costs more because it's being handled by someone who is better qualified and better paid who is also spending more time resolving the issue. But we solve problems, unlike other systems where claims and problems just go on with a life of their own."

The Collective Health experience shows how roles can be designed both to improve people's health *and* increase effectiveness for the benefit of employers—in fact, the two can be mutually reinforcing. Jobs that provide individuals more autonomy and control serve to increase their motivation, job satisfaction, and performance—while at the same time making employees healthier and helping them to live longer.

SOCIAL SUPPORT

If job control is one important aspect of a healthy workplace, social support is another. Research going back to the 1970s consistently demonstrates a connection between social support and health. Having friends protects "your health as much as quitting smoking and a great deal more than exercising," even though survey evidence suggests that the "number of Americans who say they have no close friends has roughly tripled in recent decades."[2]

The evidence shows that social support—family and friends you can count on, as well as close relationships—can have a direct effect on health and buffers the effects of various psychosocial stresses, including workplace stress, that can compromise health. For instance, one review noted that "people who were less socially integrated" and "people with low levels of social support" had higher mortality rates.[3]

Unfortunately, workplaces sometimes have characteristics that make it harder to build relationships and provide support. Consider, for example, practices that foster internal competition such as forced curve ranking, which reduces collaboration and teamwork. In fact, anything that pits people against one another weakens social ties among employees and reduces the social support that produces healthier workplaces. Equally destructive are transactional workplace approaches in which people are seen as factors of production and where the emphasis is on trading money for work, without much emotional connection between people and their place of work.

Rooting out practices like these is a good starting point for leaders seeking to build environments with stronger social support. Also invaluable are the following actions, which may sound straightforward and are already practiced by a number of companies but are nonetheless easy to overlook.

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[2] Markham Heid, "You asked: How many friends do I need?," *Time Health*, March 18, 2015, time.com.

[3] Bert N. Uchino, "Social support and health: A review of physiological processes potentially underlying links to disease outcomes," *Journal of Behavioral Medicine*, August 2006, Volume 29, Number 4, pp. 377–87.

Demonstrate commitment to offering help

SAS Institute, often found near the top of "best places to work" lists, is a company whose business strategy is premised on long-term relationships with its customers—and its employees. The company signals in ways large and small that it cares about its employees' well-being. For instance, when a SAS employee died in a boating accident one weekend, a question arose: What would happen to his children, currently enrolled in company-subsidized day care? How long would they be permitted to stay? The answer: as long as they wanted to and were age-eligible, regardless of the fact that they no longer had a parent employed by the company. And perhaps nothing signifies SAS's commitment to its employees' well-being more than its investment in a chief health officer whose job entails not just running the on-site health facility but ensuring that SAS employees can access the medical care they need to remain healthy and to be fully cared for if they get sick.

Encourage people to care for one another

The large healthcare and dialysis company DaVita created the DaVita Village Network to give employees the opportunity, through optional payroll contributions, to help each other during times of crisis—such as a natural disaster, an accident, or an illness. The company provides funding to match employee contributions of up to $250,000 per year. When southwest Florida was hit by a series of hurricanes in 2004, a dialysis administrator noted, "The DaVita Village Network provided our housing while our homes were uninhabitable, and provided funding for food until we were able to get back on our feet."

Fix the language

People are more likely to like and help others with whom they share some sort of unit relationship, to whom they feel similar, and with whom they feel connected. Language in the workplace that emphasizes divisions between leadership and employees can further alienate people and erode any sense of shared community or identity. Ensure that people are less separated by title, and use language that is consistent with the idea of community. DaVita sometimes refers to itself as a "village." The company's CEO often calls himself the "mayor." Employees are constantly referred to as "teammates" and certainly never as "workers," a term that denotes both a somewhat lower status and also people who are distinct from the "managers" and "leaders."

Support shared connections

Almost anything that brings people into contact in a pleasant and meaningful context—from holidays to community service to events that celebrate employee tenure or shared successes such as product launches—helps build a sense of common identity and strengthens social bonds. Southwest Airlines is famous for its Halloween parties. Other organizations offer their employees volunteer opportunities to help local nonprofits. A 2013 UnitedHealth survey found that 81 percent of employees who volunteered through their workplace "agreed that volunteering together strengthens relationships among colleagues."

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Giving people more control over their work life and providing them with social support fosters higher levels of physical and mental health. A culture of social support also reinforces for employees that they are valued, and thus helps in a company's efforts to attract and retain people. Job control, meanwhile, has a positive impact on individual performance and is one of the most important predictors of job satisfaction and work motivation, frequently ranking as more important even than pay. Management practices that strengthen job control and social support are often overlooked but relatively straightforward—and they provide a payoff to employees and employers alike. Ⓠ

Accelerating product development: The tools you need now

To speed innovation and fend off disruption, R&D organizations at incumbent companies can borrow the tools and techniques that digital natives use to get ahead.

by Mickael Brossard, Hannes Erntell, and Dominik Hepp

Between rising customer expectations and unpredictable moves by digital attackers, R&D organizations at incumbent companies are under intense pressure. They're being asked not only to push out innovative products and services—which is key to ramping up organic growth—but also to support the formation of digital business models that compete in new markets. Yet many R&D teams, particularly at companies that make industrial products, find themselves hampered by longstanding aspects of their approach, such as rigidly sequenced processes, strict divisions of responsibility among functions like engineering and marketing, or a narrow focus on internal innovation.

Some product-development teams have begun to overhaul the way they work as part of wider digital transformations at their companies. Those trans-formations can take a long time, though, as companies modernize their IT architectures, adopt new technologies, reorganize people, and learn agile ways of working. Since digital rivals aren't waiting, product developers at

incumbent companies need innovation accelerators that they can put to use almost immediately. But with a wide range of technologies and methods to choose from, where should they start?

In our experience helping incumbents update their R&D practices, four solutions stand out for their substantial benefits, as well as for their ease of integration with existing activities. With so-called digital twins of in-use products, R&D organizations can make sense of product data across the entire life cycle, thereby reaching new insights more quickly. Once incumbents identify promising concepts, they can shorten the product-development cycle by staging virtual reality (VR) hackathons. Some will need a jolt of inspiration to speed up the R&D process. In that case, they can try holding "pitch nights" to collect and sift through ideas from outside the company, or setting up in-house design studios, or "innovation garages," to stimulate internal collaboration. Here, we explain how established companies are using these approaches, either singly or in various combinations, to develop winning products rapidly against threats posed by digital challengers.

USING FULL LIFE-CYCLE DATA TO DRIVE INNOVATION IN REAL TIME: DIGITAL TWINS

To track customer experiences and product performance closely, many digital natives have developed sophisticated mechanisms for gathering data about items they have sold. These companies then analyze these data and use their findings to guide the development of new products, as well as software updates that correct flaws in existing products or add features to them. The potential applications, however, are moving beyond digital natives alone. Sensors embedded in mechanical equipment, for instance, can reveal more than companies have ever known about how well their machines work in the actual world. And all manner of digitally equipped products, from smartphones to farm equipment, can now be monitored and maintained using Internet-of-Things (IoT) applications.

Yet traditional incumbents often encounter complications when it comes to gleaning and acting on insights from the data generated by in-use products. Companies issue many different versions of their products—for example, models tailored to requirements that vary across geographies. The challenge that arises is keeping track of all these versions. And when companies need to issue software updates for their products, they find it difficult to first ensure that each update will work on every version of a product.

Some incumbents have started to address these limitations by employing "digital twins," which are virtual counterparts of physical products. By closely syncing existing product information (such as the exact software and hardware configuration and performance parameters) with real-world data on the usage and performance of an actual product throughout its life cycle, companies can precisely monitor problems and discover customers' unmet needs. Such insights can point companies toward breakthroughs in the design of new products, as well as significant reductions in the time and expense associated with such activities as performing maintenance, recalling products, complying with regulatory requirements, and retooling manufacturing processes. And before incumbents push out software patches remotely, they can test fixes and new functions on digital twins (Exhibit 1).

One automotive OEM struggled to provide effective maintenance services as the variety, complexity, and geographic footprint of its product lineup increased. Yet it also knew that the data emitted by its products would say a lot about how they perform and what support they require. The company chose to build a new, more flexible data architecture that would pour live product data into an array of digital twins. Based on what the company

Exhibit 1

One automotive company uses 'digital twins' to accelerate the development of new product features and performance boosters.

The manufacturer creates a digital twin of each working vehicle to track its condition.

Vehicle lifetime

Digital twin

| The car's onboard sensors wirelessly transmit real-time data to its digital twin. | Engineers study the digital twins for this car and others to identify performance problems. | Developers write code to fix performance problems and test it in many digital twins. | Engineers send a corrective software patch to each car via a wireless connection. |

learned from the digital twins, it identified a range of services to boost customer satisfaction and, ultimately, sales. These included remotely delivered software updates and digital tools for customer engagement. By sending new software out "over the air," for example, the company was able to replace the 500 or so different versions of a single model's core operating system with one new version—a shift that greatly streamlined the development of subsequent updates. All told, the company thinks that these improvements could increase its earnings before interest and taxes by up to five percentage points.

SHORTENING THE CONCEPT-TO-PRODUCT TIME FRAME: HACKING IN VIRTUAL REALITY

Emerging evidence suggests that in the digital economy, which favors first movers and fast followers, issuing a well-developed product too late is more costly than being first to market with a good product that still has some rough edges. The latter approach borrows from the hacking methods of software developers, who release beta versions of new products to get early reactions from customers, define customers' preferences through A/B testing, and then deliver on their feedback with changes made in brief, frequent cycles. As long as companies are quick to turn around each new version of a product, various styles of hacking can benefit incumbents, not just those that sell software and services.

Visualization technologies like VR, augmented reality (AR), and 3-D printing can bring still greater improvements in the rate and flexibility of R&D efforts. Whereas designers might spend five or six weeks assembling a physical prototype, they can build a VR prototype in a matter of days. With the right tools in place, cross-functional teams can alter those prototypes even more quickly and estimate in real time the cost implications of potential design improvements. In our experience, the effective use of VR can reduce R&D costs and time to market significantly—as much as 10 to 15 percent for each measure—while achieving gains in product performance (Exhibit 2).

VR technology helped one advanced-equipment manufacturer to make a breakthrough with its next-generation model of a large stationary electronic device. Competitors had been nibbling away at the company's market share for years because their versions of the device were less expensive and easier to install. But the company couldn't figure out what made its competitors' designs superior. Gathering information from a range of sources, the company created 3-D models of competitors' products. Its engineers could then closely examine those models from every angle with VR headsets. Their

Exhibit 2

What is a virtual-reality hackathon?

Virtual-reality hackathons help companies **reduce R&D costs and time to market by bringing cross-functional teams together** to refine virtual prototypes in real time.

Faster and more effective R&D

Application area	Typical impact
Time to market ⟶	15% reduction
Value proposition ⟶	20% increase
Development cost ⟶	15% reduction
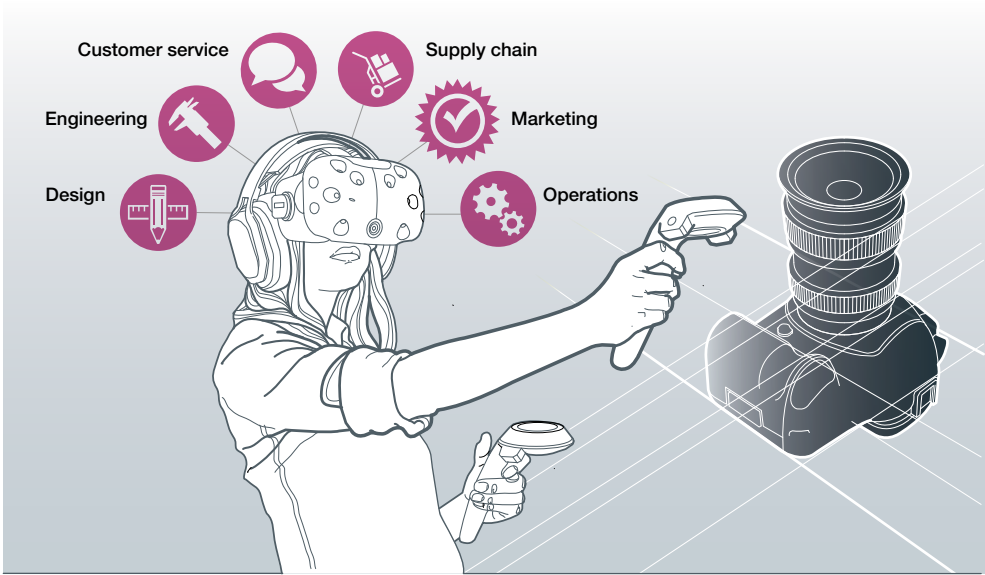
research convinced the R&D team to revisit certain assumptions about how its next model of the device should be designed.

With those outdated assumptions in mind, the company held a series of hackathons to develop the new version, bringing people from various departments together in the same room, either physically or virtually, to push a VR prototype through multiple cycles of review and adjustment. It placed its own prototype and competing models in the VR environment to make direct comparisons that would have been impractical in the physical world. The cross-functional team then adjusted the prototype on the fly as improvements were suggested. Not only did the VR technology speed up the design process, but inviting all the relevant departments to hack the virtual prototype at the same time made it possible to solve problems quickly and build new capabilities, such as working in an agile manner.

PLUGGING IN TO AN INNOVATION ECOSYSTEM: THE PITCH NIGHT

Digital twins and VR hackathons can readily help traditional companies make rapid improvements to existing products. Many companies have a different ambition—expanding their range of offerings—but lack the in-house capabilities to conceive and develop product ideas. Some need an infusion of fresh, entrepreneurial thinking. A business in either situation can benefit from hosting a "pitch night," in which it invites start-ups to consider an R&D challenge and derive solutions from their innovations.

For a tier-one industrial supplier, a pitch night led to the creation of an advanced-analytics engine used to improve the design of industrial transmissions. The supplier began the pitch-night process by issuing four use cases to a wide range of start-ups and calling for them to outline potential solutions. It chose 100 or so intriguing responses and brought in those start-ups to make four-minute presentations to a jury of the company's CEO, chief digital officer, selected board members, and business-unit heads. In the contest related to smart industrial transmissions, the jury identified an especially promising solution from a small group of data scientists who had been spun out of a university. That team was given a commission to spend eight weeks creating a minimum viable product (MVP). The MVP worked well enough that the company calculated that it would have a payback period of just three months and could be scaled into product improvements worth some €500 million in annual revenue.

The analytics engine wasn't the only useful outcome of the pitch night. Its product-development specialists have kept up with the start-ups that first responded to the challenge, thereby forming an innovation network that the company continues to rely on. One of those start-ups went on to contribute ideas for a different product, which led to a joint prototyping effort. So convinced is the company of the pitch night's usefulness that it has held more pitch nights for start-ups as well as for employees, suppliers, and academic institutions. It has also set up a dedicated global network of "innovation hubs" in Asia, Europe, and the United States to form deeper connections with local innovators and source ideas and opportunities for collaboration.

PUTTING CREATORS IN THE SAME ROOM: THE INNOVATION GARAGE

As pitch nights show, innovation in the digital age frequently springs from creative collaboration, whether in formal settings or chance encounters. This is one reason why start-ups are the sources of so many inventive products: their small head counts make it easy for every employee to stay informed about customer needs and participate in creative endeavors. Many of the R&D efforts we see at large incumbents, however, are conducted in a gated,

multistage process, where one department completes a task before handing things over to another. That can give rise to divergent points of view about what customers want, resulting in tasks that need to be redone or products that miss the mark.

To break down the silos that stymie rapid innovation, we see companies setting up cross-functional R&D teams. One form of such a team is the "innovation garage," a self-contained group responsible for quickly generating new ideas with minimal overhead (Exhibit 3). An innovation garage is distinguished by two essential features. First, it must include

Exhibit 3

An 'innovation garage' provides space for a self-contained group to generate new ideas quickly and with minimal overhead.

1 Frame
Garage director and key business stakeholders choose innovation areas that are relevant to consumers, technically feasible, and beneficial to the business. The goal: advance core business priorities and speed product development in proven market areas.

2 Collide
Consumer design, technology, and business experts codevelop product ideas, drawing on internal and external insights. They ensure that each idea has appealing features and commercial staying power and can be developed quickly. From this point on, a support team challenges ideas and coaches the experts.

3 Prioritize
Garage director and business stakeholders decide whether ideas should advance to prototyping phase, remain on hold, or be dropped. The director assigns a product owner to steer each idea through remaining stages and tracks all products in motion.

4 Prototype
Product owner and team strive to create a prototype within 15 weeks, pushing for a minimum viable product. Ideas are developed in rapid design/test cycles, with feedback from consumers, vendors, or creative experts. Teams are encouraged by the director to break rules and work outside existing processes.

5 Scale
If prototype phase confirms an idea's feasibility and business value, the product owner and team will develop it for external launch. Some products are launched in beta version to get customer feedback to refine the product and inform future garage projects.

members of every function that typically participates in R&D: engineering, data science, marketing and sales, finance, and operations, to name a few. These professionals are joined by expert practitioners of agile ways of working: a product owner, who decides what new products will consist of, and a scrum master, who orchestrates the iterative, test-and-learn development process.

Second, executives must make clear that the garage isn't a showroom, but a space for meaningful work, performed according to the new rules of digital competition. One European company housed its innovation garage just outside the head office. The garage stood as a living symbol of the company's commitment to innovation. Those assigned to the garage were expected to produce no fewer results than their colleagues working in the conventional building just outside. Moreover, the garage was given special permission to circumvent bureaucratic processes, such as hiring and technology integration, so that it would not lose time while waiting for approvals. The team's dedication has borne fruit: one of the first products to come out of the garage opened an entirely new sales channel, backed up by efficient, all-digital business operations.

In our experience, incumbents can get innovation garages up and running in a compressed time frame of about six months: several weeks of up-front planning, followed by a longer effort, usually lasting three or four months, to build and staff the new space, assign one or two initial projects, and allow

the garage team to get started. By the end of that build-out period, the team should have created its first set of MVPs for testing, in a demonstration of the pace required to keep up with digital-native competitors. Then the product owner can work with strategists and digital leaders in the core business to fast-track design projects that correspond to company goals such as expanding product ranges or entering new markets. Often, that means developing a mechanism for sourcing ideas and assessing their viability, including potential commercial models and risks to the core business.

One multinational company in the automotive industry set up an innovation garage to break out of its familiar pattern of basing new products on requests from existing customers. This approach meant that product-development activities invariably yielded extensions of the stand-alone technical offerings that had been the mainstay of the business for over a century. Unconventional product ideas had to be placed on a back burner because they didn't fit into the company's business model or would have required capabilities that the company lacked.

In the innovation garage, however, these ideas could be quickly realized and tested at a comfortable remove from the core business. As the garage comes up with prototypes of new products and services, the company showcases them at international exhibitions, where customers can respond. Exhibiting prototypes to the public has also helped the company to gain standing as an innovator, which has attracted digital talent and led other companies to propose ways of combining their respective offerings.

CHOOSING THE RIGHT METHOD

While all of these approaches have been shown to speed innovation at traditional companies, each naturally suits certain situations better than others (see sidebar, "Four product-development accelerators: When to use them and what you need"). For companies with robust pipelines of innovative ideas and slow or outdated product-development processes, digital twins and VR hackathons can serve as potent accelerators—provided that companies are willing to invest in new technical capabilities. Digital twins, in particular, require modern data architectures along with sophisticated IoT systems that let companies capture data from and push updates to products that are in the field. VR hackathons impose fewer technological demands, but they also work best when companies already have experience developing products in a cross-functional and collaborative manner.

FOUR PRODUCT-DEVELOPMENT ACCELERATORS:
WHEN TO USE THEM AND WHAT YOU NEED

Digital twins

Your goal

Gain real-time insights to drive
product development;
enhance existing products
with frequent updates

Key enablers

- Advanced analytical and data-science capabilities
- Digital data architecture
- Internet-of-Things connectivity and ability to deliver software
  updates remotely

Virtual-reality hackathon

Your goal

Optimize product design
and delivery across every stage
of the product life cycle

Key enablers

- Early-stage concept battles to generate a strong pipeline of ideas
- 3-D design/engineering talent and tools
- Tools and data that guide decisions during the hackathon
- Cross-functional product-development experience

For companies that need new ideas, other approaches may be in order.
Pitch nights are a more conventional solution in certain respects: it's
common for large companies to co-opt ideas from smaller enterprises with a
higher tolerance for risk. The pitch night serves incumbents best when
they treat it as the start of a long-term program of participating in innovation
ecosystems, rather than a one-off endeavor. The innovation garage is a
good alternative for incumbents that are struggling to penetrate new
markets or even to conceive products that might appeal to nontraditional
customers. Garages work best when companies give free rein to the garage
team by relieving the team from operating requirements and strategic
assumptions that might otherwise constrain it.

The innovation and speed to market demonstrated by digitally enabled
companies have exposed shortcomings in the R&D practices of more
conventional businesses. Now incumbents can counter their digital challengers,

Pitch night

Your goal
Expand range of offerings to existing or new customers, along with internal design and technical expertise; initiate and sustain participation in wider innovation ecosystem

Key enablers
- A reliable flow of well-defined product or market opportunities
- A manager or department responsible for sustaining relationships with innovation partners
- Funding to develop and commercialize new offerings in partnership with outside entities

Innovation garage

Your goal
Penetrate new, sometimes adjacent markets; develop suites of digital products and services

Key enablers
- Willingness to let the garage operate according to agile principles and take shortcuts around internal restrictions
- Reliable mechanism for sourcing and filtering product ideas from within
- Funding for speculative ventures and market-entry programs

and even outmaneuver them, by exploiting advanced capabilities such as the four we have discussed in this article. Those that do will achieve the pace of innovation that is required to compete and win in the digital economy. ⓠ

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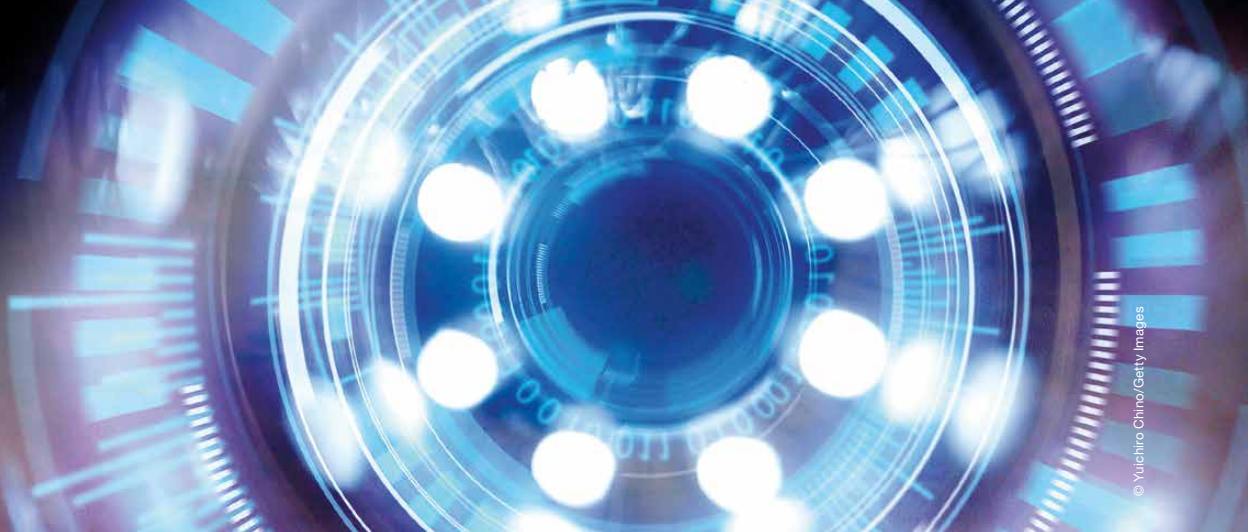
The economics of artificial intelligence

Rotman School of Management professor Ajay Agrawal explains how AI changes the cost of prediction and what this means for business.

With so many perspectives on the impact of artificial intelligence (AI) flooding the business press, it's becoming increasingly rare to find one that's truly original. So when strategy professor Ajay Agrawal shared his brilliantly simple view on AI, we stood up and took notice. Agrawal, who teaches at the University of Toronto's Rotman School of Management and works with AI start-ups at the Creative Destruction Lab (which he founded), posits that AI serves a single, but potentially transformative, economic purpose: it significantly lowers the cost of prediction.

In his new book, *Prediction Machines: The Simple Economics of Artificial Intelligence* (Harvard Business Review Press, 2018), coauthored with professors Joshua Gans and Avi Goldfarb, Agrawal explains how business leaders can use this premise to figure out the most valuable ways to apply AI in their organization. The commentary here, which is adapted from a recent interview with McKinsey's Rik Kirkland, summarizes Agrawal's thesis. Consider it a CEO guide to parsing and prioritizing AI opportunities.

THE RIPPLE EFFECTS OF FALLING COSTS

When looking at artificial intelligence from the perspective of economics, we ask the same, single question that we ask with any technology: What does it reduce the cost of? Economists are good at taking the fun and wizardry out of technology and leaving us with this dry but illuminating question. The answer

reveals why AI is so important relative to many other exciting technologies. AI can be recast as causing a drop in the cost of a first-order input into many activities in business and our lives—prediction.

We can look at the example of another technology, semiconductors, to understand the profound changes that occur when technology drops the cost of a useful input. Semiconductors reduced the cost of arithmetic, and as they did this, three things happened.

First, we started using more arithmetic for applications that already leveraged arithmetic as an input. In the '60s, these were largely government and military applications. Later, we started doing more calculations for functions such as demand forecasting because these calculations were now easier and cheaper.

Second, we started using this cheaper arithmetic to solve problems that hadn't traditionally been framed as arithmetic problems. For example, we used to solve for the creation of photographic images by employing chemistry (film-based photography). Then, as arithmetic became cheaper, we began using arithmetic-based solutions in the design of cameras and image reproduction (digital cameras).

The third thing that happened as the cost of arithmetic fell was that it changed the value of other things—the value of arithmetic's complements went up and the value of its substitutes went down. So, in the case of photography, the complements were the software and hardware used in digital cameras. The value of these increased because we used more of them, while the value of substitutes, the components of film-based cameras, went down because we started using less and less of them.

EXPANDING OUR POWERS OF PREDICTION

As the cost of prediction continues to drop, we'll use more of it for traditional prediction problems such as inventory management because we can predict faster, cheaper, and better. At the same time, we'll start using prediction to solve problems that we haven't historically thought of as prediction problems.

For example, we never thought of autonomous driving as a prediction problem. Traditionally, engineers programmed an autonomous vehicle to move around in a controlled environment, such as a factory or warehouse, by telling it what to do in certain situations—*if* a human walks in front of the vehicle (*then* stop) or *if* a shelf is empty (*then* move to the next shelf). But we could

never put those vehicles on a city street because there are too many *if*s—*if* it's dark, *if* it's rainy, *if* a child runs into the street, *if* an oncoming vehicle has its blinker on. No matter how many lines of code we write, we couldn't cover all the potential *if*s.

Today we can reframe autonomous driving as a prediction problem. Then an AI simply needs to predict the answer to one question: What would a good human driver do? There are a limited set of actions we can take when driving ("*then*s"). We can turn right or left, brake or accelerate—that's it. So, to teach an AI to drive, we put a human in a vehicle and tell the human to drive while the AI is figuratively sitting beside the human watching. Since the AI doesn't have eyes and ears like we do, we give it cameras, radar, and light detection and ranging (LIDAR). The AI takes the input data as it comes in through its "eyes" and looks over to the human and tries to predict, "What will the human do next?"

The AI makes a lot of mistakes at first. But it learns from its mistakes and updates its model every time it incorrectly predicts an action the human will take. Its predictions start getting better and better until it becomes so good at predicting what a human would do that we don't need the human to do it anymore. The AI can perform the action itself.

THE GROWING IMPORTANCE OF DATA, JUDGMENT, AND ACTION

As in the case of arithmetic, when the price of prediction drops, the value of its substitutes will go down and the value of its complements will go up. The main substitute for machine prediction is human prediction. As humans, we make all kinds of predictions in our business and daily lives. However, we're pretty noisy thinkers, and we have all kinds of well-documented cognitive biases, so we're quite poor at prediction. AI will become a much better predictor than humans are, and as the quality of AI prediction goes up, the value of human prediction will fall.

But, at the same time, the value of prediction's complements will go up. The complement that's been covered in the press most is data, with people using phrases such as "data is the new oil." That's absolutely true—data is an important complement to prediction, so as the cost of prediction falls, the value of a company's data goes up.

But there are other complements to prediction that have been discussed a lot less frequently. One is human judgment. We use both prediction and judgment to make decisions. We've never really unbundled those aspects of decision making before—we usually think of human decision making as a

single step. Now we're unbundling decision making. The machine is doing the prediction, making the distinct role of judgment in decision making clearer. So as the value of human prediction falls, the value of human judgment goes up because AI doesn't do judgment—it can only make predictions and then hand them off to a human to use his or her judgment to determine what to do with those predictions.

Another complement to prediction is action. Predictions are valuable only in the context of some action that they lead to. So, for example, one of the start-ups we work with at the Creative Destruction Lab built a very good demand-forecasting AI for perishable food such as yogurt. Despite its accuracy, this prediction machine is worth zero in the absence of a grocery retailer deciding how much yogurt to buy. So, besides owning data as an asset, many incumbents also own the action.

A THOUGHT EXPERIMENT FOR THE TOP TEAM

One approach to pinpoint ways to use AI in business is to review organizational workflows—the processes of turning inputs into outputs—and break them down into tasks. Then, look for the tasks that have a significant prediction component that would benefit from a prediction machine. Next, determine the return on investment for building a prediction machine to do each task, and simply rank those tasks in order from top to bottom.

Many of the AIs created out of this exercise will be efficiency-enhancing tools that will give the company some kind of a lift—possibly a 1 percent to 10 percent increase in EBITDA[1] or some other measure of productivity.

However, to anticipate which AI tools will go beyond increasing efficiency and instead lead to transformation, we employ an exercise called "science fictioning." We take each AI tool and imagine it as a radio volume knob, and as you turn the knob, rather than turning up the volume, you are instead turning up the prediction accuracy of the AI.

To see how this works, imagine applying the exercise to Amazon's recommendation engine. We've found its tool to be about 5 percent accurate, meaning that out of every 20 things it recommends, we buy one of them and not the other 19. That accuracy sounds lousy, but when you consider that the tool pulls 20 items from Amazon's catalog of millions of items and out of those 20 we buy one, it's not that bad.

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[1] Earnings before interest, taxes, depreciation, and amortization.

Every day people in Amazon's machine-learning group are working to crank up that prediction-accuracy knob. You can imagine that knob is currently at about two out of ten. If they to crank it to a four or a five, we'll now buy five or seven out of 20 things. There's some number at which Amazon might think, "We are now sufficiently good at predicting what you want to buy. Why are we waiting for you to shop at all? We'll just ship it." By doing this, Amazon could increase its share of wallet for two reasons. The first is that it preempts you from buying those goods from its competitors, either online or offline. The second is that, if you were wavering on buying something, now that it's on your porch you might think, "Well, I might as well just keep it."

This demonstrates that by doing only one thing—turning up the prediction-accuracy knob—the change made by AI goes from one that's incremental (offering recommendations on the website) to one that's transformational: the whole business model flips from shopping and then shipping to shipping and then shopping.

FIVE IMPERATIVES FOR HARNESSING THE POWER OF LOW-COST PREDICTION

There are several things leaders can do to position their organizations to maximize the benefits of prediction machines.

1. Develop a thesis on time to AI impact

The single most important question executives in every industry need to ask themselves is: How fast do I think the knob will turn for a particularly valuable AI application in my sector? If you think it will take 20 years to turn that knob to the transformational point, then you'll make a very different set of investments today than if you think it will take three years.

Looking at the investments various companies are already making can give you an idea of their thesis on how soon the knob will hit the transformation point. For example, Google acquired DeepMind for over half a billion dollars at a time when the company was generating almost no revenue. It was a start-up that was training an AI to play Atari games. Google clearly had a thesis on how fast the knob would turn.

So if I were a CEO in any industry right now, my number-one job would be to work with my leadership team to develop a thesis for each of the key areas in my organization on how fast the dial will turn.

2. Recognize that AI progress will likely be exponential

As executives develop their thesis on timing, it's important to recognize that the progress in AI will in many cases be exponential rather than linear. Already the progress in a wide range of applications (for example, vision, natural language, motion control) over the last 12 months was faster than in the 12 months prior. The level of investment is increasing rapidly. The quality-adjusted cost of sensors is falling exponentially. And the amount of data being generated is increasing exponentially.

3. Trust the machines

In most cases, when AIs are properly designed and deployed, they're better predictors than humans are. And yet we're often still reluctant to hand over the reins of prediction to machines. For example, there have been studies comparing human recruiters to AI-powered recruiters that predict which candidates will perform best in a job. When performance was measured 12, 18, and 24 months later, the recruits selected by the AI outperformed those selected by the human recruiters, on average. Despite this evidence, human recruiters still often override the recommendations provided by AIs when making real hiring decisions.

Where AIs have demonstrated superior performance in prediction, companies must carefully consider the conditions under which to empower humans to exercise their discretion to override the AI.

4. Know what you want to predict

I work at a business school, so, using my domain as an example, if you read business-school brochures, they're usually quite vague in terms of what they're looking for in prospective students. They might say, "We want the best students." Well, what does "best" mean? Does it mean best in academic performance? Social skills? Potential for social impact? Something else?

The organizations that will benefit most from AI will be the ones that are able to most clearly and accurately specify their objectives. We're going to see a lot of the currently fuzzy mission statements become much clearer. The companies that are able to sharpen their visions the most will reap the most benefits from AI. Due to the methods used to train AIs, AI effectiveness is directly tied to goal-specification clarity.

5. Manage the learning loop

What makes AI so powerful is its ability to learn. Normally, we think of labor as being learners and of capital as being fixed. Now, with AI, we have capital that learns. Companies need to ensure that information flows into decisions, they follow decisions to an outcome, and then they learn from the outcome and feed that learning back into the system. Managing the learning loop will be more valuable than ever before.

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In response to a surge of advances in AI by other countries, particularly China, Robert Work, a former deputy secretary of defense, was recently quoted in a *New York Times* article as saying, "This is a Sputnik moment." He was, of course, referencing America's catch-up reaction to the Soviet Union's launching of Sputnik I, the world's first Earth-orbiting satellite, in 1957. This initiated the space race, led to the creation of NASA, and resulted in the Americans landing on the moon in 1969.

This sentiment for defense applies broadly today. Organizations in every industry will soon face their own Sputnik moment. The best leaders, be they visionary or operationally oriented, will seize this moment to lead their organizations through the most disruptive period they will experience in their professional lives. They will recognize the magnitude of the opportunity, and they will transform their organizations and industries. And as long as proper care is exercised, we'll be better off for it. Ⓠ

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Video footage of the interview from which this article was adapted is available on McKinsey.com.

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Debiasing the corporation: An interview with Nobel laureate Richard Thaler

The University of Chicago professor explains how executives can battle back against biases that can affect their decision making.

Whether standing at the front of a lecture hall at the University of Chicago or sharing a Hollywood soundstage with Selena Gomez, Professor Richard H. Thaler has made it his life's work to understand and explain the biases that get in the way of good decision making.

In 2017, he was awarded the Nobel Prize for four decades of research that incorporates human psychology and social science into economic analysis. Through his lectures, writings, and even a cameo in the feature film *The Big Short* (2015), Thaler introduced economists, policy makers, business leaders, and consumers to phrases like "mental accounting" and "nudging"—concepts that explain why individuals and organizations sometimes act against their own best interests and how they can challenge assumptions and change behaviors.

In this edited interview with McKinsey's Bill Javetski and Tim Koller, Thaler considers how business leaders can apply principles of behavioral economics and behavioral finance when allocating resources, generating forecasts, or otherwise making hard choices in uncertain business situations.

WRITE STUFF DOWN

One of the big problems that companies have, in getting people to take risk, is something called hindsight bias—that after the fact, people think they knew it all along. So if you ask people now, did they think it was plausible that we would have an African-American president before a woman president, they say, "Yeah, that could happen."

All you needed was the right candidate to come along. Obviously, one happened to come along. But, of course, a decade ago no one thought that that was more likely. So, we're all geniuses after the fact. Here in America, we call it Monday-morning quarterbacking.

CEOs exacerbate this problem. Because they have hindsight bias. When a good decision happens—good meaning ex ante, or before it gets played out—the CEO will say, "Yeah, great. Let's go for that gamble. That looks good."

Two years later, or five years later, when things have played out and it turns out that a competitor came up with a better version of the same product that we all thought was a great idea, then the CEO is going to remember, "I never really liked this idea."

One suggestion I make to my students is "write stuff down." I have a colleague who says, "If you don't write it down, it never happened."

What does writing stuff down do? I encourage my students, when they're dealing with their boss—be it the CEO or whatever—on a big decision, not whether to buy this kind of computer or that one but career-building or -ending decisions, to first get some agreement on the goals, what are we trying to achieve here, the assumptions of why we are going to try this risky gamble, risky investment. We wouldn't want to call it a gamble. Essentially, memorialize the fact that the CEO and the other people that have approved this decision all have the same assumptions, that no competitor has a similar product in the pipeline, that we don't expect a major financial crisis.

You can imagine all kinds of good decisions taken in 2005 were evaluated five years later as stupid. They weren't stupid. They were unlucky. So any company that can learn to distinguish between bad decisions and bad outcomes has a leg up.

FORECASTING FOLLIES

We're doing this interview in midtown New York, and it's reminding me of an old story. Amos Tversky, Danny Kahneman, and I were here visiting the

head of a large investment company that both managed money and made earnings forecasts.

We had a suggestion for them. Their earnings forecasts are always a single number: "This company will make $2.76 next year." We said, "Why don't you give confidence limits: it'll be between $2.50 and $3.00—80 percent of the time."

They just dropped that idea very quickly. We said, "Look, we understand why you wouldn't want to do this publicly. Why don't you do it internally?"

RICHARD H. THALER

Vital statistics
Born September 12, 1945, in East Orange, New Jersey

Education
Holds a PhD and a master's degree in economics from the University of Rochester, and a bachelor's degree in economics from Case Western Reserve University

Career highlights
University of Chicago, Booth School of Business
(1995–present)
Charles R. Walgreen Distinguished Service Professor of Behavioral Science and Economics, and director of the Center for Decision Research

Cornell University, Samuel Curtis Johnson Graduate School of Management
(1988–95)
Henrietta Johnson Louis Professor of Economics, and director of the Center for Behavioral Economics and Decision Research

(1986–88)
Professor of economics

(1980–86)
Associate professor

University of Rochester, Simon Business School
(1974–78)
Assistant professor

Fast facts
Awarded the 2017 Nobel Prize in Economic Sciences

Codirector (with Robert J. Shiller) of the Behavioral Economics Project at the National Bureau of Economic Research

Has written several books, including *Nudge: Improving Decisions about Health, Wealth, and Happiness* (Penguin Books, 2008), coauthored with Cass R. Sunstein; and *Misbehaving: The Making of Behavioral Economics* (W. W. Norton & Company, 2015)

Has published articles in prominent journals, such as American Economics Review, Journal of Finance, and Journal of Political Economy

Is a member of the American Academy of Arts and Sciences, a fellow of the American Finance Association and the Econometrics Society, and a former president of the American Economic Association

Duke does a survey of CFOs, I think, every quarter. One of the questions they ask them is a forecast of the return on the S&P 500 for the next 12 months. They ask for 80 percent confidence limits. The outcome should lie between their high and low estimate 80 percent of the time. Over the decade that they've been doing this, the outcome occurred within their limits a third of the time, not 80 percent of the time.

The reason is their confidence limits are way too narrow. There was an entire period leading up to the financial crisis where the median low estimate, the worst-case scenario, was zero. That's hopelessly optimistic. We asked the authors, "If you know nothing, what would a rational forecast look like, based on historical numbers?"

It would be plus 30 percent on the upside, minus 10 percent on the downside. If you did that, you'd be right 80 percent of the time—80 percent of the outcomes would occur in your range. But think about what an idiot you would look like. Really? That's your forecast? Somewhere between plus 30 and minus 10? It makes you look like an idiot.

It turns out it just makes you look like you have no ability to forecast the stock market, which they don't; nor does anyone else. So providing numbers that make you look like an idiot is accurate. If you have a record, then you can go back. This takes some patience. But keeping track will bring people down to earth.

NUDGING THE CORPORATION

The organizing principle of *Nudge* is something we call choice architecture. Choice architecture is something that can apply in any company. How are we framing the options for people? How is that influencing the choices that they make? It can go anywhere from the mainstream ideas of *Nudge*—say, making employees healthier.

One of the nice things about our new building at Chicago Booth is that the faculty is divided across three floors: third, fourth, and fifth. There are open stairwells that connect those floors. It does two things. One is it gives people a little more exercise. Also it makes us feel more connected. You can hear people. I'm on the fourth floor, so in the middle. If I walk down the hall, I may have a chance encounter not just with the people on my floor but even with people on the adjacent floors. Because I'll hear somebody's voice, and I wanted to go talk to that guy.

There are lots of ways you can design buildings that will make people healthier and make them walk more. I wrote a little column about this in the *New York Times,* about nudging people by making stuff fun. There was a guy in LA [Los Angeles] who wrote to me and said that they took this seriously.

They didn't have an open stairwell in their building, but they made the stairwell that they did have more inviting. They put in music and gave everybody two songs they could nominate. They put in blackboards where people could put decorations and funny notes. I was reading something recently about another building that's taken this idea.

Since you have to use a card to get in and out of the doors, they can keep track of who's going in and out. So they can give you feedback on your phone or your Fitbit, of how many steps you've done in the stairwells. But the same is true for every decision that the firm is making.

ON DIVERSITY

There's lots of talk about diversity these days. We tend to think about that in terms of things like racial diversity and gender diversity and ethnic diversity. Those things are all important. But it's also important to have diversity in how people think.

When I came to Chicago in 1995, they asked me to help build up a behavioral-science group. At the time, I was one of two senior faculty members. The group was teetering on the edge of extinction. We're up close to 20 now. As we've been growing, I've been nudging my colleagues.

Sometimes we'll see a candidate and we'll say, "That guy doesn't seem like us." They don't mean that personally. They mean that the research is different from the research we do. Of course, there is a limit. We don't want to hire somebody studying astrophysics in a behavioral-science department. Though we could use the IQ boost. But I keep saying, "No, we want to hire people that think differently from how we do, especially junior hires. Because we want to take risks." That's the place to take risks. That person does things that are a little different from us.

Either that candidate will convince us that that research is worthwhile to us, or will maybe come closer to what we do, or none of the above, and he or she will leave and go somewhere else. None of those are terrible outcomes. But you go into a lot of companies where everybody looks the same and they all went to the same schools. They all think the same way. And you don't learn.

There's a quote—I may garble it—from Alfred P. Sloan, the founder of GM, ending some meeting, saying something like, "We seem to be all in agreement here, so I suggest we adjourn and reconvene in a week, when people have had time to think about other ideas and what might be wrong with this."

I think strong leaders, who are self-confident and secure, who are comfortable in their skin and their place, will welcome alternative points of view. The insecure ones won't, and it's a recipe for disaster. You want to be in an organization where somebody will tell the boss before the boss is about to do something stupid.

Figure out ways to give people feedback, write it down, and don't let the boss think that he or she knows it all. Figure out a way of debiasing the boss. That's everybody's job. You'd like it to be the boss's job, but some bosses are not very good at it.

MAKING BETTER DECISIONS THROUGH TECHNOLOGY

We're just scratching the surface on what technology can do. Some applications in the healthcare sector, I think, are going to be completely game changing. Take diabetes, for example, a major cause of illness and expense. [For type 2 diabetes], most of the problem is people don't take their medicine.

If they improved their diet and took their medicine, most of their problems would go away. We basically now have the technology to insert something in your body that will constantly measure your blood sugar and administer the appropriate drugs. Boom, we don't have a compliance problem anymore, at least on the drug side.

There's lots of fear about artificial intelligence. I tend to be optimistic. We don't have to look into the future to see the way in which technology can help us make better decisions. If you think about how banks decide whom to give a credit card and how much credit to give them, that's been done using a simple model for, I think, 30 years at least.

What I can see is the so-called *Moneyball* revolution in sports—which is gradually creeping into every sport—is making less progress in the human-resources side than it should. I think that's the place where we could see the biggest changes over the next decade.

Because job interviews are, to a first approximation, useless—at least the traditional ones, where they ask you things like, "What do you see yourself doing in ten years?" or "What's your biggest weakness?" "Oh, I'm too honest. I work too hard. Those are my two biggest weaknesses."

So-called structured interviews can be better, but we're trying to change the chitchat into a test, to whatever extent you can do that. We wouldn't hire a race-car driver by giving them an interview. We'd put them in a car or, better yet, because it would be cheaper, behind a video game and see how they drive.

It's harder to see how people make decisions. But there's one trading company I used to know pretty well. They would recruit the smartest people they could find right out of school. They didn't care if they knew anything about options. But they would get them to bet on everything, and amounts of money that, for the kids, would be enough that they would think about it. So there's a sporting event tonight, and they'd all have bets on it. What were they trying to do? They were trying to teach them what it feels like to size up a bet, what it feels like to lose and win. This was part of the training and part of the evaluation.

That was the job they were learning how to do, how to be traders. Now that job probably doesn't exist anymore, but there's some other job that exists. Figure out a way of mimicking some aspects of that, and test it, and get rid of the chitchat. Because all that tells you is whether you're going to like the person, which may be important if it's somebody you're going to be working with day and night. If a doctor is hiring a nurse that's going to work in a small office, it's important that you get along. But if you're hiring somebody that's going to come to work in a big, global company, the chance that the person interviewing that candidate will work with that candidate is infinitesimal. So we don't really care what the interviewer thinks of the interviewee. We care whether the interviewee will add something to the organization. Ⓠ

UNIVERSITIES AND THE CONGLOMERATE CHALLENGE

Complex business combinations have been unwinding for years. Will the bell toll for universities?

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Business leaders in the United States and across the world spend countless hours in the boardrooms of major research universities. For many institutions and trustees, those meetings have become more challenging due to some well-documented threats. Rapidly rising tuition, shifting demographics, the growing popularity of online learning, pressure on research funding, volatile endowment earnings, and parental and graduate dissatisfaction with employment opportunities: all are trends that pose significant risks for university departments, colleges, and central administrations.

Lurking beneath the surface, and making those trends more ominous, is an issue that corporate executives have been wrestling with for years. It's what we call the "conglomerate challenge" of today's research universities. In short, today's research universities mirror corporate conglomerates in structure, but without the degrees of freedom enjoyed by their corporate counterparts. We believe that by better understanding the realities and the limits of their corporate conglomerate–like structures, university leaders can increase their odds of successfully addressing the many threats they face.

The theory of the case is straightforward: from a strategic-management and corporate-finance perspective, a university can be viewed as a diversified conglomerate of independent strategic business units (SBUs): colleges, divisions, and schools. Each of these SBUs has a business-level strategy that is driven by its intellectual traditions, educational objectives, and professional disciplinary norms. The corporate strategy of a university supports these strategic intents by serving as a platform for attracting and allocating resources across its academic units.

In business, much of the economic value created by a conglomerate lies in the coinsurance of risks across its SBUs. Conglomerates can attract a lower cost of debt because lenders expect that downturns suffered by one SBU will be offset (or coinsured) by other revenue-generating units.

Against this advantage, conglomerates also suffer from the well-known conglomerate or diversification discount. The discount exists because of the costs of coordination across SBUs, the inefficiencies that arise because SBU operations aren't transparent to the external capital markets, and the tendency for conglomerates either to overinvest relative to comparable stand-alone firms in segments with limited opportunities or to slow walk the divestment of formerly good opportunities that have soured.[1]

In the higher-education conglomerate, there are analogous disadvantages. These include the "carrying" of economically inefficient academic units (defined as those chronically unable to earn their cost of capital in tuition, endowment, or research funding); the nonfungibility of specialized real-estate assets and scientific equipment; and the immovability of the tenured faculty.

In business, when conglomerates face the combination of declining demand, insufficient returns on capital employed, and less patient capital markets, they restructure by selling fringe or unprofitable businesses, or by breaking up and spinning out stand-alone businesses to unlock free cash flows from underutilized assets. Those that choose not to do so rather quickly add themselves to the ranks of failed conglomerates.

Most universities struggle to take either step. That's partly due to institutional rigidity and partly to the fact that not all strategic options available to a business are accessible to a higher-education conglomerate. Barriers to restructuring include regulation (the closing and launching of programs requires governmental approval in some states) and the stickiness of faculty contracts. Also, there are the many and varied interests, expectations, and demands of past and present donors, students, and alumni to consider.

Neither these barriers nor the fundamentals of the university's conglomerate challenge are anything new. Making them more significant today are shifts such as the growth of online learning, whose economies of scale are creating new competitive dynamics, and the growing skepticism among employers and parents (the actual "customers" of the university) over the value of a university credential.

There has never been a better time, therefore, for business-minded trustees to bring their strategic-thinking skills to bear on the conglomerate challenge—and most are well prepared to do so. Many corporate executives have been well schooled in the trade-offs associated with diversification and focus. They may also have scars from keeping disparate businesses together for too long or from unwinding overly complex combinations. All of that positions them extremely well to encourage university leaders and other trustees to start thinking of the university not as a collection of individual SBUs but as a portfolio of revenue-producing or cost-incurring assets, each with different risk profiles and possibilities for navigating disruptive change in the sector.

To ensure their asset portfolios can deliver, at acceptable cost, high-quality outcomes for students, funding agencies, employers, and other consumers of intellectual capital, trustees and administrators must ask themselves some

difficult questions: What mix of academic programs is best able to generate sustainable growth, stable cash flows (in portfolio parlance, businesses with countercyclical demand patterns), and brand equity? What programs are truly critical, and which are "nice to have?" What current academic programs and areas of research do not contribute to sustainability, stability, and reputation of the whole? What new innovations (academic programs and emerging domains of research) deserve further investment to create new sources of revenue and new opportunities for mission and brand building?

We do not want to imply that the decision making for academic initiatives be centralized, or that economic criteria must hold sway. Conglomerates sometimes choose to carry unprofitable SBUs if these units serve specific operational and marketing purposes, and universities may choose to do the same. What's critical, for both conglomerates and universities, is do so consciously, with an eye toward understanding the value they create for other units and the options they create for the future. The trade-offs made plain by dispassionate, comparative analysis of SBUs against a common set of shared economic metrics such as contribution margins (in addition to academic criteria) are likely to be eye-opening for universities, which generally find it easier to launch programs than to close them down.

Making choices about structure, resource allocation, and shift of focus and mind-set are challenging for the leaders of any enterprise—which is precisely why we encourage business leaders serving on university boards to tackle the conglomerate challenge head-on and university administrators to seek their advice. By wrestling with questions such as the ones we have posed, trustees and administrators can better address the external vulnerabilities of our research universities, while preserving the health, influence, and growth potential of these important institutions for many more years to come. Ⓠ

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[1] Recent research has attempted to explain the diversification discount by pointing to sample selection, measurement, and model-estimation biases. Still, none of the explanations has been able to fully account for the size of the implied gap between the coinsurance advantage and the conglomerate discount. For a good summary of these issues, see Linda Gorman, "The diversification discount and inefficient investment," National Bureau of Economic Research, nber.org.

Choose well

Job control and social support are no joke: academic research suggests they are crucial to health and happiness in the workplace.

"Our choices come down to a management approach that allows for more individual autonomy, while fostering a high degree of social support. Or simply making any outward sign of stress a fireable offense."

Learn more about job control, social support, and the practical steps leaders can take to promote them in "The overlooked essentials of employee well-being," on page 82, by Stanford University Graduate School of Business professor Jeffrey Pfeffer.

Highlights