BCG

JANUARY 2019

ADVANCING DIGITAL AND ANALYTICS IN HEALTH CARE

Lessons for Payers, Providers & Services

Preface

Contents

2018 was filled with announcements of changes that have the potential to redraw the health care industry landscape: the vertical merger of Aetna and CVS; Cigna and Express Scripts coming together; a new health-care-focused collaboration among Amazon, JP Morgan, and Berkshire Hathaway; the Vatican-approved largest Catholic health system merger between CHI and Dignity; Apple's and Google's continuing forays into health care; and many others.

As payers increase their scope of services, providers organize for scale, and tech companies seek to disrupt the existing system, industry leaders are determining how best to meet the challenges they face. Chief among those challenges is pressure to provide offerings that meet consumer expectations for digitally enabled services on demand—the very strategy that technology players have used to disrupt other industries. Payers and providers also face continued cost pressures, as well as the expectation that they will improve their quality and service experience. Organization reinvention remains another critical imperative. And as companies age and grow, how do they keep at least one eye on nontraditional competitors, disruptive technologies, and new business models?

All players should ask themselves if they are effectively pursuing the opportunities that data and technology present. Our feature article in this collection looks at the impact of advanced analytics for payers. It argues that most companies assess their analytics investments in a siloed, piecemeal fashion, rather than taking a more purposeful approach that starts with asking where the power of analytics could be most valuable. We argue elsewhere that big data can have an especially large impact on improving patient outcomes and experience, while reducing the total cost of care and making health care more affordable.

Increasingly, organizations are looking at perspectives both from within and from the outside of health care. How do they organize and derisk digital and advanced analytics initiatives? AI is a topic of the moment; we look at why build-or-buy decisions are different from similar decisions in other fields. Other topics include blockchain and the IoT, where we offer a strategic context for framing the right questions to ask.

Big changes provide plenty of food for thought. In the pages that follow, we've tried to set a table of probing ideas.

Sanjay B. Saxena, M.D.
Senior Partner and Managing Director
Global Sector Leader—Health Care Payers, Providers & Services

BOOSTING HEALTH CARE PAYER PERFORMANCE WITH ADVANCED ANALYTICS

by Sanjay Saxena, Ashish Kaura, and Michael Ruhl

ADVANCED ANALYTICS HAVE BEEN slower to make a major impact in health care than in other industries, where new uses for data have been transformative. But this is starting to change. Consider the following:

- One payer saved more than $350 million in administrative costs alone by using advanced analytics to transform care management and develop richer member segmentation and targeting.

- Another reduced sales and marketing administrative costs 30% to 60% with a data-driven sales force effectiveness program that used AI and advanced analytics-enabled tools to automate marketing, prioritize leads, and better understand clients' needs.

- A mutual insurance company reduced administrative costs for underwriting functions 26% by using advanced analytics and artificial intelligence (AI) to help triage claims, automate tasks on standard claims, and improve risk-scoring algorithms.

Top health care executives are buying into the power of advanced analytics. "I really think of our future as a medicines and data science company, centered on innovation and access," Vas Narasimhan, CEO of Novartis, told the *Financial Times*. "It's essential that we use the combined power of data analytics and care teams to help people understand how lifestyle can impact health…" said Humana CEO Bruce Broussard. Plenty of companies are making significant investments in capabilities and solutions: we have found that leading payers are committing up to 10% of administrative budgets.

Still, examples of the successful use of advanced analytics in health care, particularly among payers, are more episodic than extensive. The biggest reason is that much of today's analytics activity is driven by, and held within, a siloed department or function. It is often focused on a particular technology or technology solution, such as machine learning or natural-language processing, rather than on strategic opportunities or the needs of customers (both providers and patients). In addition, outputs are not shared across the organization. Advanced-analytics initiatives without a connection to changes in organization-wide strategy and operating model create little scalable value. Think about a payer that hires data scientists for its care management group but does not use their capabilities to support its pharmacy function. Most payers are making or assessing their analytics investments in a piecemeal fashion, trying to discover what analytics can do rather than taking a more purposeful approach that starts with asking where the power of analytics would be most valuable.

To gain competitive advantage, boost performance, and realize real value from data and analytics, payers should take a more strategic tack, determining first which business problems are most pressing and then how advanced analytics can best solve them. In this way, payers can develop capabilities that have lasting impact and deliver rapid business value. Here's how they can go about it.

Start at the End

Companies should start by defining the end result they desire, such as reduced waste in specialty drugs or better, more timely support for the chronically ill. They should think big from the get-go—for example, aiming for a 2% to 3% impact on the bottom line. Ambitions that start small are more likely to stay small.

Payers should focus on the most critical problems they face and the use cases that are consistent with the enterprise strategy—for example, enabling providers to take on risk in value-based care programs if the strategy is to pass on risk to providers. They should also prioritize initiatives that can generate

quick return. Programs that are self-funded and show early wins generate enthusiasm within the organization. Payers can then employ survey input, expert interviews, and benchmarking to identify a list of specific transformative use cases and prioritize each one on the basis of business potential and feasibility considerations (such as cost and time to implement).

Defining the desired outcomes will also dictate how to approach the other steps of the analytics journey, from identifying the required insights through enabling the technology. (See Exhibit 1.) There's no shortage of opportunities for impact, from member acquisition to medical management to administrative management. Examples of specific use cases in which we have seen advanced analytics have a significant effect include rationalizing product proliferation by eliminating underperforming plans, identifying consumers likely to develop expensive conditions and intervening to reduce risks, and improving customer service with simple AI algorithms. Other areas where advanced analytics can move the needle include personalization and customization for customers, continuous

EXHIBIT 1 | The First Step in the Analytics Journey Is Deciding Where You Want to End Up

DESIRED OUTCOME	Lower medical costs, shorter wait times
REQUIRED INSIGHT	Members at highest risk for an adverse event, physicians with lowest adherence to evidence-based guidelines
TANGIBLE ACTION	Enrollment in chronic care management program, outreach to potential new customers
SPECIFIC TARGETS	Providers, patients
DETERMINING BEST TECHNOLOGY AND REQUIRED DATA	Natural language processing, customer credit data, etc. (can be created in-house or outsourced)

Source: BCG analysis.

evaluation and improvement of processes, and greater efficiency in service delivery and operations.

One key step in the process that should not be overlooked is the last: integrating the resulting insights into business processes in ways that change how the company operates. For example, if the goal is to identify high-potential ROI patients for care management, how the payer integrates its newly developed priority patient list into the care management enrollment process will be a critical factor in successfully meeting that goal.

Organize for Impact

Companies tend to get caught up in questions of talent (How many data scientists do we need? Where do we find them?), organization (Should we centralize the analytics operation or house it in the business units?), and investment (How much do we need to spend?). There are no hard and fast answers to any of these questions. What's more important, by far, is that companies to focus on organizing for impact. The goal should be state-of-the-art analytics capabilities that will generate insights that translate into value-creating care management actions. Invest in what we call integrators—people with both technical and business knowledge—match the structure to your organizational maturity, and invest in the areas aligned with your strategy.
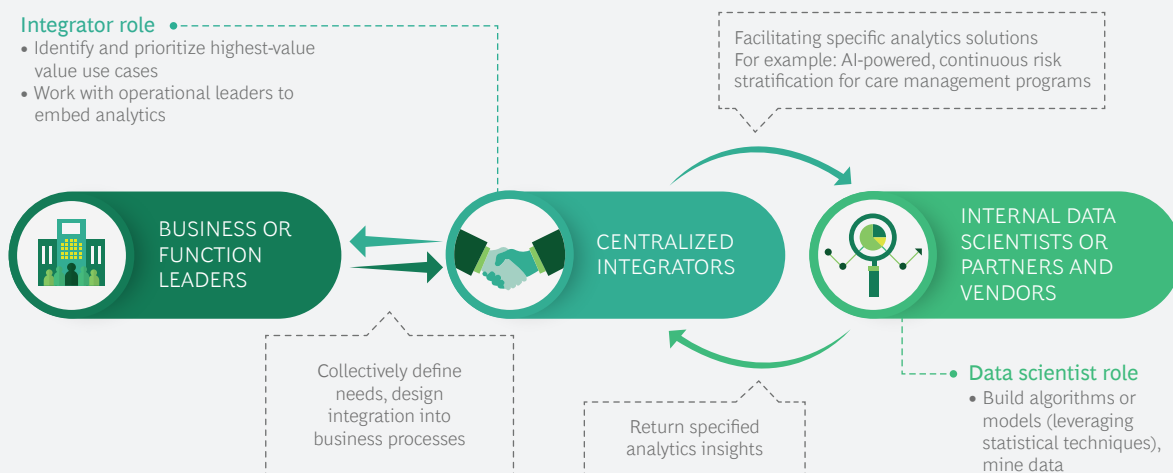
TALENT

Most companies focus first on technical talent—data scientists and software engineers, for example. In our experience, smart companies look initially to hire or develop integrators—people whose understanding of the drivers of business value and working knowledge of analytics will help them lead the effort to turn data insights into operational results. These individuals are able to work with business leaders and technical personnel (whether internal or outsourced) to identify and prioritize the highest-value use cases, develop the necessary data assets, and incorporate analytics into business processes. (See Exhibit 2.) Integrators must have a good understanding of statistics and analytics. They may have previous experience in the payer industry, but the more important requirement is strong problem-solving skills.

The analytics team will also need technical experts who can handle a variety of specialized tasks, including training integrators, assessing vendors, and leading technical integrations with vendors. These data scientists, engineers, and business development specialists can also help identify and structure partnerships, joint ventures, and acquisitions.

One startup health plan recruits people who come from different backgrounds, many of whom have no experience in health care. It trains all its employees in coding by leveraging

EXHIBIT 2 | Integrators Promote Collaboration Between Business Leaders and the Analytics Team

Integrator role
- Identify and prioritize highest-value value use cases
- Work with operational leaders to embed analytics

Facilitating specific analytics solutions
For example: AI-powered, continuous risk stratification for care management programs

BUSINESS OR FUNCTION LEADERS

CENTRALIZED INTEGRATORS

INTERNAL DATA SCIENTISTS OR PARTNERS AND VENDORS

Collectively define needs, design integration into business processes

Return specified analytics insights

Data scientist role
- Build algorithms or models (leveraging statistical techniques), mine data

Source: BCG analysis.

the skills of a few data scientists to teach analytically minded employees who then train their colleagues. At the same time, other employees teach the ins and outs of Medicare to new recruits with little health care background. The goal is to develop employees who understand both business processes and coding and can staff project teams made up of diversified operations and technical expertise.

ORGANIZATIONAL MODELS

Companies tend to organize their analytics programs using one of three models, each with its plusses and minuses:

- **Virtual.** This model uses a small central management group with team members in business units or functions. Governance, such as budgeting and reporting lines, is kept simple, and analytics teams are embedded in the business, so it is easier to implement findings. Disadvantages include lack of scale, no sharing of best practices, and the absence of an insulated culture for analytics talent.

- **Hub and Spoke.** The analytics function is independent and works with associated units located in the businesses. This model takes advantage of scale while allowing for specialization of analytics capabilities in the business units. Governance can be difficult, however, particularly in delineating responsibilities between the hub and the spokes.

- **Centralized.** The analytics function is organized under a top executive (typically the CFO, or CIO) with dedicated resources. This approach leverages scale, ensures that analytics is treated as a priority, and provides an insulated analytics culture. At the same time, though, the analytics function is disconnected from business units that require attention if they are to integrate insights and incorporate results into daily operations.

Our experience shows that while many payers have distributed their analytics capabilities throughout their organizations, the best practice for a company in the early stages of analytics strategy development is to ring-fence a centralized advanced-analytics team with the goals of leveraging scale and creating a culture of innovation. After the group is developed and running efficiently, a more distributed model, such as hub and spoke, may make sense, with an analytics center of excellence working closely with integrators and technical experts at the business unit level.

UnitedHealth Group has gone so far as to set up its analytics unit as a standalone operation, with its own P&L. OptumIQ supports United Health's business units and also sells its services to outside health plans. The model has achieved significant scale benefits, and the service buyback model encourages investment in use cases with the highest ROI.

INVESTMENT

Many large payers currently devote about 2% of their administrative budgets to advanced analytics, while the most innovative payers are investing as much as 8% to 10%. One startup Medicare Advantage plan is spending 10% to 15% of its administrative budget on advanced analytics. Among the broader universe of financial services companies that we have benchmarked, analytics spending averages about 3% of SG&A, with an average absolute amount of about $250 million.

How much you spend is less important than where the spending is targeted. Successful companies take on specific use cases rather than large infrastructure development investments, and they focus on developing execution skills. In our experience, most payers need to increase spending, but they should do so only in support of a clearly defined, needs-backed analytics strategy.

Adopt a Transformational Mindset

Building an advanced-analytics function takes time and is best approached as a type of transformational journey that will ultimately change how the company works. It's important to notch some early wins—use cases with near-term impact whose success will generate income increases or cost savings that will help fund the rest of the journey. Most companies will want to adopt some form of agile ways of working that involve cross-functional

teams developing analytics tools and applications in short, iterative sprints. Each iteration is tested with the business users and their feedback is incorporated into the next version. Companies should also resist trying to do everything themselves. Building the necessary algorithms requires technical expertise that many payers do not have. They will need to outsource some of the analytics through a joint venture, partnership, or purchase, which can speed the development process and contribute to a successful result.

Putting It All Together

To demonstrate the potential advanced-analytics offers for health care, we recently modeled the impact of a successful transformation on a hypothetical regional payer. (See Exhibit 3.) For a company with about $6 billion in revenues, our analysis showed a 6% boost in sales from increased member retention, optimized member acquisition pricing, and data-driven B2B sales. Improving chronic care management and provider enablement, along with reducing fraud, waste, and abuse, improved the medical loss ratio by 8 percentage points. Applying AI to automate manual processes and removing care management work that didn't add value cut administrative costs by 13 percentage points. The overall result was an increase in

the company's operating margin from 1% to more than 10% and an accompanying boost in operating income from about $61 million to $680 million, money that can be reinvested in the company's growth through lower plan prices and higher-quality care.

These are achievable results for payers that embrace advanced analytics and follow the type of roadmap outlined above to build their capabilities. There is no reason not to start now.

Sanjay Saxena *is a senior partner and managing director in the San Francisco office of Boston Consulting Group and global leader for Health Care Payers, Providers & Services. You may contact him by email at saxena.sanjay@bcg.com.*

Ashish Kaura *is a partner and managing director in the firm's Chicago office. You may contact him by email at kaura.ashish@bcg.com.*

Michael Ruhl *is a partner and managing director in BCG's Dusseldorf office. You may contact him by email at ruhl.michael@bcg.com.*

EXHIBIT 3 | The Potential Impact of Advanced Analytics on a Typical Payer

	Hypothetical health plan	Impact of advanced analytics	Plan after transformation	Primary drivers
REVENUE	$6.1 billion	Additional **6%** growth	$6.55 billion	• Increased retention • Member acquisition price optimization • Data-driven B2B sales
MEDICAL COST	−$5.05 billion	Medical loss ratio is reduced by **8** percentage points	−$4.94 billion	• Improved chronic care management • Increased provider enablement • Reduced fraud, waste, and abuse
ADMINISTRATIVE COST	−$992 million	Administrative cost is reduced by **13%**	−$924 million	• AI assistance • Removing non-value-added care management work
INCOME	$61 million		$680 million	
MARGIN	1.00%		10.39%	Additional margin used to invest in the plan's growth via lower plan prices and higher-quality care

Source: BCG analysis.

MAKING BIG DATA WORK

HEALTH CARE PAYERS AND PROVIDERS

by Karalee Close, Stefan Larsson, John Luijs, Neil Soderlund, and Anna Vichniakova

HEALTH CARE PAYERS AND providers have access to more data than the vast majority of organizations. So why hasn't more been done with that data to slow the rapid climb in health care spending and begin competing on outcomes rather than expenditures?

The answer is that, despite the promise of electronic medical records, much of the data that reveals what works in health care has been inadequate and unusable—or is missing altogether. What's more, organizational silos have made it difficult to link together pieces of information to show health-related patterns for any given patient group.

Policy makers and industry leaders in most countries are trying to shift to reimbursement and delivery models, such as payment by results, episode-based payment, and value- and population-based health care. These models demand much more detailed insights into what drives outcomes than previous ones did. They also require significantly different data sources in order to tease out the impact of a current treatment and its associated expenditures and other variables, such as treatments performed, genetics, risk factors, patient behaviors, and the environment. (See *Competing on Outcomes: Winning Strategies for Value-Based Health Care*, BCG Focus, January 2014.)

Big data and advanced analytics, used intelligently, provide an opportunity to bring to-

gether diverse data sources—including patient records, clinical trials, insurance claims, government records, registries, wearable devices, and even social media—to understand health in a truly value-oriented way. Payers and providers—and, by extension, all health care consumers—can now discern the extent to which each intervention and its associated expenditures contribute to better health.

Three High-Potential Opportunities

Data can transform health care in seemingly endless ways. But are these future scenarios real?

Most areas of health care are in the early stages of using big data and advanced analytics; many more sources of data and ways to combine and analyze information will emerge. Still, based on our work with payers and providers across many countries, we see three particular opportunities among many that offer high potential right now. Exploiting them could measurably improve outcomes as well as generate significant additional revenues and profits.

Optimizing Care for Patient Populations.
Governments and other integrated payers and providers often lack a comprehensive view of complex usage, needs, and outcomes trends at the local, regional, or national level.

This is particularly true for chronic diseases, which consume most health care resources in the developed world.

To achieve the greatest improvement in outcomes, payers and providers need to allocate resources proactively, before patients seek care, and then track their impact. But to do this well, data needs to be comprehensively aggregated and analyzed at the level of large populations. The data can be used to target services more directly to the area of need, reduce waste, and redirect spending to effective interventions.

Payers and providers need to allocate resources proactively, before patients seek care.

Consider the case of the department of health for the state of Victoria in Australia, which undertook a major effort to analyze health care spending on citizens. Federal and state governments, along with private insurers, each pay for about one-third of third-party health care spending for every individual in Australia. But they have little visibility into—and no control over—one another's expenditures, which allows for the possibility of duplication and gaps in services. With overlapping responsibilities, governments and insurers cannot link together the need for services, the level of care being delivered, and the outcomes of those services. Not surprisingly, no payer or provider is prepared to be accountable for outcomes, and data for comparing outcomes among citizens is not available.

The health department wanted to create an integrated picture of health care across the state of Victoria by combining data about health needs from population surveys with information about services paid for by each of the responsible payers and with outcomes data from patient, population, and clinical sources. Even though this data had been collected for some time, the complexities of aggregating and interpreting it had discouraged earlier efforts.

The health department developed a seven-step model of the natural progression of chronic diseases in order to organize the more than 400 health-related measures gathered. This was done at the city and neighborhood levels to pinpoint specific needs while still maintaining individual privacy. The department compiled a picture of health needs, service usage, and outcomes across 200 areas—each with a population of around 25,000—to identify areas of over- and undersupply and to assess the effectiveness of the health services they received.

The state learned, for example, that while primary-care providers are quite effective in managing chronic diseases in more affluent communities, they are relatively ineffective in low-income communities, resulting in high costs, hospitalization rates, and mortality levels in those areas. The results of the analysis highlighted a number of neighborhoods with particularly poor chronic-disease outcomes, despite adequate access to and use of services, suggesting opportunities for quality improvements. (See Exhibit 1.)

The analysis looked at the rate of hospitalizations for ambulatory-care-sensitive conditions (which include illnesses such as diabetes, asthma, and chronic obstructive pulmonary disease) because hospitalization serves as an important barometer of patient access to primary care in these cases. The department discovered that even a modest reduction in avoidable hospital admissions through better primary care would save health care payers an estimated A$60 million per year. In addition, it found that rates of screening colonoscopy in areas with high levels of private insurance were six to seven times the expected rates given the demographics, and outcomes were no better than in areas with low rates of screening, suggesting a significant opportunity to redirect resources and improve patients' quality of life without adversely affecting population health.

Reducing the Cost of Care. Payers, whether governments or private insurers, face a huge hurdle in bending the cost curve downward to slow the pace of growth in health care expenses. One area ripe for improvement lies in reducing the cost of care. Since the cost of

Unexplained variation in avoidable admissions

Difference from expected rate of avoidable admissions per year
(percentage points)

Expected rate of avoidable admissions per year (%)[1]

- Hume
- Northern and Western Metro
- Southern Metro
- Eastern Metro
- Grampians
- Gippsland
- Barwon South Western
- Loddon Mallee

○ 1,000 chronic hospitalizations for ambulatory-care-sensitive conditions
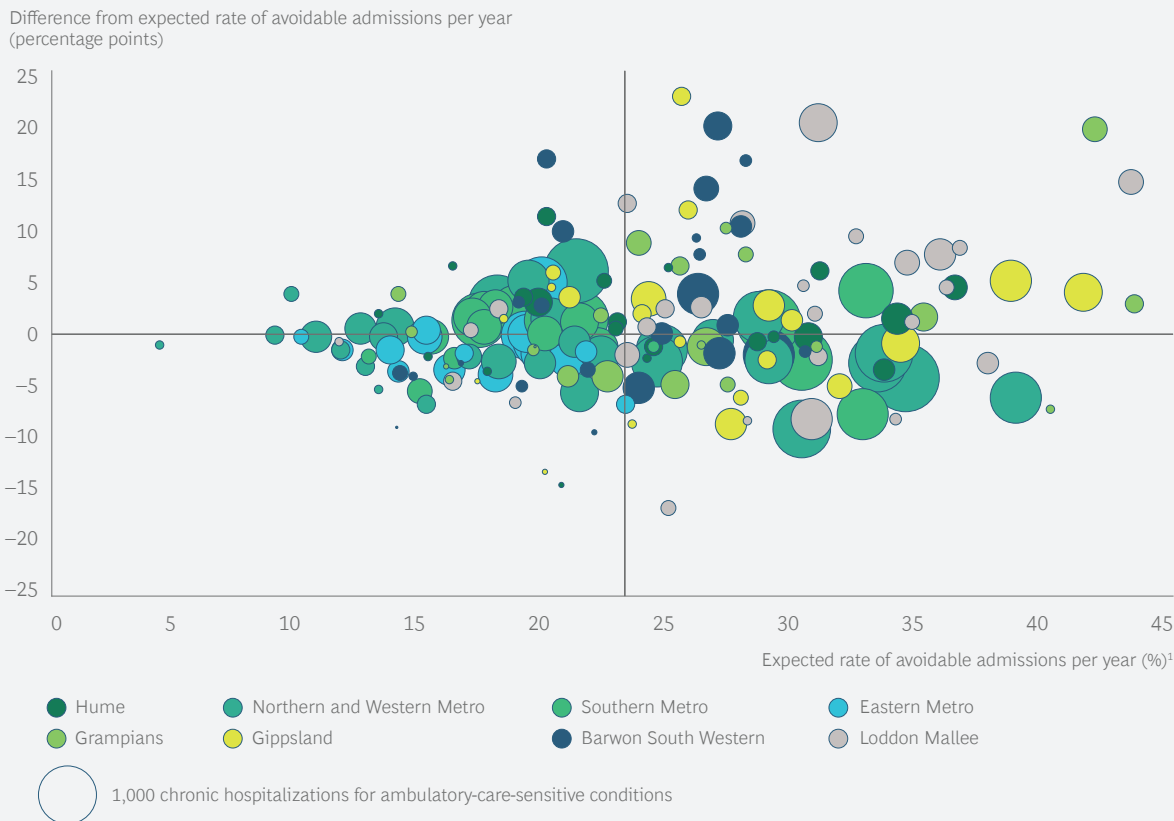
Sources: Victorian Admitted Episodes Dataset 2007–2011; integrated Victoria Department of Health dataset; BCG analysis.
[1]Expectations after accounting for demographics, risk, morbidity, and utilization of ambulatory care.

care generally accounts for 90% to 95% of total costs for an efficient payer, every 1% reduction in the cost of care has the same effect as a 10% to 20% reduction in operational costs.

Still, many payers consider the cost of care to be unchangeable. They routinely enter into contracts with hospitals based on historical budgets plus a small percentage increase for inflation growth. Frequently, they do not differentiate their negotiations by hospital. And they conduct only limited benchmarking about differences in costs or quality across hospitals and providers.

In the area of procuring care alone, we see enormous potential to drive down costs through the use of big data. A leader in this area is VGZ, one of the largest payers in the Netherlands, with about 4 million clients and a cost of care of about €10 billion per year. As

a result of major investments in data-driven health care procurement, the company has identified significant potential for improving quality while producing estimated savings of more than €500 million by 2016. One target was prescription drugs, which accounted for about 15% of costs. The company focused on prescriptions for generic drugs when they first became available off patent as a substitute for brand-name drugs. Often, generics cost less than 10% of branded medicines. An analysis showed that switching almost entirely to generics for just one cholesterol-controlling drug, Lipitor, would save more than €30 million.

In most countries, pharmacies are obliged to deliver a generic drug instead of a branded drug. But prescribers can state that medical necessity requires the patient to receive the expensive branded drug instead. Since the active ingredient in generics is the same as in

branded drugs, prescriptions for a branded drug on the grounds of medical necessity should be rare—for example, less than 5% of prescriptions, according to calculations based on best practices. In practice, however, VGZ found that for a number of important drugs, the expensive branded version accounted for approximately 30% of prescriptions. In an effort to bring up the rate of generic adoption among doctors much more quickly, the payer decided to use its own records to pinpoint exactly who appeared to be overprescribing branded drugs.

First, VGZ brought order to millions of rows of chaotic, raw claims data by using advanced analytical techniques to unravel the prescription patterns of every doctor and specialist by drug. The company looked in particular for anomalies and outliers that indicated overprescribing behavior by specific doctors and groups and unusual combinations of prescribers and prescriptions. The analysis focused on the top 25 medicines with the greatest potential for reducing prescription drug costs. A compelling visualization showed the prescribing behavior of groups of doctors

and, when required, the prescribing behavior of individual doctors as well. For the first time, the payer could show groups of doctors how the behavior of their members compared with best practices. Extreme outliers were highly visible. (See Exhibit 2.)

This visual tool created an opportunity for the payer to have constructive discussions with providers and to improve their prescribing behavior. The focus on costs helped bring down the rate of branded-drug prescriptions to below 5% for nearly all the drugs studied, saving the payer more than 10% of total pharmaceutical costs. Similar benchmark analyses are now being used in other areas, such as diagnostics, hospital contracting, and claims verification. For instance, VGZ has developed advanced analytic algorithms to automatically analyze millions of lines of data across different areas of care in order to highlight suspicious combinations of treatments and instances in which medical specialists seem to choose the most complex or expensive treatments.

Reducing Hospital Readmissions. Health care organizations frequently struggle to capture,

EXHIBIT 2 | A Big-Data Analysis Showed Which Doctors Were Overprescribing Expensive Branded Drugs

The top five drugs with the highest savings Potential in one regional group of doctors
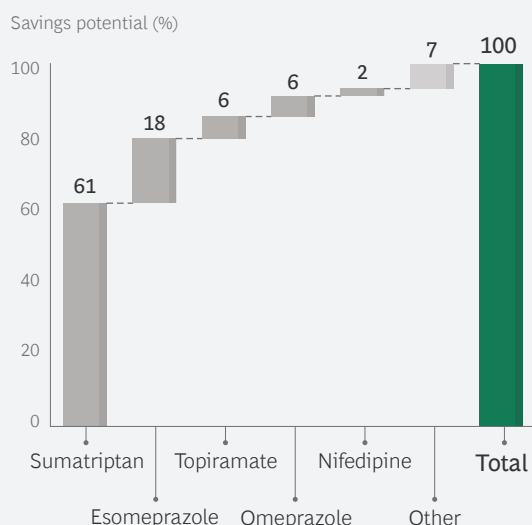
The individual doctors who tended to Overprescribe one branded drug[1]
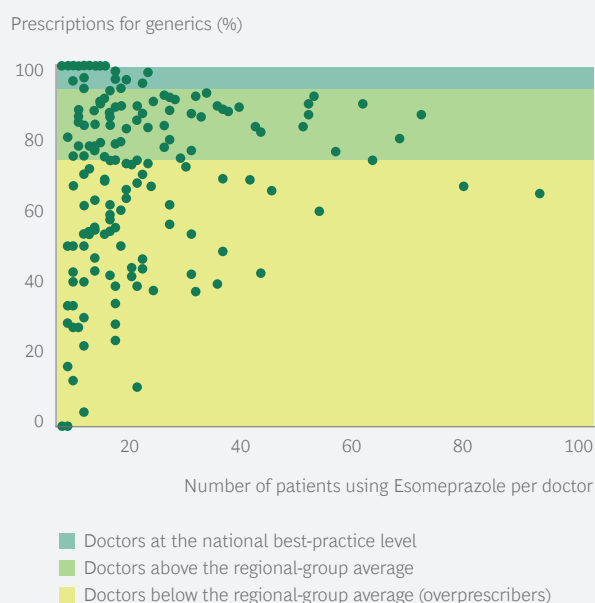
Source: BCG analysis.
Note: Based on one regional group of doctors.
[1]Each data point represents an individual doctor.

integrate, and share valuable information among internal departments and external partners. But organizational and technological barriers often prevent payers and providers from seeing the big picture, which would enable them to transform the cost and quality of care.

Many people hoped that electronic medical records (EMRs) would solve these problems. But traditional EMR systems do not provide much of the data required to assess outcomes and behaviors, such as socioeconomic status and health patterns within populations—obesity and smoking rates, for example. Another problem is that 80% of hospital data is unstructured, often taking the form of patient interviews and paper-based records, which may be stored in incompatible systems by different organizations. Claims data may be readily available but is typically poorly structured and inconsistent. Privacy regulations also limit how data is combined and used.

Integrating disparate data sources, as is done with big data, can overcome these hurdles. A large government-run hospital trust in the UK, for example, achieved powerful results with this approach. The trust wanted to decrease readmissions by 5% within a year and thereby reduce the length of hospital stays, the number of preventable deaths, and the incidence of hospital-acquired infections. The move would also help hospitals avoid the significant financial penalties imposed by regulators for high rates of readmission.

The hospital trust first combined existing internal data about patients and locations with publicly available data. This enabled the trust to identify factors—such as specific diagnoses, wards, and times of discharge—that were associated with higher-than-expected readmission rates.

Next, the trust developed a predictive algorithm that could identify—at the time of admission—the groups of patients who were most at risk of readmission. Identifying those patients at such an early stage meant that providers could do the most to lower the odds of readmission by adjusting staffing levels, planning for medical reviews on discharge, and arranging training for patients

about their drug regimens after discharge. For instance, the provider learned that information such as the age of the patient, the length of any previous stays, the time of admission, the reason for the hospital visit (such as an elective procedure or an emergency), and whether there were any previous emergency admissions could be combined to create a highly predictive profile of patient risk. The profile was then converted to a color-coded system that was easy to understand so the staff could quickly set in motion the right approaches upon admission.

Integrating disparate data sources can overcome barriers to seeing the big picture.

The trust also identified four groups of patients with high numbers of avoidable readmissions and devised tailored interventions to address their needs. For example, when the trust found that 50% of urology readmissions occurred within one day of discharge, it established a program for educating patients on proper catheter use, supported by rapid-response community nursing.

As a result of the hospital trust's use of these tactics and others, preventable readmissions have fallen, and the approach is now being rolled out across the trust.

How to Begin

As payers and providers explore the opportunities enabled by big data, they should take the following initial steps.

- **Start where there is tangible value.** Small steps combining existing data in new ways to solve specific issues can have more immediate impact than big-bang solutions that try to do everything. EMR systems and data warehouses are not always the best places to start, either because they do not have the most relevant information about outcomes or because a more agile and iterative approach could capture value more quickly. Some of the most interest-

ing initial insights can be gleaned from creating segmentations and population-level analyses of existing information, such as the age of patients and referral patterns.

- **Focus on the patient—not on the institution.** Care delivery is a complex, multidimensional process involving many providers. For chronic diseases, it can span a lifetime. Providers spend considerable time and energy reducing budgets and optimizing processes. The patient perspective is often missing, however. To generate new insights, organizations need to understand the novel sources of data that offer insights into groups of patients. Often that data lies beyond the four walls of the hospital, such as with patients themselves.

- **Ensure trust.** Health information is often quite sensitive and involves important legal and regulatory constraints about its management and use. Health care providers cannot afford to lose the trust of regulators and patients. To earn trust and gain access to even greater amounts of personal data for big-data applications, payers and providers must communicate transparently how they use and secure confidential data across multiple organizations and demonstrate the important benefits to patients of emerging big-data approaches. (See *The Trust Advantage: How to Win with Big Data*, BCG Focus, November 2013.)

- **Develop analytic capabilities to improve costs, value, and the coordination of care.** Most payers and providers have pockets of expertise in clinical processes and IT but require additional capabilities to generate integrated insight and improvements in practice. They must bring together a combination of skills in order to find related internal and external sources of population-level data and to work with emerging tools. They may need to create new partnerships or work within new ecosystems to source, combine, and explore data across multiple organizations and locations.

BIG data and advanced analytics offer tremendous potential to solve some of health care's thorniest problems—if the industry can overcome significant barriers to improving its efficiency and effectiveness. Today's data-rich world offers vast new potential. The key to success lies in focusing on pragmatic steps that drive real value instead of chasing the latest fads.

Karalee Close is a partner and managing director in the London office of Boston Consulting Group, and the global leader of BCG's Technology Advantage practice. You may contact her by email at close.karalee@bcg.com.

Stefan Larsson is a senior partner and managing director in the firm's Stockholm office, the global leader of the payer and provider sector in the firm's Health Care practice, and the leader of BCG's efforts in value-based health care. You may contact him by email at larsson.stefan@bcg.com.

John Luijs, an expert in payer analytics, was formerly a principal in BCG's Amsterdam office.

Neil Soderlund was formerly a senior advisor in the firm's Sydney office.

Anna Vichniakova was formerly a principal in BCG's London office and a core member of the firm's Health Care and Technology Advantage practices.

HOW VITAL COMPANIES THINK, ACT, AND THRIVE

by Martin Reeves, Gerry Hansell, and Rodolphe Charme di Carlo

"Vitality shows in not only the ability to persist but the ability to start over."
— F. Scott Fitzgerald

"How do you keep the vitality of day one, even inside a large organization?"
— Jeff Bezos

LEADERSHIP HAS ITS BENEFITS—SCALE, knowledge, influence, and financial stability among them. But our research shows that as companies age and grow, incumbents increasingly focus their attention on internal matters, have more difficulty freeing themselves from legacy businesses and approaches, and progressively shift their priorities toward running—rather than reinventing—the business. Nontraditional competitors, disruptive technologies, and new business models are making corporate reinvention a critical priority.

How can legacy leaders remain vital—to preserve and develop their capacity for growth, risk taking, innovation, and long-term success? In creating a quantitative measure of corporate vitality and its underlying drivers, we hope to provide a working framework of what matters when managing the balance between delivering near-term execution and investing in the future. The drive to maintain vitality has organizational, financial, and cultural levers—all of which reinforce each other.

VITALITY: A NECESSITY FOR LONG-TERM GROWTH

The challenge is straightforward: growth is critical for sustained value creation. In the short term, companies can create value by optimizing costs or assets or by building investors' expectations. Yet in the long run, most value creation comes from top-line growth, which accounts for 74% of total shareholder return of S&P 500 top-quartile-performing companies over a ten-year period. (See Exhibit 1.)

Approximately 10% of large US companies are growing at double-digit rates.

The good news is that achieving sustainable growth is still possible for today's incumbents. Approximately 10% of large US companies are growing at double-digit rates. (See Exhibit 2.) Among that 10%, many—such as Visa and Mastercard (credit cards), Hilton (hotels), Constellation Brands (alcoholic beverages), and O'Reilly (auto parts)—are from nontech industries. What is their secret?

In today's rapidly changing environment—with elevated political, social, and technological uncertainty—what will make a company

EXHIBIT 1 | Growth Is Critical for Long-Term Value Creation

Sources of TSR among top-quartile S&P 500 companies

Change in annual TSR,
1990–2009 (%)

	One year	Three years	Five years	Ten years
Other growth	71%	50%	42%	26%
Sales growth	29%	50%	58%	74%

Share of total | ■ Other growth ■ Sales growth
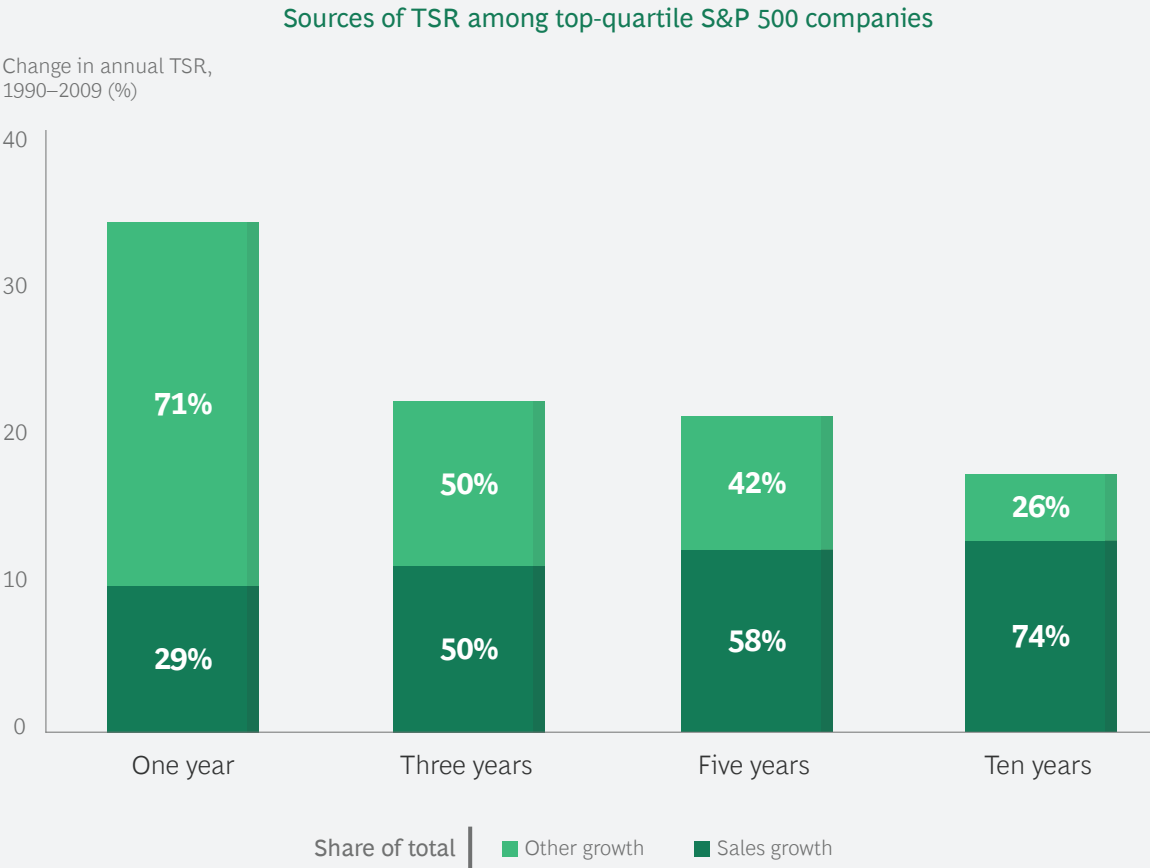
Source: BCG Henderson Institute.

EXHIBIT 2 | Few Incumbents Maintain Strong Growth

Five-year growth by market capitalization

>$20 billion

$10 billion–$20 billion

$1 billion–$10 billion

~10%

−20   −10   0   10   20

CAGR, 2011–2016 (%)
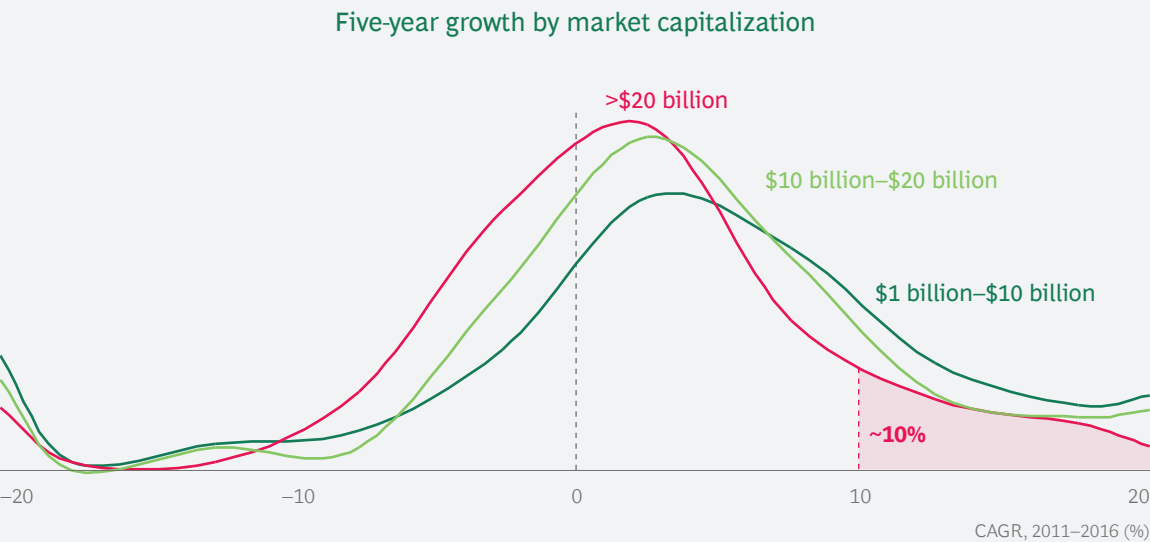
Source: BCG Henderson Institute.
Note: Market capitalization as of 2011, excluding energy companies.

thrive tomorrow is different from what makes it succeed today. Current performance is less and less predictive, and an overreliance on backward-looking metrics can be deceptive. Many of today's large incumbents are vulnerable, even if they have a solid track record of past performance.

And abrupt failures are happening increasingly frequently—think Kodak or Blockbuster—in no small part because of the risk of digital disruption. Even when their positions seem comfortable, incumbents need to create a sense of urgency and preemptively address the requirements to sustained success. They must develop their capacity for growth and reinvention. This is what we call vitality.

We can measure vitality by using BCG's proprietary methodology behind the Fortune Future 50—the result of a two-year research partnership between BCG and Fortune magazine. This index ranks the most vital US-listed companies. To build it, we collected theories purporting to explain the ability of a company to grow and associated them with measurable variables. We then tested the theories against historical data and kept only variables that had a measurable and robust impact on long-term revenue growth. As expected, a company's age and size of have a negative impact on growth, confirming that the more established the incumbent, the harder it is to remain vital.

We were also able to identify these key building blocks for vital companies (see Exhibit 3):

- **The Ability to Continuously Develop Future Growth Options.** This is the main driver of vitality for incumbents. It can be achieved by constantly renewing a pipeline of potential bets, catalyzed by an entrepreneurial spirit that facilitates ongoing exploration—even when the fruits of a previous exploration are in the midst of paying off.

- **The Willingness of Leadership to Think Differently About Strategy.** Unlike the companies that are narrowly focused on maximizing short-term total shareholder return, leaders of vital incumbents are focused on exploration and have a long-term orientation. We know this because we trained a natural-language-processing algorithm on 70,000 annual reports filed by companies to the US Securities and Exchange Commission. This enabled us to detect future-oriented strategic thinking and demonstrate that it is positively correlated with long-term revenue growth.

Furthermore, leaders must drive this long-term orientation into the organization, by promoting "day one" mentality, for example, and allocating sufficient resources to place and evolve bets.

EXHIBIT 3 | The Key Building Blocks of a Vital Company

Source: BCG Henderson Institute.
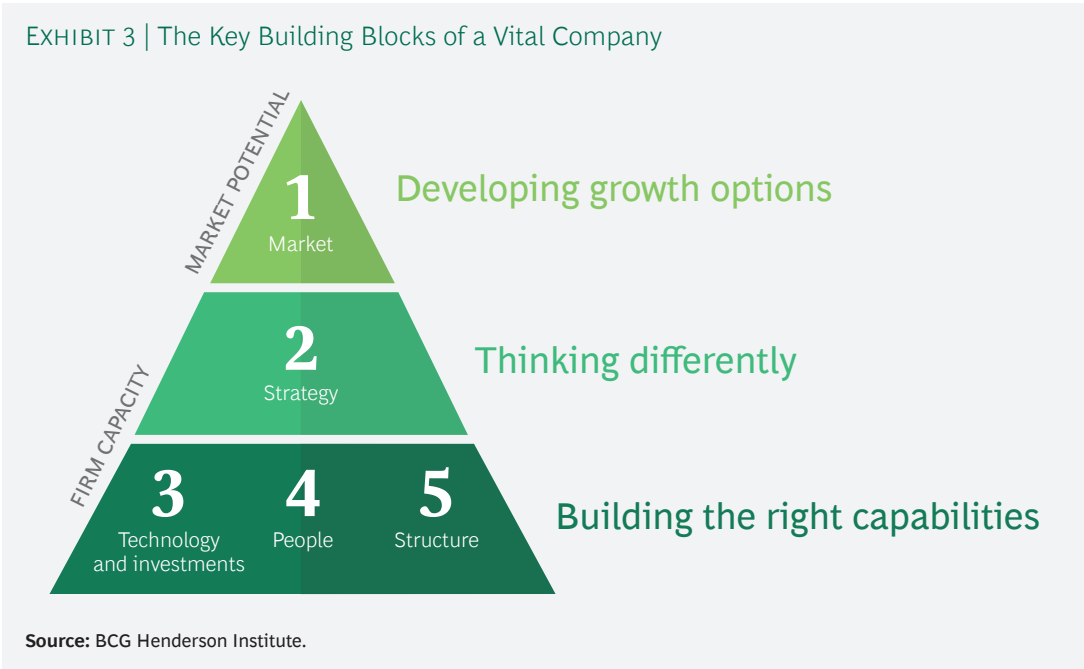
Thornton Tomasetti, a leading engineering firm, embraces this mindset fully in its five-year strategic vision: "We keep our eyes and minds open, test new ideas thoroughly, and invest selectively and quickly."

- **The Determination to Build the Right Capabilities.** Strategy and execution cannot be separated from one another, and to be vital, companies need to build the right capabilities—especially in relation to technology and people. Vital incumbents are able to stay on top of relevant emerging technology, in part by using transformative (as opposed to scale- and cost-driven) M&A moves when needed. They employ "post-merger rejuvenation" to acquire smaller, faster-growing companies and inject new capabilities and stimulate growth.

In addition, the most vital companies maintain a diverse and youthful organization at all levels—including within the boardroom—by providing leadership opportunities for upcoming talent. Our research shows that there is a statistically significant relationship between innovation and diversity in its many dimensions.

THE CHALLENGE OF AMBIDEXTERITY

Vitality alone is not enough for incumbents to thrive and grow sustainably. Overperformance within the core business is also necessary in order to finance vitality. Even if having deeper pockets is a potential advantage for incumbents, they must still work at realizing ambidexterity—being able to run and reinvent the company at the same time. (See Exhibit 4.)

It is difficult for any company to embrace the contradiction of ambidexterity—optimizing current performance while building the potential for long-term growth. This is especially true for incumbents, whose current business model can easily dominate resources, talent, and thinking. The most obvious impediment to ambidexterity for incumbents is sheer size, and there are several factors that can turn the benefits of scale into the burden of inertia.

First, as companies grow older, successful behaviors from the past tend to ossify into fixed thinking and processes, as well as specialized talent. Leaders can be part of the problem, since they are likely to be associated with, and personally invested in, the current model of success.

EXHIBIT 4 | To Grow Sustainably, Incumbents Need to Focus on Vitality and Ambidexterity

Performance

Vitality

PRESENT

FUTURE

AMBIDEXTERITY

Source: BCG Henderson Institute.
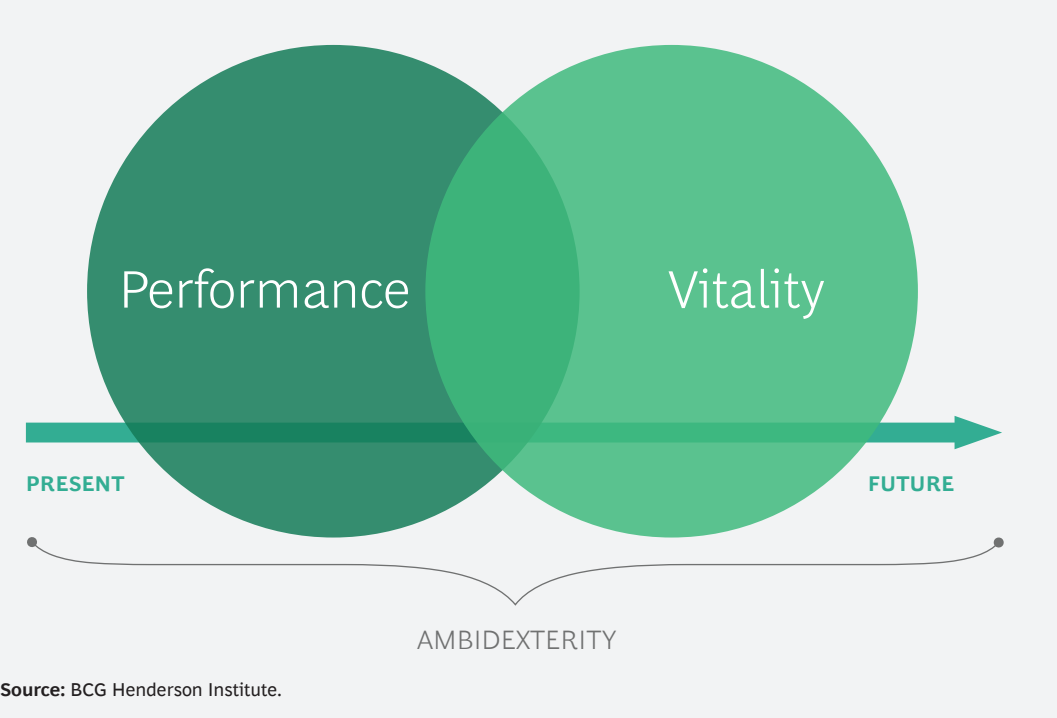
Second, slower decision making and an aversion to risk can be harmful in their own right and also make it more difficult to attract and retain entrepreneurial talent.

Third, companies focused on exploitation—or current performance—have a tendency toward *financialization*: decisions are based predominantly on financial metrics, such as profitability or earnings per share. Exploration might look unattractive or poorly defined when judged by the crisp financial metrics possible for a mature business.

The risk-weighted returns on individual exploratory investments might be low or difficult to quantify, but when considered collectively they can be essential for the continued existence of the company. Sometimes the best way to assess whether a bet is worth the risk may be to compare it with a scenario of the eventual demise of the cash-cow business.

Finally, having a strong TSR track record and a generous dividend policy can also increase investors' expectations of continued short-term cash returns. This can narrow management focus toward optimizing short-term financial wins over long-term investments—that is, performance over vitality.

THREE STEPS TOWARD ENHANCING VITALITY

Building vitality is essential for established companies that want to survive and thrive. Even when measured on the criterion of short-term health, vital companies are in the lead. From 2011 through 2016, the top-10% most vital incumbents in the Fortune Future 50 outperformed their peers by 5% per year in growth and by 10% per year in TSR. (See Exhibit 5.)

To become a more vital organization, company leaders must follow three steps.

Step one: Assess your current vitality. Establish a clear understanding of your starting point from the outside in (by using the Fortune Future 50 methodology) and from the inside out, by answering the following questions:

- What is the growth potential of your pipeline of "future bets"?

- To what extent does your strategy encompass long-term exploration?

- What are you doing to develop leading capabilities in technology?

EXHIBIT 5 | Vital Incumbents Outperform Their Peers

Only 10% of incumbents are highly vital

Market potential score, 2016

~10%

Firm capacity score, 2016

Vital incumbents in the *Fortune* Future 50 perform better than their peers

~5%
Higher growth per year

~10%
Higher TSR per year

Source: BCG Henderson Institute.
Note: Incumbents are companies older than 40 years with market capitalizations of more than $20 billion; energy companies excluded. Scores are calculated using the Fortune Future 50 index. Fortune Future 50 incumbents are compared with all other incumbents. Growth comparison is over a five-year period, from December 31, 2011, through December 31, 2016.

- Are you willing to challenge the approaches and beliefs that have historically made you successful?

- Are you taking a risk on new talent, and is your organization cognitively diverse?

Step two: Strengthen or renew sources of vitality. This can include a range of measures:

- **Create a portfolio of growth options.** Companies need to have a balanced portfolio of bets on different timescales. In order to do this, they must develop a tolerance for failure and create incentives for entrepreneurship.

  Recruit, one of Japan's most successful large companies in recent times (20% growth per year in the past five years), embodies this culture perfectly. Recruit's New Ring program, which receives more than 1,000 proposals every year, allows any employee, sometimes in collaboration with outside stakeholders, to propose starting a new business in line with the company's hybrid ecosystem philosophy. By doing so, leadership is able to systematically identify, nurture, and celebrate entrepreneurial talent within the company.

- **Build adaptive and shaping capabilities.** Incumbents often have strongly developed capabilities to deal with classical strategy and execution, which is powerful and necessary in mature businesses. But the uncertain environment of many emerging businesses requires a more adaptive approach to strategy and execution. This requires, for instance, a system to seed, test, and scale new ideas in a rapid and iterative fashion.

  In addition, shaping capabilities enable incumbents to influence their business environment rather than be at its mercy. These include the ability to conceive and create new markets, mobilize others around new win-win propositions, create and orchestrate collaborative ecosystems, and allow these ecosystems to evolve as circumstances change. A famous example is Apple's transformation of the smartphone market. It triumphed against incumbent players by building an ecosystem of collaborators that together could create a smartphone and a rich library of software, instead of attempting to build everything internally.

- **Invest in technology.** Technology capabilities are even more important than one might imagine. Our analysis shows that a common feature of the least vital incumbents is the weakness of their technology portfolio. At the other end of the spectrum, Mastercard (number 14 on the Fortune Future 50 ranking) illustrates how having a strong emphasis on technology can help incumbents evolve and thrive. Mastercard has shifted from being a payments company to also becoming a technology leader, as expressed through its mission: "We're providing the technology that's leading the way toward a world beyond cash."

- **Maintain dynamism and diversity.** Compositional diversity is not enough. Diversity of employee backgrounds favors but does not guarantee innovation. Also necessary is an environment that is conducive to encouraging diversity of thought and a collision of ideas. Thornton Tomasetti's five-year strategic vision states, "Everyone contributes to learning, and new ideas are given a chance."

  There are several other ways to broaden an organization's thinking, including maverick scans and scenario-based stress tests. In addition, using a flat, adaptive structure as well as team-based leadership helps to foster further diversity of thought. The more fluid an organization, the more it allows people to self-organize around new ideas and better ways of doing things. For example, Morningstar Foods has adopted an extreme "no-hierarchy" structure that allows for "a lot of spontaneous innovation and ideas for change [to] come from unusual places."

- **Self-disrupt *before* being disrupted.** Recent research shows that only one-third of incumbents facing disruption survive and thrive. Survival depends on preemptively creating a sense of urgency and a will to self-disrupt before being disrupted.

- **Self-disruption can either happen internally or through M&A moves.** The former requires boldly rethinking the business model, while building on existing advantages. Restructuring to separate or divest legacy businesses can be part of the solution, too. Otherwise, incumbents can look outside and consider acquiring—or *acqui-hiring*—disruptive and emerging companies. This can result in post-merger rejuvenation, as happened to Disney when it used Pixar as a stimulus for self-disruption, learning, and ultimately growth.

Step three: Lead with ambidexterity, according to the following checklist:

- **Choose the right approach to strategy for each part of the business.** Mature core businesses require very different approaches to strategy and execution than emerging ones do. As laid out in *Your Strategy Needs a Strategy*, the approach to strategy and execution needs to be flexed, based on the business environment that each part of the business faces.

- **Structure to enable multiple approaches.** Ambidexterity enables firms to deploy different approaches to strategy simultaneously in each part of the business and manage the resulting contradictions. As a result, ambidextrous firms can simultaneously perform strongly and be vital. This is challenging for incumbents, but adopting the right organizational structure can help.

The Chinese consumer-goods company Haier, which went from near-bankruptcy in the 1980s to its global market-leader position today, is a powerful example of how adjusting organizational structure can be the path to ambidexterity. How did it do it? In an effort to improve its ability to deliver customer value, the conglomerate flattened its organization and developed 2,000 self-governing units. This drastic change enabled each unit to function like an autonomous company and use an approach to strategy tailored to its specific situation.

- **Manage the "investor story."** As a response to short-term-oriented investor

pressures, incumbent leadership needs to convince investors that current performance is on track and the business case for future investment is sound. This is a very important step in buying time and permission to strengthen vitality.

Andrew Wilson, CEO of Electronic Arts (number 25 in the Fortune 50), gave a presentation to investors that exemplifies how a forward-looking vision should be communicated. He started by emphasizing the positive short-term and midterm financial outlook driven by the core portfolio and then laid out an inspirational long-term-growth strategy focused on new portfolio bets, new geographic expansion, and business model innovation.

INCUMBENT businesses are at a crossroads. Short-term performance is strong overall, but political, social, and technological change and uncertainty cloud the horizon. Thus, the prize for being vital is more valuable than ever. With equal emphasis on performance and vitality, companies can thrive into the future.

Martin Reeves is a senior partner and managing director in the New York office of Boston Consulting Group and the director of the BCG Henderson Institute. You may contact him by email at reeves.martin@bcg.com and follow him on Twitter @MartinKReeves.

Gerry Hansell is a senior partner and managing director in the firm's Chicago office and a senior member of BCG's Corporate Development and Strategy practices. You may contact him by email at hansell.gerry@bcg.com.

Rodolphe Charme di Carlo is a project leader in the firm's New York office and an ambassador at the BCG Henderson Institute. You may contact him by email at charmedicarlo.rodolphe@bcg.com.

THE BUILD-OR-BUY DILEMMA IN AI

by Philipp Gerbert, Sylvain Duranton, Sebastian Steinhäuser, and Patrick Ruwolt

As companies in all industries explore the rising power of artificial intelligence (AI), they face a familiar dilemma: Should we build or buy? This is rarely an either-or choice. AI vendors have attracted most of the AI talent, so companies are compelled to work with them. At the same time, AI vendors rely heavily on data that only their customers can provide, so such vendors need to work more closely with clients than they may be accustomed to doing.

Consequently, companies have several challenges. They must decide how to select and work with AI vendors both efficiently and in ways that strengthen rather than sacrifice competitive advantage. And they should have a plan for building their internal AI capabilities in an era of short-term scarcity.

Why AI Is Different

Recent computing advances—fostered by Moore's law and its corollaries, as well as big data and algorithmic advances—have caused AI business applications to mushroom. A number of them also take advantage of recent advances in vision and language by machines. (See "Competing in the Age of Artificial Intelligence," BCG article, January 2017.) Machine vision, for example, is a core component of robots, drones, and self-driving vehicles, while speech recognition and natural language processing are integral to document processing, chatbots, and translation devices.

But until recently, AI was largely relegated to an academic niche. As a result, few seasoned professionals currently work in the field—and still fewer of them understand business processes, such as supply chains, or have experience interacting with business executives. This supply-and-demand imbalance will eventually self-correct as academic institutions around the world, including those in China and Eastern Europe, respond to market demand by churning out greater numbers of AI-trained graduates. Until that happens, the question remains how—not whether—to work with AI vendors.

Vendors play a distinct role in an AI world. That's because AI learns inductively— through trial and error, best guesses, and feedback. Vendors, therefore, need to train their AI tools using data, which often includes sensitive information from their clients. As a result, vendors normally cannot sell plug-and-play applications; they need to work closely with their clients on AI training both during and after the run-time deployment. (See the sidebar.)

AI can bring both enormous benefits and disruption. With such high stakes, companies cannot afford to play a passive role. If they are careless, for example, they may share

GETTING SMART ABOUT AI

Companies that pursue AI strategies should have a grounded understanding of how the field differs from other technological endeavors and how they should approach their decisions about what tasks to outsource, what things to do in-house, and what skills to develop.

Data and Tools
Most AI algorithms are available for free, and by themselves they are rarely a source of competitive strength. They need to be trained on data. Vendors should be measured by their ability to help companies manage the interplay of data and tools and by their ability to work side by side with business executives. At the same time, business executives should develop a practical and intuitive understanding of AI in order to maximize the effectiveness of their supplier relationships.

Bias
Because AI is inductive, looking for similarities in the training data, the algorithms are subject to three biases: observation bias, selection bias, and model or forecasting bias. In particular, when the training data is not carefully scrutinized, companies can inadvertently discriminate against minorities, run afoul of regulators, or be exposed

to "black swan" events. This is aspect of data-tool interdependence is absent from most other technological domains; it requires companies to understand, adjust, and potentially complement the data feeding their AI engines.

Black Box
The use of inductive learning essentially makes AI an "intuition machine." As a result, it is often hard to understand in hindsight why an algorithm generated a particular answer. Remedies to this black-box problem constitute an active field of research. For the practitioner, a simple rule of thumb is to build transparency into the upfront design specification. This is especially relevant in regulated industries and situations in which liability issues can arise.

Cybersecurity
Since AI always involves partial or full automation of decision making and action, and often includes highly sensitive data and cloud-based architecture, cybersecurity becomes a top priority. When choosing a vendor or platform, companies should make sure that their data will be protected from a potential breach.

valuable intelligence that weakens their competitive position. And if they don't build internal capabilities, they risk becoming dependent on vendors.

When assessing AI's potential, executives should be familiar with the current capabilities, limitations, and potential of what we call the AI building blocks. These blocks, such as machine vision, are functioning units that contribute to creating an operational application. Every use of AI incorporates one or more of these building blocks, and each block relies on a collection of algorithms, application programming interfaces, and often pretrained data. (See "The Building Blocks of Artificial Intelligence," BCG article, September 2017.)

Dissecting the Build-or-Buy Dilemma

Companies can work with AI vendors in many ways, ranging from outsourcing an entire process to buying selected services, seeking help in building in-house solutions or training internal staff. Executives should view these options in light of two questions:

- How valuable is the process or offering to your future success?

- How strong is your ownership, control, or access to high-quality, unique data, relative to the AI vendor?

By analyzing the AI landscape in this way, companies will discover that their AI efforts

land in one of four groups. While the boundaries may be fuzzy, and assessments may shift over time, each of these groups shares similar sets of challenges and opportunities. (See the exhibit.)

Commodities. This area is the closest to an off-the-shelf solution and a great entry portal into AI for companies. They can share data with vendors without fear of losing competitive differentiation. If they manage their relationship with vendors properly, they can lower costs and improve the performance of such processes as HR, finance, IT infrastructure, and maintenance. It is the proverbial low-hanging fruit of AI.

Business process outsourcers are revising their business models to take advantage of these opportunities. Infosys, for example, recently required all employees to undergo intensive design-thinking training in order to spur them to come up with ways both to automate their current jobs and to offer clients creative AI-technology-enabled solutions.

Many smaller vendors offer turnkey AI services for specific subprocesses. For example, HireVue screens job candidates for Goldman Sachs on the basis of such characteristics as word choice and facial expression, which an AI engine analyzes. HireVue currently has a database of more

than 20 million video interviews—a data trove that an individual user company would be challenged to duplicate.

Before entering into negotiations with a vendor, companies should do their homework to understand the value of these AI-enabled offerings and the vendor's distinctive contribution. A wind park operator, for example, conducted proof-of-concept work internally before negotiating with an AI turbine vendor on a predictive maintenance contract. By establishing a new baseline of what it could achieve without the help of the vendor in terms of greater uptime and lower maintenance of its turbines, the operator managed to strike a better deal.

Hidden Opportunities. Sometimes companies have access to data sources in areas that are not critical to competitive advantage. These data sources provide an opportunity for companies to tap into the technological expertise of AI suppliers and to generate quick wins and insights.

Woodside Energy, for example, worked with IBM Watson to make 30 years of expert knowledge gained from oil platform operations accessible to all employees in the company. The company relied on Watson's natural language processing technology to analyze and classify all data, including 38,000 written

Four Ways to Approach the Build-or-Buy Choice
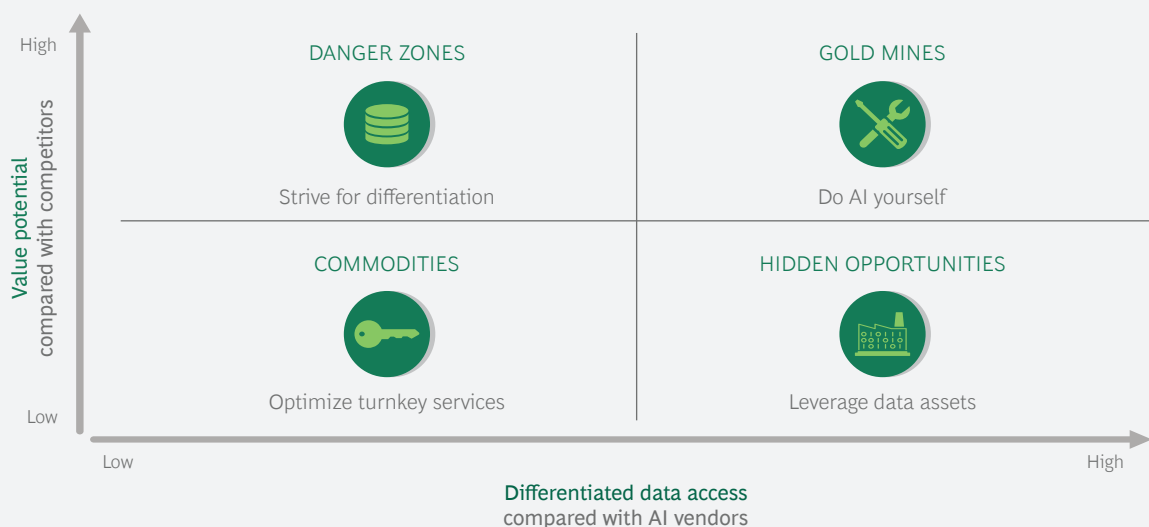
Source: BCG analysis.

documents. Users can ask simple questions, such as "What is the maximum weight of a helicopter landing on the platform?" Although Woodside worked with IBM Watson on the project, it maintained proprietary control of the underlying data.

These approaches can pay dividends in several ways. Often companies can uncover a hidden treasure in massive collections of data and gain skill and experience in training AI algorithms. More ambitiously, companies could conceivably partner with a data-constrained AI vendor to sell application services, pretrained on the company's data, to other companies in related fields. These arrangements could be exclusive, or several companies could work on a data-sharing pool with a vendor.

Danger Zones. Danger zones pose both perils and opportunities. The perils arise because vendors have better access to data than the companies themselves in strategically critical areas. When companies are in a danger zone, they should take care to limit their dependency on the vendor and minimize the possible loss of competitive differentiation. But if companies can manage the relationship well and develop or acquire their own competitive sources of data, danger zones can morph into gold mines—areas of strong competitive importance and data differentiation.

For health care providers, machine diagnosis of radiological images is a danger zone. By working with hospitals, research organizations, and others, a vendor could conceivably create a comprehensive, high-quality database of images that would trump the capability of any single provider. For instance, a company called Arterys is building an AI system in the cardiovascular field that protects patient privacy and is continually improving.

Arterys is a small company. But at scale, automated diagnostics can fundamentally alter industry dynamics and value creation for health care providers, medical technology companies, and insurers. All these companies need to develop strategies that take advantage of the transformative capabilities of AI.

A large metals producer recently took those steps when it recognized that competitors, suppliers, and other vendors within its industry could pool data and gain a powerful edge. The company began to acquire data on prices, suppliers, and materials from a wide variety of public, research, and industry sources. This database will allow the company to accelerate both its AI and R&D efforts and its success in the market. It can potentially open new business opportunities by providing complementary services to other industry participants.

Companies in a similar situation should have data-acquisition strategies that will support their AI activities. They need to find ways to acquire differentiated data, create a novel data mashup from multiple sources, or even acquire suppliers of data in areas critical to their competitive advantage. Without a distinct collection of data to feed into their AI engines, they will be stuck in a bad place.

Often companies can uncover a hidden treasure in massive collections of data.

Gold Mines. Companies need to do AI themselves when they have a gold mine. Vendors and experts can be brought in to accelerate development but only in supportive roles.

A global tire manufacturer followed this approach when it developed an AI platform to predict demand at individual stores for individual models of tires based on anticipated tire wear. The tool, whose development BCG Gamma supported, relies on more than 1.6 billion public and private data points and helped to increase overall sales and reduce inventory levels at dealers.

Many of the most promising gold mines will necessarily involve managing complex "frenemy" relationships with suppliers. In the self-driving vehicle market, for example, all manufacturers deal with the leading AI vendors for various services. In such an environment, companies must have a sharp sense of what they should manage in-house, when

they must look externally for data or expertise, and how to protect their competitive position. Ultimately the greatest value may emerge through cooperation. By partnering with other companies, vehicle manufacturers could conceivably create a global platform that facilitates self-driving vehicles more effectively than any of them could do on their own.

More so than for the other three groups, gold mines require strong in-house talent and the right mix of vendors providing expertise and project management. Robust negotiation and vendor management skills are critical, as are the transfer of knowledge and the training of in-house staff.

THE analysis outlined here should help companies become more efficient and effective in structuring and sourcing AI applications and capabilities. Decisions such as whether to build or buy an AI product or service are too important to be approached haphazardly, but uncertainties should not stand in the way of progress. Companies should make decisions within the context of a coherent data strategy, the pursuit of competitive advantage, and a recognition that boundaries will continually shift over time. Areas of competitive differentiation will evolve, and data

pools that are distinctive today may lose their value as data continues to proliferate. In this dynamic environment, acting systematically, intelligently, and decisively will itself help secure the future.

Philipp Gerbert is a senior partner and managing director in the Munich office of Boston Consulting Group and a BCG fellow. He leads the firm's AI initiative and supports companies' efforts to take advantage of AI in business. You may contact him by email at gerbert.philipp@ bcg.com.

Sylvain Duranton is a senior partner and managing director in the firm's Paris office and the leader of BCG Gamma, an advanced data analytics team. You may contact him by email at duranton.sylvain@bcg.com.

Sebastian Steinhäuser is a principal in BCG's Munich office and a member of the Industrial Goods and Strategy practices. He has extensive experience in digital strategy, analytics, and artificial intelligence. You may contact him by email at steinhaeuser.sebastian@bcg.com.

Patrick Ruwolt was formerly a consultant in the firm's Munich office and an ambassador for the BCG Henderson Institute.

A PRESCRIPTION FOR BLOCKCHAIN IN HEALTH CARE

by Karalee Close, Emily Serazin, Alexander Aboshiha, Amy Hurwitz, Lise Lørup, and Nayel Hakim

AMONG THE INDUSTRIES IN which expectations for blockchain technology run high, health care holds a leading position. And there are a number of good reasons for its prominence. Health care is complex and data intensive. The industry has lots of players. Currently, health care transactions are slow, cumbersome, and expensive. Constraints on access to critical data sets limit progress in research. Data privacy is a big deal. Data security can be a life-or-death matter.

Many industry experts and analysts point to blockchain—the technology that underlies Bitcoin and other cryptocurrencies—as a possible solution for some of the biggest issues that health care faces. They predict powerful new capabilities and a potentially massive disruption of current approaches to services, care, and accountability. Blockchain's potential to speed up and improve R&D, care delivery, and care management, and to reduce costs, they say, is enormous. They may be right, but the road to nowhere is paved with unfulfilled potential, so it pays to be cautious.

A blockchain is a distributed online ledger that can prove whether a piece of data is authentic. Every owner of a Bitcoin—the most widely used commercial application of blockchain so far—can see the history of that particular coin, including where and how it has been spent (although not the identities of its previous owners), to confirm that it is not counterfeit. This online ledger is publicly accessible to anyone on the internet, and no single version exists for a hacker to corrupt. Blockchain thus has the potential to change how we store and share confidential data and how we conduct all manner of transactions, by eliminating agents, brokers, traders, and other intermediaries.

Several of our colleagues have outlined how blockchain can reshape the economics of transaction costs and trust. (See "Thinking Outside the Blocks," BCG essay, December 2016.) Our colleagues did not try to prescribe what companies should do; instead, they offered a strategic context to help executives frame the right questions to ask. Our goal in this article is to bring a similar perspective to the potential for blockchain in health care.

Four High-Impact Scenarios

The same attributes that enable secure, validated, anonymous, and efficient financial transactions with cryptocurrencies—and disintermediate such middlemen as banks and brokers—can be applied to transactions in other data-intensive, highly regulated, and inefficient industries such as health care. All health care applications today are still in early stages of development and proof of concept—but let's consider four promising health-care-related scenarios. (See Exhibit 1.)

EXHIBIT 1 | Four Potential Applications for Blockchain in Health Care

	SECURE SUPPLY CHAINS	PUT PATIENTS IN CHARGE OF THEIR DATA	ACCELERATE R&D	TRANSFORM SERVICE DELIVERY
Today	Track product through every step of supply chain, and record activity	Record audit trail of attempts to access and process data	Use smart contracts to authenticate and authorize data access	Develop use cases for new services by companies and consortia
Future	Apply intelligent algorithms to data to detect fraud or environmental breakdowns	Enable patients to use public and private keys to license data access to third-party organizations	Maintain distributed data analysis platforms, with automated protocol verification and regulatory approval	Develop new services such as using smart contracts to facilitate secure payments
	NEAR TERM	MEDIUM TERM		SIGNIFICANT DEVELOPMENT REQUIRED

Source: BCG analysis.

Securing Supply Chains. Because transactions using blockchain are recorded on a chronological, validated (by an audit trail), and unalterable ledger, blockchain can completely remake supply chains across the health care sector. One major potential application—already in use in other industries such as grocery, luxury goods, and shipping—involves having pharma and medtech companies track the journey of raw materials, compounds, or components through every step of the supply chain, from the source to company facilities to the consumer or patient. The supplier can log information onto a blockchain ledger by direct data entry or by data transfer from sensors connected to the Internet of Things (IoT). Since information on a blockchain is both accessible (to those with permission) and unchangeable, blockchain owners can identify counterfeit materials, malfunctions, or environmental breakdowns, and can validate that materials or components have not been tampered with or subjected to adverse environmental conditions—thus confirming a tamper-free cold chain, for example.

Companies in health care and other industries are developing such solutions. The MediLedger Project, backed by a group of companies that includes pharma giants Genentech and Pfizer, has successfully piloted a program that uses blockchain tools provided by Chron-

icled, a US-based startup, to track medicines. Modum.io combines sensors and blockchain technology to monitor products requiring cold-chain handling to improve pharma supply-chain efficiency. BlockVerify authenticates products by tracking QR codes on packaging on a blockchain (for pharmaceuticals, precious stones, electronics, and various luxury items).

Putting Patients in Charge of Their Data. Blockchain can help put patients in charge of their data, and it can enable physicians at different institutions (that have been granted permission) to access that data for better diagnoses and medical interventions. Today it is technologically possible to record all medical data transactions on a blockchain record, which could enable patients to maintain a complete audit trail of every doctor, provider, payer, medical device, health information exchange (HIE), or other person or entity that has had access to their data. In addition to the obvious diagnosis- and treatment-related benefits of ready access, such full transparency helps build trust between patients and other participants in the health care system. It also avoids the potential privacy and ethical dilemmas that may arise when patients inadvertently share, or companies gain access to, more data than is desired or intended.

One company exploring blockchain's potential with respect to patient data, Google's DeepMind, is working with Britain's National Health Service (NHS) to deploy a private blockchain (a blockchain distributed within a closed network of participants) to create robust audit trails that track exactly what happens to personal data. The goal is to enable the NHS—and eventually patients—to track personal data access and use in real time.

MIT Media Lab has developed MedRec, which it describes as "a novel, decentralized record management system for EMRs that uses blockchain technology to manage authentication, confidentiality, accountability, and data sharing."

Accelerating R&D. Blockchain has the potential to streamline and accelerate R&D, boosting innovation and lowering costs at pharma and medtech companies. For example, it can automatically validate, coordinate, and maintain consistent adherence to approved trial protocols across R&D projects and sites. Patients can self-identify and enroll in clinical trials, and the system will automatically assess and verify their eligibility. Researchers can quickly gather needed clinical data in reliably verified ways, as the system stores all data in a consistent, accessible infrastructure in which patients grant access to others by sharing public and private keys. Richer data sets will enable more complex studies and robust results. Smart contracts (lines of code executed in certain circumstances) can monitor data continuously mined from health records to identify appropriate new trials or to prevent complications.

All of this means faster, more cost-efficient completion of trials through more efficient patient recruitment, sharing of data across multiple sites, decreased preprocessing of data, and faster regulatory approvals. With better information available earlier in the process, companies can end trials when success appears unlikely and shift resources to higher-potential endeavors.

Academic institutions and pharma companies are exploring ways to realize this potential. For example, researchers at MIT are developing the OPAL/Enigma platform, which en-

ables parties to jointly store and analyze data with complete privacy.

Transforming Service Delivery. Blockchain can enable entirely new delivery models that speed up services, reduce costs, and potentially disrupt long-standing procedures. One possibility is a prescription drug exchange—a patient-driven prescription fulfillment system independent of any one pharmacy or pharmacy benefit manager. Such a model would lower the cost of prescriptions by opening market competition to small and new large players, removing barriers to entry, and streamlining how companies comply with formula regulation. It might also improve access to prescription drugs, while maintaining patient confidentiality and a secure marketplace.

Blockchain has the potential to boost innovation and lower costs at pharma companies.

Although we know of no concrete examples of this kind of activity yet, the history of other industries and recent moves by new-to-healthcare players such as Amazon (which provides blockchain services through its Amazon Web Services platform) suggest that sooner or later these companies will wield their technological capabilities in disruptive ways in the health care industry.

From Evolution to Revolution?

Blockchain will not disrupt health care overnight or even over the next few years. Various aspects of funding, technology and talent, governance, and collaboration need to develop further before we reach a tipping point in adoption and impact. Even so, lots of players are aggressively pursuing solutions. As blockchain technology overcomes hurdles and continues to mature—moving from establishing initial performance requirements to building a pilot proof of concept to scaling up successful models, and ultimately to integrating those models into business processes—we expect adoption to increase. (See Exhibit 2.)

Exhibit 2 | Four Likely Phases of Blockchain Maturity

PHASE 1 (TODAY)
Initial performance
requirements

PHASE 2
Pilot proof of concept

PHASE 3
Scale for broad adoption

PHASE 4
Integration of business
processes and optimization

Breadth of adoption

Activities

- Define use case and participants
- Establish basic infrastructure
- Create private–public chain

- Standardize data formats
- Establish basic governance
- Add algorithmic functionality

- Verify security, privacy, and speed
- Refine governance rules
- Expand number of connections

- Define processes and organizational teams
- Transfer data ownership
- Expand use cases and functionality

Example use cases

Put patients in charge of their data

Accelerate R&D

Transform service delivery

Secure supply chains

No use cases yet in this phase

No use cases yet in this phase

Maturity of technology

Source: BCG analysis.

Funding. Venture capital firms and angel investors are actively investing at early stages in blockchain health care companies. In 2016, Gem, a California-based startup that focuses on blockchain solutions for health care (among other applications), received $7.6 million from Pelion Venture Partners, bringing Gem's total funding raised since 2014 to $12.5 million.

New ventures continued to find backing in 2017. In March, PokitDok, raised $5 million from GIS Strategic Ventures and McKesson Ventures, which brought its total funding raised since 2012 to $50 million. In June, the blockchain-powered health informatics exchange Patientory raised $7.2 million from 1,728 investors in three days. And in September, Candor Insurance, a private health care exchange established to democratize health insurance through the use of blockchain, raised $3.0 million.

Compared with investments in artificial intelligence for health care, which totaled almost $800 million in 2016, the amounts invested in blockchain thus far are small. The pace of funding activity is accelerating, however. Philips launched a blockchain R&D facility in the Netherlands in 2016 and is

seeking collaborators. Other large players such as IBM and Microsoft are bullish about incorporating blockchain platforms and development in their customer support systems. While much of the activity to date is based in the US and the UK, few barriers prevent others—including health care and technology entrepreneurs, funding partners, and corporate partners in other countries— from joining the party.

Technology and Talent. A 2017 article in the *Harvard Business Review* draws parallels between the development of TCP/IP—the technology behind the World Wide Web— and blockchain. The authors point out that it took decades for TCP/IP to reach widespread use; but when it finally did, it upended just about everything. A similar trajectory seems likely for blockchain, since it still has to overcome major technological hurdles, such as those involving standards and scalability. As with TCP/IP, the timing of blockchain development is harder to predict than the likely extent of its impact once it reaches critical mass.

Among the technical challenges that remain are issues related to processing speed (blockchain ledgers must be able to handle large

volumes of complex transactions at high speed), security, privacy (ensuring adequate levels of encryption for data stored on the distributed ledger), and breadth of capabilities (at the moment, blockchain skills are limited and concentrated in a few clusters around the world).

Perhaps most significant, in order to mature beyond proof of concept and deliver on their promise, actual applications must be built on scalable protocols. Finding the skills to build the right technology is a major challenge today. Competition for talent among companies working in multiple advanced technologies (such as artificial intelligence and machine learning) means that the supply of skills and expertise will remain a bottleneck for the foreseeable future. Over time, however, technology-related issues are likely to be less of a barrier to blockchain's broader application than governance and collaboration.

Governance. Any potentially transformative technology raises complex questions about governance, which will require significant effort to resolve. Even basic questions must be addressed. For example, what are the responsibilities and rights of individual participants in blockchain ecosystems? What should be done when something goes wrong?

Cryptocurrencies remain largely unregulated and operate under the paradigm of "Code is law," meaning that little or no regulation governs the technology or its use. A company called Dfinity has developed a next-generation decentralized decision-making system, the Blockchain Nervous System, which it says can act as a "benevolent decentralized superuser that can solve problems otherwise intractable without human intermediaries." In this paradigm, "AI is law."

Before patients, providers, and others feel entirely comfortable handing over personal data to a blockchain, we expect that laws and regulations—including laws that govern blockchain's smart contracts, procedures for data sharing, and regulations for reporting financial transactions—will have to supersede technological self-enforcement. Many tricky issues remain unsolved. For example, if patients control their own data, how do we en-

sure that health care services have access to sufficient information in emergency situations, such as when a patient is unconscious or otherwise incapacitated? Under many legal provisions governing data privacy (such as Europe's General Data Protection Regulation), a consumer has the right to insist on the erasure of certain data. How does this right apply to an immutable ledger?

Collaboration. Because blockchain's power lies in simplifying, speeding, and lowering the cost of transactions, its effectiveness depends on the willingness of multiple parties to participate in blockchain-enabled systems or networks. Realizing the full benefits of such a system requires cooperation among entities across the health care industry, which is difficult to achieve. There is positive activity in that direction, however.

To deliver on their promise, actual applications must be built on scalable protocols.

Hyperledger, an open-source collaborative effort hosted by the Linux Foundation to advance cross-industry blockchain technologies, has established the Hyperledger Healthcare Working Group. Hashed Health, another consortium of health care companies, offers its members product development and management services to support blockchain solutions and networks.

There are also significant barriers to collaboration. Achieving blockchain's full potential in health care requires the adoption of common data definitions, an issue that has bedeviled the industry for years. Similarly, the implementation and enforcement of smart contracts will require coordination and agreement among multiple participants. As in other industries, participants must decide whether the prospective gains in growth and efficiency outweigh the risk of being at least partially commoditized by a new, dominant transaction platform; and if not, whether they can act in concert (as banks are attempting to do) to protect their autonomy.

Collaboration is already proving to be a stumbling block to wider use of blockchain in financial services. Private (or permissioned) blockchains offer one potential solution to many issues involving collaboration, but they come with tradeoffs, such as the ability of other participants to connect to the network and the security that only a large number of participants can provide. (With smaller networks, the computer power needed to disrupt the blockchain networks decreases, increasing the system's vulnerability to an attack.) In addition, like companies, consortia struggle to recruit core talent in an environment where people with the requisite knowledge and expertise are scarce.

What Should Health Care Companies Do Now?

No one knows how quickly blockchain will become integrated into health care or how big its impact will be. But evidence of potential use cases with substantial benefits is strong enough to justify confidence that the technology will eventually change current practices and models to some degree—and perhaps extensively. Clearly, companies throughout the sector need to prepare.

Currently, preparation encompasses such measures as starting to engage with blockchain, considering potential uses and applications, and beginning to build initial capabilities. This will entail committing modest resources to developing internal skills, collaborating with others, and adopting a test-and-learn approach. The goal is to prepare the organization to move quickly and participate more actively (through internal initiatives, accelerators, external partners, or consortia, for example) when evidence emerges that blockchain is maturing.

The actual steps to take in preparation will vary by industry segment.

Pharma. Supply chains are among the business areas most likely to feel blockchain's influence. Companies can realize significant value by ring-fencing supply chains from counterfeiters, validating product quality, improving operational efficiency, and accelerating R&D.

Companies can get up to speed on blockchain by identifying and sizing the value that blockchain can provide in improving supply chain operations and cutting costs. Companies should determine how best to acquire capabilities—whether to develop in-house technologies, acquire startups, or buy capabilities as a service, for example. They may also consider establishing incubators, accelerators, or internal or external innovation centers. (See "Bringing Outside Innovation Inside," BCG article, January 2017.)

Potential applications of blockchain to pharma supply chains and R&D are sufficiently advanced that companies can identify concrete use cases and start experimenting with off-the-shelf solutions as these become available. Alternatively, companies can enter into partnerships with startups to develop solutions for specific applications.

_____

Organizations must be ready to move quickly as evidence shows blockchain maturing.

_____

Medtech. For medtech companies, patient ownership of data can lead to new ways of interacting directly with patients and may open new markets. Being able to enter into contracts with patients about the exchange and use of data could help overcome constraints on innovation that HIPAA and other privacy regulations have imposed. Medtech developers will want to explore how they can use blockchain technology to secure data transactions among connected devices (especially remote devices such as pacemakers, insulin pumps, and sleep apnea equipment) and perhaps to establish broader ecosystems (patient, provider, medtech supplier) around connected devices.

Providers and Payers. Like any emerging technology, blockchain can present both an opportunity for and a threat to incumbents. If patients truly controlled their own data, the benefits of blockchain to providers and payers (as well as to patients) in terms of efficiency and improved service capabilities

would be difficult to overstate. However, the industry would also be open to an unprecedented risk of disruption. Blockchain technology can accelerate exposure to potential disintermediation, lowering switching costs and making it easier for startup services to enter the market and challenge the dominance of established paradigms of care.

First, nontechnical barriers must be surmounted. These include legal and regulatory constraints (some countries do not permit assimilation of patient identity and data from multiple sources, for example) and the absence of industry and technical standards for assimilation and use of data. To maintain their competitive advantage in potential new paradigms, incumbent players need to understand how blockchain can augment their traditional strengths in areas such as medical management, member services, network management, and support functions.

Payers and providers are well positioned to shape change through advocacy, participation in cross-industry dialogue on technology governance issues, and encouragement of partners, such as analytics providers, to include blockchain-enabled privacy controls in their applications. Because they deliver actual care, providers occupy an especially influential place in the health care sector. For their part, payers, since they control payments, can mandate which new formats of service delivery they will support.

Both payers and providers are now actively funding and participating in ventures aimed at delivery of new services. One example is Gem, which reports that it is prototyping a global, blockchain-based patient identifier that could link hospital records and data from other sources, such as employee wellness programs and wearable health monitors. Insurance company consortia have also formed in China (initiated by the Shanghai Insurance Exchange) and Europe (the Blockchain Insurance Industry Initiative, or B3i) to test use cases collaboratively.

THE actual path or paths that blockchain will take in health care remain to be seen. But like other advanced technologies, such as the IoT and AI, blockchain has extreme disruptive potential—so much so that no company can afford to neglect the learning curve. Once they approach the tipping point, digital technologies move fast and can overwhelm organizations that are unprepared. Throughout the industry, pharma and medtech companies, payers, and providers need to engage with blockchain technology, learn the ropes, and think through potential scenarios so they will be ready to play when fast-moving commercial applications approach the mainstream.

Karalee Close is a partner and managing director in the London office of Boston Consulting Group, and the global leader of BCG's Technology Advantage practice. You may contact her by email at close.karalee@bcg.com.

Emily Serazin is a partner and managing director in the firm's Washington, DC, office. You may contact her by email at serazin.emily@bcg.com.

Alexander Aboshiha is a partner and managing director in BCG's Los Angeles office. You may contact him by email at aboshiha.alexander@bcg.com.

Amy Hurwitz is a consultant in the firm's Los Angeles office. You may contact her by email at hurwitz.amy@bcg.com.

Lise Lørup is a consultant in BCG's Oslo office. You may contact her by email at loerup.lise@bcg.com.

Nayel Hakim is a senior knowledge analyst in the firm's Boston office. You may contact him by email at hakim.nayel@bcg.com.

WINNING IN IOT

IT'S ALL ABOUT THE BUSINESS PROCESSES

by Nicolas Hunke, Zia Yusuf, Michael Rüßmann, Florian Schmieg, Akash Bhatia, and Nipun Kalra

THE B2B MARKET FOR the Internet of Things (IoT) is taking off. And huge numbers of vendors—including software, hardware, and internet companies; startups; service providers; and telcos—are jockeying for position and market share. With so much action in the IoT space, one question should be at the top of every IoT provider's list of concerns: Where are the growth opportunities?

All IoT technology layers will grow through 2020, but not all layers are equally attractive.

To understand how IoT is being deployed by businesses today—and where the major growth opportunities will be in the future—we analyzed trends currently shaping the IoT landscape. Our analysis uncovered three major findings. One, there is no such thing as "the" Internet of Things: today's market is heavily driven by specific use case scenarios. Two, while in the aggregate, companies will spend an incremental €250 billion on IoT in 2020 (over and above their normal technology spending), three industries will account for approximately 50% of that spending. And three, although all layers of the IoT technology stack are poised to grow through 2020, the layers are not equally attractive.

Growth Opportunities in IoT

From 2015 through 2020, all layers of the technology stack are expected to have achieved a compound annual growth rate of at least 20%, but certain layers have much higher growth potential than others. (See Exhibit 1.)

IoT's real value, from the customer's perspective, is in the top two layers of the technology stack; that is, services and IoT analytics and applications. We expect that by 2020 these two layers will have captured 60% of the growth from IoT. The rest of the technology stack—identity and security, IoT backbone (cloud and platform), communications, and connected things—are enabling components with lower growth potential.

Use Cases Driving IoT Adoption

Companies will likely spend some €250 billion on IoT, but they need to know which IoT applications have the potential to deliver the most value. Determining this requires recognizing that business leaders are using IoT to solve discrete business challenges. They're asking, How can IoT help our company increase customer satisfaction, improve quality, support new business models (such as data-driven services), and reduce costs?

A few use cases are driving IoT adoption and growth and will continue to do so through

Technology layer	Description	Market size (€billions)	CAGR, 2015–2020 (%)	Value
Services	Allows companies to integrate and customize data so that it's readily accessible and actionable	2015: 10, 2020: 60	⬆	IoT users need customization
IoT applications	Allows companies to make sense of data and generate meaningful insights	2015: 10, 2020: 60	⬆	Application and software development precedes hardware rollout
IoT analytics		2015: 3, 2020: 20	⬆	Analytics support applications and drive insights
Identity and security	Restricts access to the IoT system and safeguards connected devices	2015: 3, 2020: 20	⬆	Financial and technical challenges will limit initial spending
IoT backbone (cloud and platform)	Captures and stores data from connected devices	2015: 3, 2020: 15	◆	Platforms will initially be given away and will lag behind point solutions
Communications	Allows sensors attached to or embedded in connected things to communicate with the internet	2015: 10, 2020: 25	➡	Commoditization and scale effects will lead to price erosion; existing network infrastructure will likely be reused
Connected things	Allows sensors, processors, and microcontrollers to monitor, for example, homes, packages, inventory, and machinery	2015: 20, 2020: 50	➡	Commoditization and scale effects will lead to price erosion in sensors

Scale: 0 20 40 60

■ 2015 ■ 2020 ⬆ CAGR, 2015–2020 = ~40% ◆ CAGR, 2015–2020 = ~30% ➡ CAGR, 2015–2020 = ~20%

Sources: IDC; Gartner; ABI Research; BCG Internet of Things buyer survey; expert interviews; BCG analysis.

2020 at least. To gain meaningful market share over the near term, companies need to focus their IoT product offerings on the right use cases.

With this in mind, we identified a wide range of use cases for IoT. From this long list, we pinpointed ten IoT use cases that are poised to mature rapidly and experience widespread adoption (in a B2B context) through 2020. (See Exhibit 2.) Insight into where customers plan to invest in IoT, when they will invest, and how much they plan to spend helps clarify which use cases will drive IoT growth through 2020. Ten IoT use cases show the most promise.

Predictive Maintenance. Inevitably, businesses lose valuable time and money when equipment malfunctions or breaks down. And many companies also lose money each year by adhering to fixed maintenance schedules by which equipment vendors make routine calls—even when no maintenance is required. IoT technologies can predict or detect when a machine requires maintenance, reducing or eliminating unplanned downtime, extending maintenance cycles, and reducing costs. A host of industries—including discrete manufacturing, transportation and logistics, energy, and health care—can benefit from predictive maintenance. Of course, solutions need to be tailored to suit specific industry needs and applications.

Self-Optimizing Production. Connected factories and plants can use IoT to monitor and optimize production processes in real time, making automated adjustments to improve quality, enhance efficiency, and reduce waste. This use case is ideal for discrete manufacturing and process industries.

Automated Inventory Management. IoT can provide much greater insight into the status of inventory and the supply chain, allowing companies to track inventory location and condition (including, for example, temperature, humidity, and damage). The ability to monitor products across the supply chain allows companies to increase processing and response time, reduce stockouts and inventory pileups, and improve just-in-time production processes.

EXHIBIT 2 | Ten Use Cases Will Drive IoT Growth Through 2020
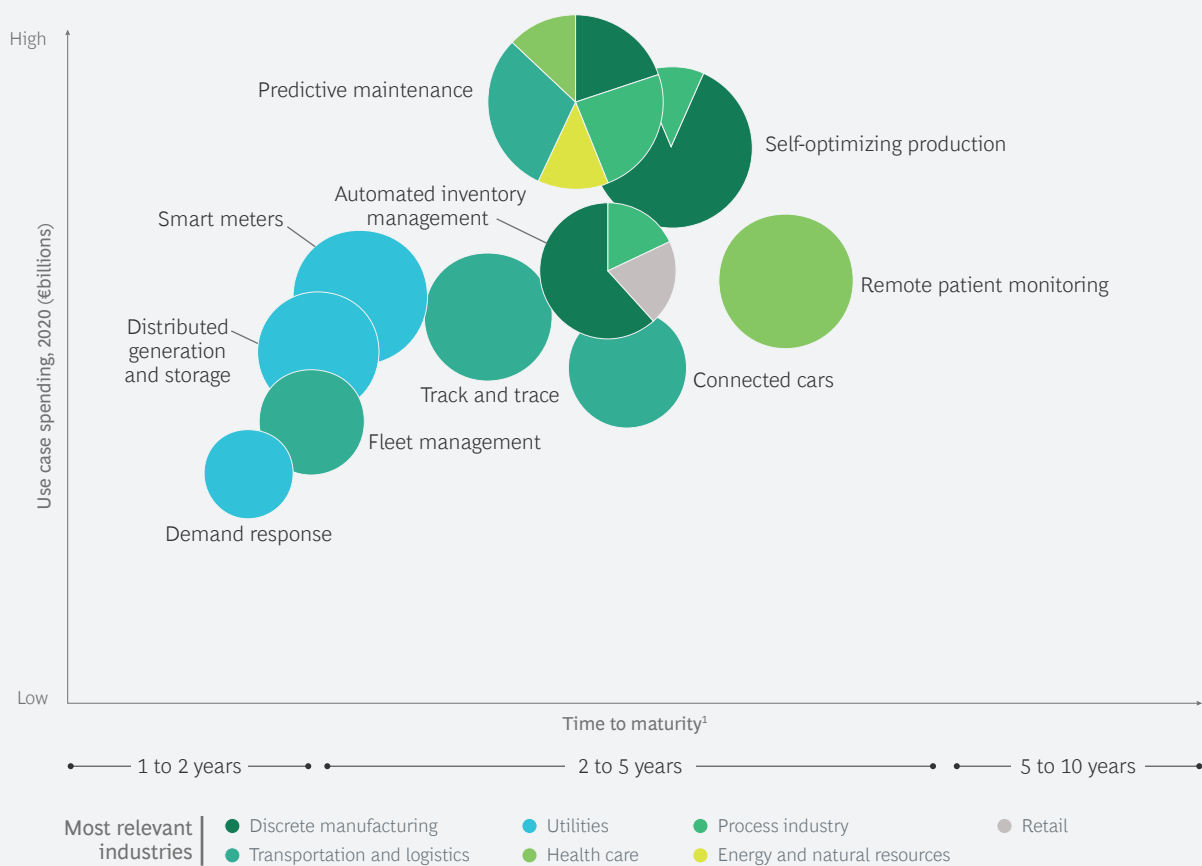
Sources: BCG Internet of Things buyer survey; IDC; expert interviews; BCG analysis.
Note: The bubble sizes indicate relative amounts of spending.
[1]Productive and scaled use within real-life settings (that is, no pilots). To capture opportunities, vendors must quickly ramp up activities. The timing of commercial viability for these use cases was derived from responses to a survey question: "When do you expect to productively use [name of use case]?"

Remote Patient Monitoring. Physicians can track patient health remotely, in real time, to improve health outcomes and reduce health care costs. By tracking patient data and monitoring compliance, health care providers can help patients stay healthier and recover more quickly.

Smart Meters. Sensors can be used to monitor utilities—including electricity, gas, and water consumption—in real time. Smart meters can help consumers monitor their usage, reduce the number of technicians needed to read meters, provide real-time billing data, and enable more dynamic pricing.

Track and Trace. IoT sensors are ideally suited for increasing systems' efficiency. They can, for example, enhance transparency in

order fulfillment and provide information that can help reduce workstation transition times. The sensors can be used in the assembly area to identify the status of products and to locate tools, components, and materials.

Distributed Generation and Storage. IoT can be used to automate and optimize supply and demand across multiple energy sources. By remotely monitoring and controlling distributed energy generation and storage, companies can balance energy usage across the grid and reduce energy costs.

Connected Cars. Through new types of sensors, wireless connectivity, and onboard processing units, vehicles are increasingly connected, and many consumers already expect this type of functionality. Connected cars offer enhanced navigation, better safety

features, and various creature comforts, including advanced music and entertainment options. Some features of connected cars are expected to mature slowly over the next five to ten years.

Fleet Management. In addition to tracking inventory and parcels, IoT is being used to track vehicles in real time. With better information related to fleet location, usage, and condition, companies can be more efficient, reduce maintenance and repair costs, and allow for dynamic rerouting to avoid congestion and delays. This use case is expected to mature quickly—within the next one or two years.

Demand Response. IoT is starting to change the way end users interact with utilities. Through demand-response programs, customers can allow the remote control of their use of certain appliances—air-conditioning systems, washing machines, and other energy-intensive appliances—during peak-demand periods. These processes can be automated to reduce supply and demand volatility and lower customers' energy bills.

An Industry-Specific View

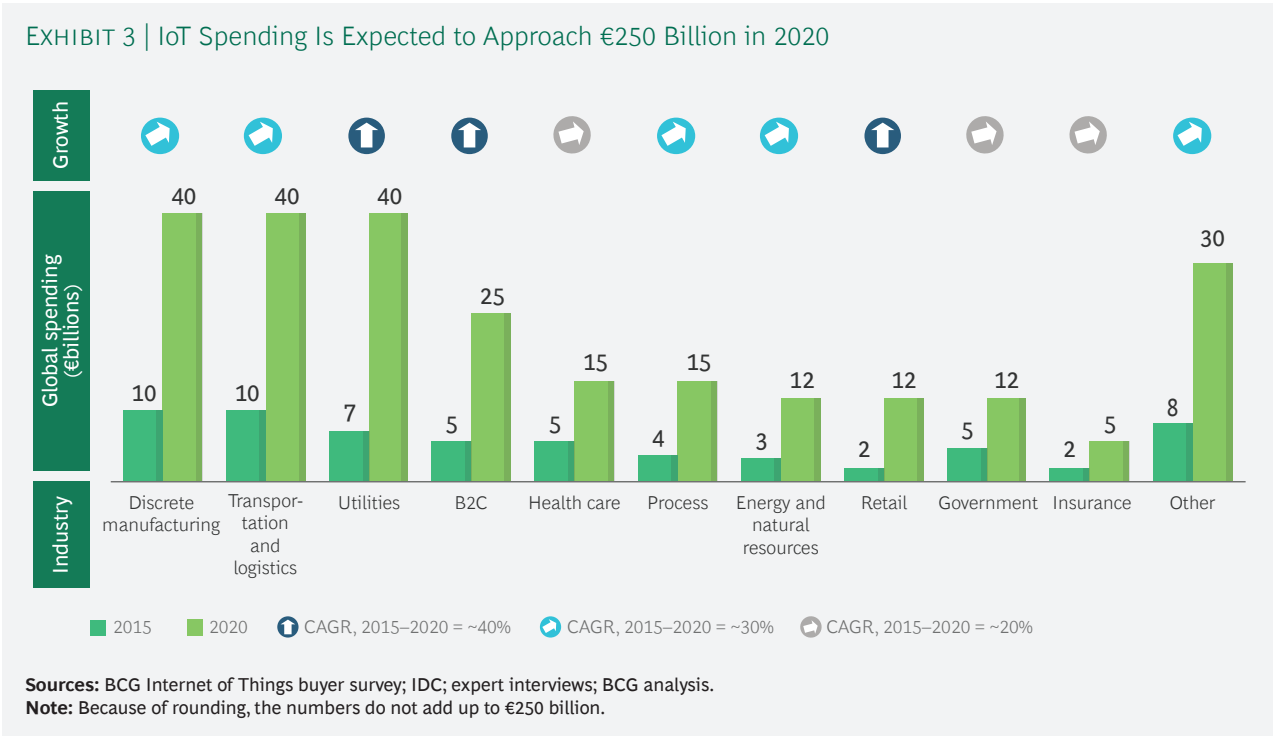Although advanced-technology companies already have integrated digital capabilities, the same cannot be said for companies in other, more conventional businesses, such as industrial goods or logistics. IoT is certainly an important source of growth for technology companies; for less technology-centric companies, it can be utterly transformative.

By cross-referencing use cases with industries, we can see, from an industry perspective, where the most value will be created in the coming years. Three industries will likely account for approximately 50% of IoT spending: discrete manufacturing, transportation and logistics, and utilities. (See Exhibit 3.)

Some use cases, such as predictive maintenance, represent a great opportunity for all industries. Still, each offering must be tailored to meet any given industry's unique needs. The expected time to maturity is significantly different for each use case, depending on its share of customers and how quickly it scales.

Players and Plays

There's plenty of room for all kinds of companies to grow in IoT—and there are numerous possible ways to engage in the IoT market. Major industrial companies are increasingly transitioning from being IoT customers to

EXHIBIT 3 | IoT Spending Is Expected to Approach €250 Billion in 2020

Sources: BCG Internet of Things buyer survey; IDC; expert interviews; BCG analysis.
Note: Because of rounding, the numbers do not add up to €250 billion.

being IoT providers. General Electric, for example, released Predix, an end-to-end IoT industrial operating system designed to help GE customers' machines run more efficiently, in 2015. Siemens, with its MindSphere platform, is pursuing a similar path. Other companies are focusing on a specific layer of the stack and making a horizontal play, as Microsoft has done with its Azure IoT Suite. The SAP HANA Cloud Platform, IBM Watson IoT Platform, and Cisco IoT System all allow companies to build and deploy their own IoT applications—and they are providing specific applications as well. Device makers, such as Intel and Bosch, are offering hardware and complementary operating systems to provide customers with a more comprehensive IoT ecosystem.

Today's IoT customers prefer IoT solutions from traditional software companies.

Although a wide variety of players has entered the IoT space, our survey shows that 40% of today's IoT customers prefer to use traditional and well-established software companies for their IoT solutions. In selecting an IoT software vendor, customers' top three criteria include product functionality, the vendor's reliability, and assurance that the solutions can be integrated.

This last point about integration is very important. Today's IoT customers are looking for end-to-end solutions. World-class applications and services deliver value only when the underpinnings (the connected things, communications, backbone, and security layers) work seamlessly with the top layers. IoT providers don't necessarily have to master all the components within the technology stack, but it is essential to craft a go-to-market plan that takes into account the customer's desire for an end-to-end solution.

Winning in IoT: Key Questions

To compete successfully, IoT vendors need to develop a strategy for where they will play

and how they will win. Executives who are strategizing about where to play should respond to the following sets of questions:

- **Addressing Use Cases.** What are the company's strengths and how can these be leveraged to address use cases? Do we want to address one or more use cases within a specific industry (for example, targeted solutions for medical-device manufacturing) or build a single adaptable solution that can be used by a number of industries (automated inventory management)?

- **Targeting Customers.** What types of customers do we want to attract? Is the company better positioned to directly serve clients that operate assets (such as transportation companies that need predictive-maintenance capabilities) or should we pursue clients that manufacture IoT-ready assets for these businesses (such as large industrial manufacturers that supply products to oil and gas companies)?

- **Developing End-to-End Solutions.** What will the company offer our customers? Can the company develop an end-to-end solution that covers all layers of the stack under our brand, or will we specialize in a particular layer of the stack (as a means to enable other IoT solution providers)?

Once an IoT vendor decides where to play, management must determine how to win in that space. As companies explore this angle, they must address the following:

- **Leveraging Partnerships.** How can the company leverage existing assets and capabilities to optimize its position within the technology stack? Is a software company, for example, well positioned to build up talent and capabilities in hardware? Or is it preferable to form strategic partnerships with other players, such as hardware companies, service providers, and systems integrators?

- **Understanding How Sensor Data Will Be Used.** In IoT, sensors can provide a flood of data, and it's critical to ensure that the data is linked to clear business

objectives (such as increasing revenues and reducing costs). What business metrics will we measure once IoT sensors are in place?

- **Building Capabilities.** What new capabilities does the company need? Should we build up internal capabilities, pursue M&A, or establish partnerships?

- **Crafting a Go-to-Market Strategy.** What is our go-to-market strategy? If the company has focused mainly on B2C, for example, how should the strategy change to reach B2B customers? If the company has historically sold software to IT departments, how will we reach out to business stakeholders? IoT conversations have to be centered on use cases and business value.

- **Evolving the Business Model.** Given the granularity of available sensor data, new business models are emerging. Instead of selling equipment for an upfront fee, for example, companies get compensated for actual use and uptime of that equipment. How can we use these business models to capture more value and create a compelling business case for our customers?

The right path forward will vary depending on each company's starting point:

- **Enterprise software companies** need to leverage their brands' strong reputation and build an end-to-end solution through M&A or partners. As far as most customers are concerned, platforms don't drive major value in IoT solutions: 80% of the IoT customers we surveyed were not at all aware that they were using a platform. Nonetheless, platforms represent an important horizontal play and hold vast potential to scale over the long term.

- **Established internet players** need to leverage their strong B2C position and make a more aggressive move into the B2B space.

- **Specialized startups** should carve out their sweet spot for highly targeted IoT offerings—ideally in a segment that will not be better served by larger competitors.

- **Industrial and technology companies** must extend their product offerings to defend their large B2B customer base and find new ways to engage with customers across the product life cycle.

- **Telcos** can leverage their telecommunications assets and capabilities—including data access—to push beyond connectivity and provide higher-value offerings.

IoT offers tremendous opportunity, and hundreds of companies have already made big bets in this space. But it's not simple to provide the end-to-end IoT solutions that customers want and need. It is not easy for a hardware manufacturer of connected devices, for example, to acquire (or become) a software provider that delivers value in the applications and analytics layer. Moving up and down the technology stack will be a challenge.

But there is good news: companies need not simply grit their teeth and build these capabilities through hiring or M&A. They can pick the areas in which they want to compete and develop partnerships with other companies in order to build a powerful suite of end-to-end offerings.

Armed with a clear vision of where—and by whom—dollars are actually being spent in IoT, companies have a timely opportunity to gain significant traction in the IoT space, and they can position themselves to stake a claim in one of the biggest market opportunities of our generation.

Nicolas Hunke is a partner and managing director in the Munich office of Boston Consulting Group. You may contact him by email at hunke.nicolas@bcg.com.

Zia Yusuf is a partner and managing director in the firm's Silicon Valley office. You may contact him by email at yusuf.zia@bcg.com.

Michael Rüßmann is a senior partner and managing director in BCG's Munich office. You may contact him by email at ruessmann.michael@bcg.com.

Florian Schmieg is a principal in the firm's Munich office. You may contact him by email at schmieg.florian@bcg.com.

Akash Bhatia is a principal in BCG's San Francisco office. You may contact him by email at bhatia.akash@bcg.com.

Nipun Kalra is principal in the firm's Mumbai office. You may contact him by email at kalra.nipun@bcg.com.

DATA-DRIVEN TRANSFORMATION
ACCELERATE AT SCALE NOW

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

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

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

Yet CEOs are right to be wondering how their organizations—where managers and execu-

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

■ Data-driven company

COMPANY: MARKET CAPITALIZATION

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

Source: S&P Capital IQ, "Top 10 Companies with Highest Market Capitalization Worldwide."
Note: Market capitalization figures have been rounded and are in $billions.

tives already complain about a lack of data skills and where overburdened IT systems seem unlikely to be able to handle a tenfold increase in company data—can pull off such a transformation. These CEOs want to find a reliable way to move their companies into the data-driven future so that they can set up their companies to survive—and not put them in danger in the process.
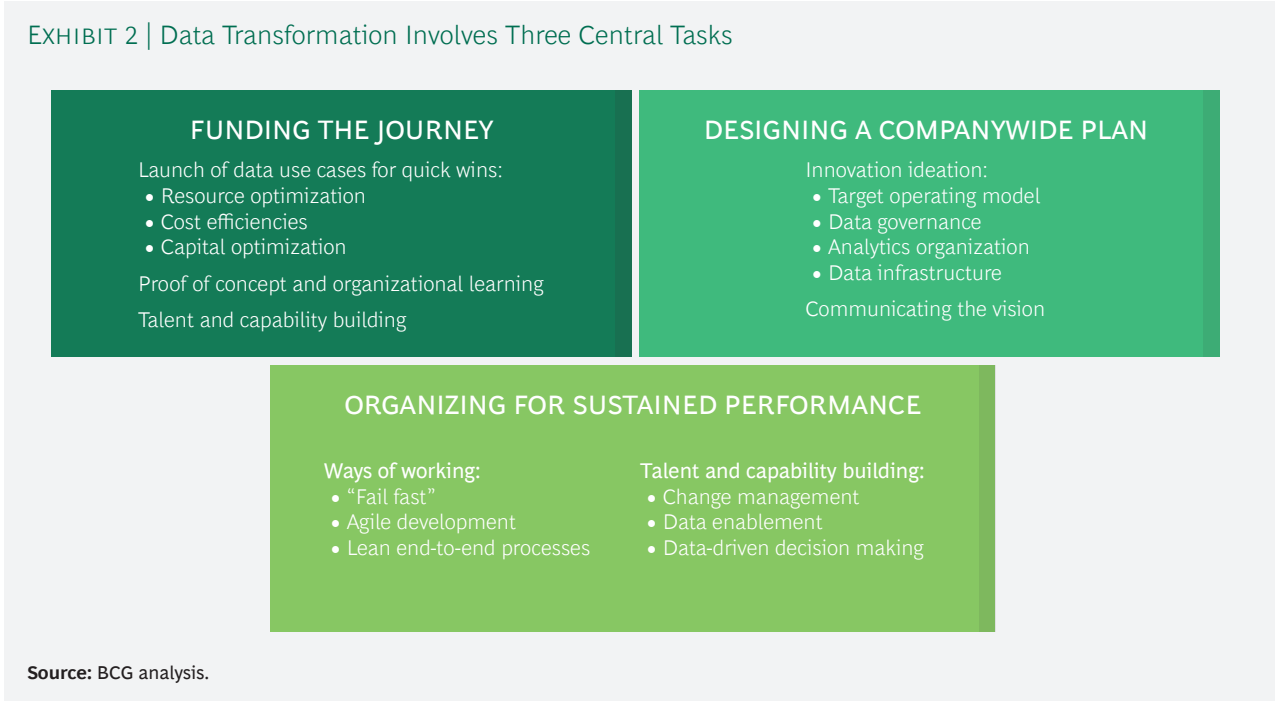
There is a better way to approach data transformation. In our experience, these initiatives can succeed only if they are cost effective, incremental, and sustainable. Transformations should start with pilots that pay off in weeks or months, followed by a plan for tackling high-priority use cases, and finishing with a program for building long-term capabilities.

Working with clients across industries, we have developed a three-phase approach to data-driven transformation. It starts with small-scale, rapid digitization efforts that lay the foundation for the broader transformation and generate returns to help fund later phases of the effort. (See Exhibit 2.) In the second and third phases, companies draw on knowledge from their early wins to create a roadmap for companywide transformation, "industrialize" data and analytics, and build systems and capabilities to execute new data-driven strategies and processes.

This three-step approach is faster, less costly, and more likely to succeed than a system-wide overhaul. Using existing data systematically and combining it with external data (from social networks, for example) for marketing or customer issue resolution can deliver fast results. We have seen companies achieve 15% to 20% of the potential of a full data-driven transformation in six to nine months.

Use quick wins to learn and fund the digital journey. In this first phase, companies identify the low-hanging fruit—discrete, rapid digitization efforts that can deliver quick wins. These projects immediately move the needle on performance in a key area—sales support or supply chain, for example. And rather than taking years, implementation occurs in months and starts paying back almost immediately. The pilot projects show that the company can benefit from digitization, and they provide important lessons in how to roll out digital transformation across the company. Crucially, the extra value that the quick wins create can help pay for longer-term efforts, potentially making the transformation self-funding.

Design the companywide transformation. In the second phase, which can begin while the first initiatives are still under way, the compa-

---

EXHIBIT 2 | Data Transformation Involves Three Central Tasks

FUNDING THE JOURNEY

Launch of data use cases for quick wins:
- Resource optimization
- Cost efficiencies
- Capital optimization

Proof of concept and organizational learning

Talent and capability building

DESIGNING A COMPANYWIDE PLAN

Innovation ideation:
- Target operating model
- Data governance
- Analytics organization
- Data infrastructure

Communicating the vision

ORGANIZING FOR SUSTAINED PERFORMANCE

Ways of working:
- "Fail fast"
- Agile development
- Lean end-to-end processes

Talent and capability building:
- Change management
- Data enablement
- Data-driven decision making

Source: BCG analysis.

ny draws a roadmap for company-wide transformation. This involves building a portfolio of opportunities—identifying and prioritizing functions or units that can benefit most from transformation. It also involves locating and starting to address roadblocks to transformation. During the design phase, companies also invest in framing and communicating the vision for the transformation to build support for needed changes, and they invest in systems to industrialize data analytics—making analytics a resource for every operation.

Organize for sustained performance. With a detailed roadmap in place and with the experience and funding available from the early projects, the company is ready to undertake a full-fledged digital transformation. In this phase, digital and data-driven processes and work methods spread to every corner of the company. Employees learn to work across silos to enable data-driven processes, and leaders make the organizational changes necessary to sustain the new approaches.

The company creates a data-driven culture by investing in capabilities to use analytical insights and by launching a change management program to embed new mindsets, behaviors, and ways of working.

Use Quick Wins to Learn and Fund the Digital Journey

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

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

Leaders should choose quick-win initiatives carefully, on the basis of several critical criteria: they must have a high chance of success, a significant and rapid payback, and visibility across the company. A major industrial company, for example, started by digitizing high-profile processes, including inventory management. (See "Building Momentum Through Pilots.")

> ## Leaders should choose quick-win initiatives on the basis of several critical criteria.

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

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

Design the Companywide Transformation

As soon as it is clear that the early digital transformation projects are off to a solid start, the company can start preparing the roadmap for extending digital transformation

BUILDING MOMENTUM THROUGH PILOTS

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

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

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

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

---

across the enterprise. This starts with a high-level vision, which company leaders translate into a portfolio of initiatives (or use cases) to be rolled out in a logical order, on the basis of factors such as size of impact and competitive needs or opportunities. Then the company must agree upon some underpinnings of digital operations—analytics, data governance, and data infrastructure. (See Exhibit 3.) Creating a roadmap for use cases and projects to build data infrastructure and other resources needed for data-driven operations can not only make the transformation run more smoothly but also ensure that these investments pay. (See "Driving Fast Value from Data Transformation in Logistics.")

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

company's starting point in data and analytics capabilities and assets, backing up the assessment with extensive, continually updated benchmarks.
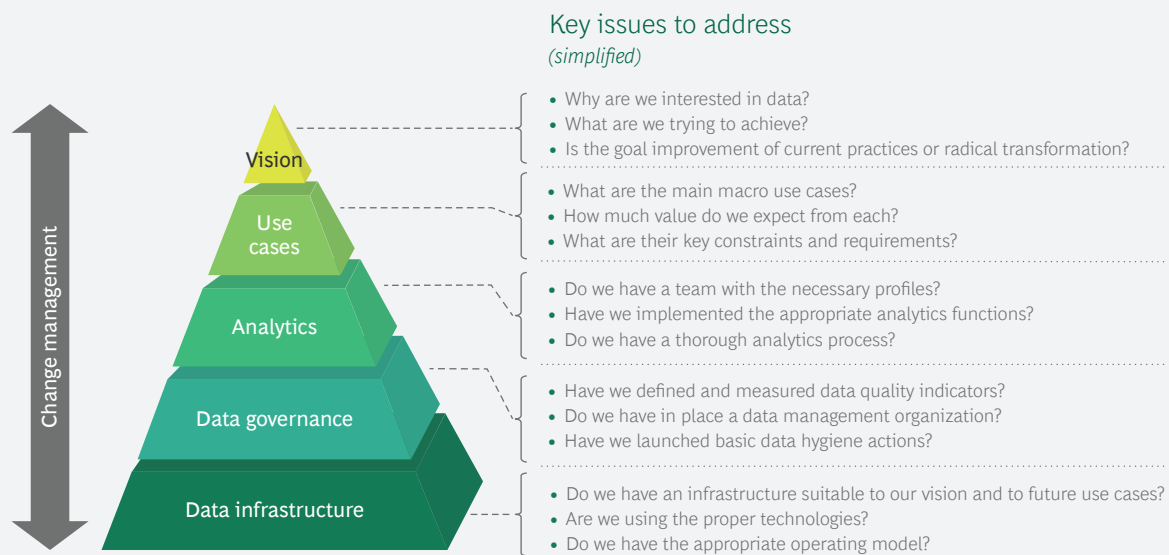
Five Critical Steps for a Successful Data Transformation

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

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

Select the portfolio of initiatives. Using its vision and its list of macro projects for reference, companies can create a full list of transformational initiatives. The company

Exhibit 3 | Fully Leveraging Data Requires a Comprehensive Model

Key issues to address
(simplified)

- Why are we interested in data?
- What are we trying to achieve?
- Is the goal improvement of current practices or radical transformation?

- What are the main macro use cases?
- How much value do we expect from each?
- What are their key constraints and requirements?

- Do we have a team with the necessary profiles?
- Have we implemented the appropriate analytics functions?
- Do we have a thorough analytics process?

- Have we defined and measured data quality indicators?
- Do we have in place a data management organization?
- Have we launched basic data hygiene actions?

- Do we have an infrastructure suitable to our vision and to future use cases?
- Are we using the proper technologies?
- Do we have the appropriate operating model?

Pyramid (top to bottom): Vision; Use cases; Analytics; Data governance; Data infrastructure. Vertical arrow labeled "Change management."

Source: BCG analysis.

DRIVING FAST VALUE FROM DATA TRANSFORMATION IN LOGISTICS

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

Then the company took a new, agile tack. This time it created a detailed roadmap for transformation based on two primary considerations: an examination of the data needed monthly, weekly, and in real time to optimize functions or operations and to generate the most impact for the company; and an assessment of the systems and data already available to fill the newly identified business needs. On the basis of this roadmap, the company began a series of pilot projects, using benchmarking data to optimize important cost drivers such as

fuel consumption, maintenance, and labor. Another project aimed to improve pricing performance by accessing data such as customer P&L through new analytics.

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

should use a structured ideation process to compile the list, and it should use a rigorous prioritization methodology to set the schedule. Factors such as data availability, regulatory compliance, and technical or modeling difficulty, as well as dollar value, customer benefits, and strategic importance must also be weighed.

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

A hub-and-spoke operating model can ensure consistent strategy and execution.

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

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

INDUSTRIALIZE DATA EARLY TO ENSURE FULL TRANSFORMATION AND LONG-LASTING IMPACT
While the company continues to sketch the transformation roadmap—if not sooner—it needs to begin industrializing its data and analytics. This means setting up a way to standardize the creation and management of

data-based systems and processes so that the output is replicable, efficient, and reliable. Digital systems are the new means of production, and they need to have all the attributes of industrial machinery, including reliability and consistency. Above all, the company needs to have a way to guarantee that it generates and harnesses high-quality data and has an efficient data environment.

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

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

Organize for Sustained Performance

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

Many companies may be capable of managing this change on their own; but if a company faces competitive challenges that re-

quire a rapid transition, or if it is far behind in digitization or lacks the resources and capabilities to manage the transformation, it may benefit from adopting a build-operate-transfer model (which we discuss below). This involves creating a dedicated organization—usually run with the guidance of an outside expert partner—that takes over the organizational change effort.

Define new roles and governance rules. To ensure the sustainability of the benefits it obtains through the adoption of new digital processes, a company needs to make clear who has responsibility for building and running new systems and maintaining specific types of data—and how to manage those people. The changes begin at the top: senior leaders should adopt data-driven objectives and cascade those goals throughout the organization. Top management may want to set up data councils to extend the work to all sectors of the organization and to carry it out more effectively. The company should promote data awareness by using data champions to disseminate data-driven practices. The company can set up a change management function under the chief data officer, too. The data awareness effort should extend to all work, including tasks that the digital transformation does not directly affect. For example, the company might create data-based metrics for functions such as HR, perhaps measuring the number of applications processed per job filled.

Build a data-first culture. Not everyone needs to become steeped in data analytics or learn to code in order for digital transformation to work. However, everyone does need to adopt a less risk-averse attitude. To move quickly and to continually find new ways to apply data, companies should behave a bit like software development operations, embracing a test-and-learn culture that encourages experimentation, accepts—even celebrates—failure, and is always learning. Companies can also encourage the desired cultural change through organizational moves, such as creating internal startup units where employees can focus on experimentation or co-locating data labs within operating units. The company can also promote the new culture by using cross-functional teams that

share data across silos, thereby encouraging openness and collaboration throughout the organization.

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

———————

Companies can adopt many agile tactics to increase their everyday responsiveness.

———————

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

Consider the build-operate-transfer model. In some instances, a company may need to adopt bolder steps to accelerate its data-driven transformation. This may be because it is starting from far behind its competitors or because it lacks the capabilities and resources needed to drive the transformation internally.

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

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

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

Antoine Gourévitch is a senior partner and managing director in the Paris office of Boston Consulting Group. He leads the firm's global work in digital transformation and big data in the Technology Advantage practice. You may contact him by email at gourevitch.antoine@bcg.com.

Lars Fæste is a senior partner and managing director in the firm's Copenhagen office and the global leader of the Transformation practice. You may contact him by email at faeste.lars@bcg.com.

Elias Baltassis is a director in BCG's Paris office and the leader of the data and analytics team in Europe. You may contact him by email at baltassis.elias@bcg.com.

Julien Marx is a principal in the firm's London office. You may contact him by email at marx.julien@bcg.com.

DIGITAL TRANSFORMATION FROM THE PEOPLE PERSPECTIVE

AN INTERVIEW WITH MARIE-FRANÇOISE DAMESIN

French automaker Renault has launched a comprehensive digital transformation that seeks to deliver €1 billion in cost improvements and revenue increases annually, starting in 2020.

As the executive vice president for human resources for the Renault-Nissan-Mitsubishi Alliance, Marie-Françoise Damesin stands at the forefront of this transformation. She recently sat with Stéphanie Mingardon, a senior partner in the Paris office of Boston Consulting Group, and shared her views on the implications and challenges that digital transformation presents for a large industrial group.

A graduate of the ESSEC business school in France with a postgraduate degree from Paris-Dauphine University, Damesin has served in her current position since 2014. She has held a variety of management roles in the organization, sales, and marketing departments since first joining Renault in 1984, after four years in the service business.

Damesin described Renault's digital transformation and discussed how it has been changing the company's ap-proach to management, employees, organization, product development, and customers.

How far has Renault progressed in its digital transformation?

We have made a huge leap forward this year with the creation of Renault Digital, a separate entity dedicated to developing applications and software for all of the group's businesses. The delivery of the first digital products and the physical reality of the Digital Hub—a new building dedicated to digital and innovation—make the results very concrete and visible to our employees and clients. As an illustration, several hundred employees attended the recent Open Day at Renault Digital. Beyond these very tangible results, we are also starting to see a change in mindset throughout the company. Overall, a year and a half ago, I would have said that we were not ahead of the curve. Now, I think we really have made a significant step.

You mention a change in mindset. How would you characterize this change?

Some people who really wanted to work on digital and had not declared their interest are now coming forward. There is also broader realization that the transformation is going to be profound and that we will have to revisit most of our ways of working—in the plants, in R&D, and in regard to customers. Beyond the pure economic impact and the few places where applications are actually developed, what is important is that digital is entering our employees' mind and daily routines. I recently spoke with a marketing manager who told me that her team used to use a very complex tool that required them to compile 70 Excel tables in order to analyze marketing expenses. Now, you get all of the information in 30 seconds. It is extraordinary. Digital opens new fields of opportunity and allows us to be more reactive and flexible.

At the same time, it is true that digital transformation also worries some people in the company. They wonder what will become of their jobs tomorrow. The feeling is stronger in some sectors than others. So while there are those who think that change is an opportunity and,

therefore, are very positive about the transformation, others worry about change. One of our key roles as human resources is to educate, reassure, and embark all employees in the transformation, for example, by renovating our training offers and preparing for skilling up.

From a people perspective, what are the key digital transformation topics? Where do you start?

I think there are three main challenges to be addressed at the beginning. The first is to build digital skills. Agile methodology, for example, is not something everyone is familiar with. We have to help our employees upgrade their skills or develop new ones. The second is management. Digital brings management styles that are different from the traditional ones. We have to shift from a somewhat top-down management to a more collaborative style. The third is attracting new digital talent.

How well has Renault succeeded in attracting new talent?

We are devoting a lot of effort to attracting and retaining new talent. We have repositioned our employer branding with a new motto: Move the world forward. We are very clear on the profiles we are looking for. We want mobile, connected, and autonomous people—an interesting parallel with the technological disruptions we are facing.

Beyond employer branding, we have started working on improving the onboarding and integration processes. How do we make sure that the new recruits find roles in the company that are right for them? How do we help them develop themselves in line with the promises we have made? It is clear that a company like Renault

has to move somehow away from the culture of Taylorism, a system that has historically been linked to the automobile industry in which each task is heavily standardized and employees are highly specialized. Instead, we have to develop a more innovative, more agile, and more collaborative culture.

Finally, we have to take into account that new generations have changing expectations regarding work. The quality of work and daily behavior become top criteria of choice. I am not talking only about nice buildings with sofas and foosball tables but also of how people are treated on a daily basis. We have to make sure that we offer an aspirational environment.

What you describe is quite a cultural shift. In your opinion, what does it mean to create a digital-supportive culture?

We have already worked a lot on this, first by renewing our core values, which we summarize in what we call the Renault Way. There are five of these core values: keep the customer in mind, share reality openly, bring your own contribution, keep learning, and make it simple.

As you see, these values really align with the digital culture. Our previous model dated from 15 years ago, and we felt we had to change to better express what we are and where we want to go. We also seized this opportunity to build a unique model for all our employees. Before, we had two different models for managers and employees. This is also an important message in the age of digital: we all play by the same rules. We are now rolling this out and plan to reach everybody in the group by 2020. This should help us transform the group's mindset.

The second challenge is to create a digital-supportive culture that breaks down silos. A company such as ours is traditionally organized and follows the value chain: design, manufacturing, sales, and after sales. How do we move from a culture that says, "I'm performing very well in my team or my department" to "I'm performing very well collectively, for the whole company"? This shift also challenges several systems, such as individual KPIs, performance evaluation, promotion, learning and development, and recruitment.

I think this shift will take some time. Some teams, such as those within Renault Digital, are already following this new framework. These people will return to their original departments after some time. This is a strong, yet important bet because it should help accelerate the transformation within departments.

Then, if we project ourselves further down the line, we might have to completely review our organization to align with key customer processes in the company instead of the current organization, which follows the value chain.

What are the next steps Renault must take to become a fully digitized company?

We have not yet defined the plan to fully digitize the company. For now, we have used a method I think is the right one: we conduct various experiments in many sectors so that all can gradually build their own digitization. For me, the next step is to build a global digitization plan for the whole company, building on these many experiments. We need to transform each main process, not only within each individual business function but also across functions throughout

the whole company. This is where the real power of digital lies. That means looking at the customer process, for example, as well as at our factories, engineering, design, and distribution. For me, this will be our main topic for 2018.

We have to remind ourselves that we are in a heavy industry that builds complex products with thousands of parts and has long development and commercialization cycles. The digital transformation will help us bring agility and speed to manufacturing.

Mitsubishi recently joined the Renault-Nissan Alliance. How is the alliance model affecting the way the group envisions its digital transformation?

As our president and chairman, Carlos Ghosn, regularly states, the objective of the alliance is to generate synergies among the three groups and accelerate technological changes to deliver better value and service to our customers. This is particularly important at a time when the automotive industry is facing a number of technological revolutions, such as electrified connected cars that are equipped with autonomous-driving systems. Instead of having Renault, Nissan, and Mitsubishi each develop these technologies, innovations are shared among the member companies. The current strategic plan, Alliance 2022, reflects these goals: we aim, for example, to build more than 14 million vehicles, share common platforms, increase the portion of common power trains from one-third to three-quarters. We also plan to collaborate on electrification, connectivity, and autonomous technologies.

Another strength of the alliance is permanent emulation and exchange of best practices.

How do you envision your personal role—executive vice president for human resources—in promoting and accelerating the group's digital transformation?

There are two things. First, I believe that a company's digital transformation cannot be successful without the full participation of top management, employees, and stakeholders. It is therefore extremely important to make sure that everyone understands the stakes for the company and themselves. For the employees, the stakes will notably be around training and skill development. We also have to help managers with the evolution of their roles, dealing with more empowered teams and creating a benevolent environment where everybody can express himself or herself. Finally, we will work with the trade unions and then employee representatives to raise awareness of the ongoing technological and digital changes.

My second personal role involves transforming the human resources function itself by, for example, digitizing the end-to-end employee journey.

What are the consequences of the digital transformation on the human resources function?

As I said, we have one huge challenge around digitizing the end-to-end employee journey. This, by the way, is not purely an HR topic because it also affects many other functions. The foundation work we have been doing over the past years to globally harmonize our HR tools, processes, and standards will be of tremendous help in accelerating this transition.

The other big change is that digital will enable us to gain access to much more data than we have to-

day. We will, therefore, be able to transition from mostly descriptive to predictive analysis. I believe this is going to be the main transformation for our centers of expertise.

The role of operational human resources business partners is also going to evolve because employees will be able to do more and more things by themselves in much simpler and quicker ways. This will reinforce the role of HR business partners as providers of advice and support.

Employees will play a more active role in managing their careers. They will also probably become more demanding regarding the HR function, expecting easy-to-use HR tools for their daily tasks, stronger support for learning and development, and more technical expertise when they interact with HR. Just like people who come into dealerships to buy a car today, they will obtain the basic information online and arrive with much more technical questions for the HR representative.

For me, digital will increase both the quality of service and the efficiency of the HR function. In our case specifically, as our efficiency ratios are already pretty good, quality of service will be the main focus. To support this effort, this year, we have intensified the training of the HR staff in digital and agile methods.

Stéphanie Mingardon is a senior partner and managing director in the Paris office of Boston Consulting Group. You may contact her by email at mingardon.stephanie@bcg.com.

BRINGING DIGITAL DISRUPTION TO BUILDING MATERIALS

REINVENTING THE CUSTOMER JOURNEY

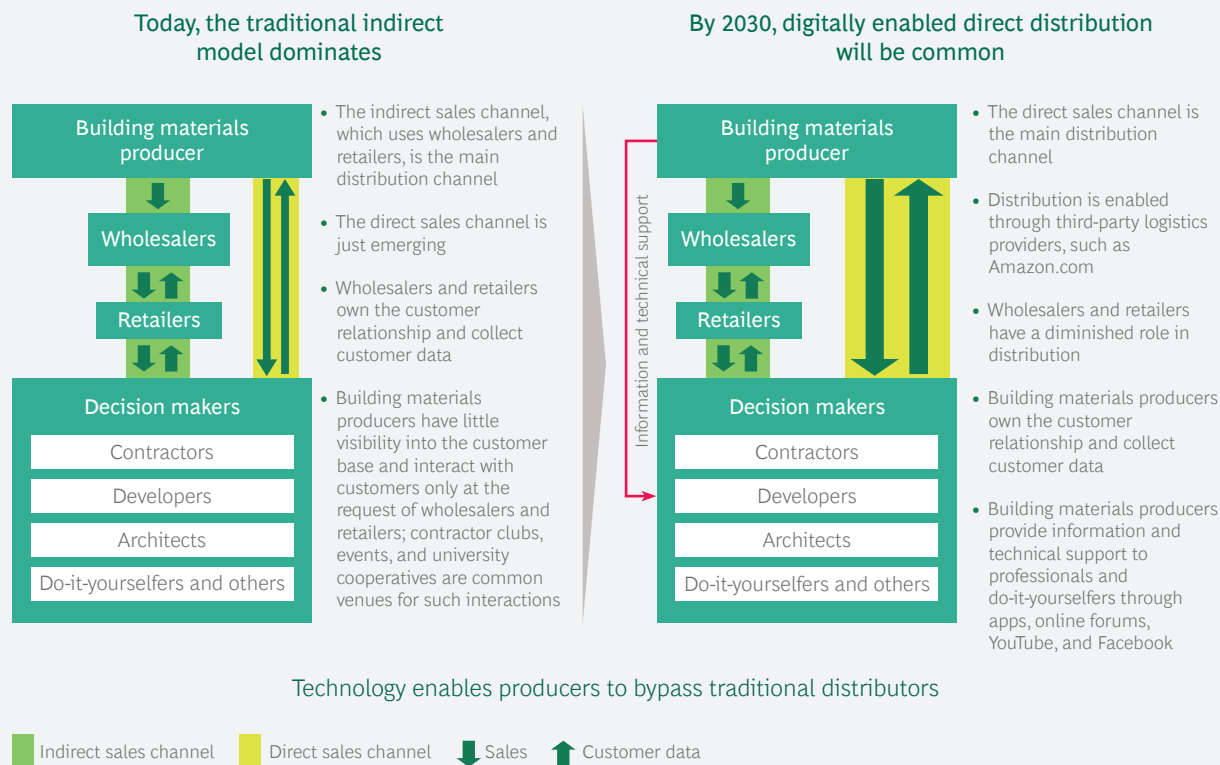by Arne Burfeind, Urs Rahne, Philipp Heck, and Ian Gross

A BUILDING CONTRACTOR WE'LL CALL Bob meets with a client to discuss ideas for a bathroom renovation. Rather than visiting a distributor's showroom, Bob uses his iPad to display a 3D visualization of the client's bathroom. Bob and the client experiment with options for the colors of tiles, fittings, and sanitary ceramics. Bob uses a smartphone app provided by the producer of these materials to calculate his final price on the basis of the client's selections. The selections are made within the visualization and automatically transferred to a cloud-based building-information modeling (BIM) platform. The BIM platform places the order with the producer and creates the design plan for using the materials. To fulfill and deliver the order, the producer uses logistics services provided by a major e-commerce company. Bob uses the producer's smartphone app for real-time tracking of his order, which arrives on schedule within the one-hour delivery window he selected. The producer uses the app to send Bob a video that demonstrates the right way to apply the materials. The producer also recommends other building materials on the basis of Bob's past purchases and current location. Looking beyond today's purchase, the producer uses the data about Bob's buying behavior as one of many inputs to refine its commercial strategy.

Although much of the technology already exists to make this vision of digitally enabled

direct distribution a reality, few building-materials producers have embraced the technology as a means to reinvent the customer journey. Distribution remains rooted in the traditional indirect model in which producers sell building materials to the wholesale and retail distributors that have a direct relationship with contractors and other end customers or decision makers. (See Exhibit 1.) These distributors select the assortment of products offered and provide credit services to customers. In most cases, the distributors are also responsible for delivering products. But, as has happened in other industries that have been disrupted by the digital revolution, this indirect model will inevitably give way to a model in which building materials producers bypass traditional distributors. In this digitally enabled model, manufacturers will sell their products directly to end customers and use third-party logistics services for fulfillment and delivery.

In our view, it is a question of when, not if, this transformation of the distribution model will occur in the building materials industry. And the experience of other industries has shown that a digital disruption can arrive with startling speed. Indeed, top building-materials wholesalers and retailers have already launched digital distribution initiatives to counter the threat of direct distribution by traditional manufacturers in or new entrants to the industry. The early results indicate that

Today, the traditional indirect model dominates

By 2030, digitally enabled direct distribution will be common

Building materials producer

Wholesalers

Retailers

Decision makers

Contractors

Developers

Architects

Do-it-yourselfers and others

- The indirect sales channel, which uses wholesalers and retailers, is the main distribution channel
- The direct sales channel is just emerging
- Wholesalers and retailers own the customer relationship and collect customer data
- Building materials producers have little visibility into the customer base and interact with customers only at the request of wholesalers and retailers; contractor clubs, events, and university cooperatives are common venues for such interactions

Information and technical support

Building materials producer

Wholesalers

Retailers

Decision makers

Contractors

Developers

Architects

Do-it-yourselfers and others

- The direct sales channel is the main distribution channel
- Distribution is enabled through third-party logistics providers, such as Amazon.com
- Wholesalers and retailers have a diminished role in distribution
- Building materials producers own the customer relationship and collect customer data
- Building materials producers provide information and technical support to professionals and do-it-yourselfers through apps, online forums, YouTube, and Facebook

Technology enables producers to bypass traditional distributors

Indirect sales channel   Direct sales channel   Sales   Customer data

Source: BCG analysis.

businesses and other end customers are interested in purchasing building materials directly through the web and mobile apps, just as they do other products. This is especially true in some emerging markets, such as Indonesia, where the rate of internet usage on mobile devices is high among businesses and end customers. Building materials producers should not let distributors capture all of the value arising from this opportunity. Higher margins are only one of the benefits of establishing direct relationships with end customers. Producers would also gain access to a trove of customer data that allows them to develop targeted sales-and-marketing efforts, refine their product offerings, and enhance onsite and offsite support. These applications of data promise to increase customer loyalty and unlock significant growth opportunities.

Building materials producers should take action now to adapt their strategies and capabilities, before the full effects of the digital revolution alter the industry landscape. The first producers to become first movers and

successfully adopt a digitally enabled direct-distribution model will gain major competitive advantages. These advantages will arise not only from stronger customer relationships but also from alliances with technology and logistics companies that provide the infrastructure and support for e-commerce and direct distribution. Early movers are likely to benefit from a strong lock-in effect with customers and business partners, which could ultimately threaten the survival of producers that take a wait-and-see attitude.

To help producers capture this opportunity, Boston Consulting Group has explored the current state of digital adoption in the building materials industry and the important trends that are reshaping the distribution model. Our research included discussions with executives at 20 of the top building-materials producers and distributors and a comprehensive web survey of more than 100 building-materials purchasers in the US. We focused our research on the application of digital technology to the customer-facing stages of

the building materials value chain (marketing, sales, and logistics), giving less emphasis to sourcing and production. By applying our findings to develop strategies and capabilities, producers can emerge as the winners in their industry's new environment.

The State of Digital Adoption Today

Our research found that building materials companies have reached one of three stages of a digital transformation. (See Exhibit 2.) Heavy-side producers (those in the aggregates, ready-mix concrete, cement, asphalt paving, and construction industries) are at the earliest stage of the transformation. Light-side producers (makers of concrete products, wallboard, insulation, bricks, tiles, pipes, and glass) are at the earliest or middle stage. Distributors (wholesalers and retailers) have reached the middle or advanced stage. But even the most digitally advanced building-materials companies lag significantly behind companies in industries such as media, retail, and travel.

Breaking Ground. Companies at the earliest stage of the transformation are pursuing only a few uncoordinated digital initiatives and have not defined a company- wide ambition for the use of digital technology. The main focus of these companies has been on digital implementations in marketing, such as incorporating basic e-commerce features into their website, providing intranet communication tools, and developing online marketing programs. These companies have not explored which "pain points" along the customer journey could be addressed by digital initiatives.

Building the Foundation. At the next stage, companies have articulated a digital ambition and begun to centrally coordinate digital initiatives. They have moved beyond undertaking basic digital initiatives in marketing to addressing the pain points for all of the steps in the customer journey. These efforts include developing rich website content, collecting and structuring big data by implementing advanced customer-relationship-management systems, and participating in social media.

EXHIBIT 2 | Producers Lag Behind Distributors in Digital Maturity
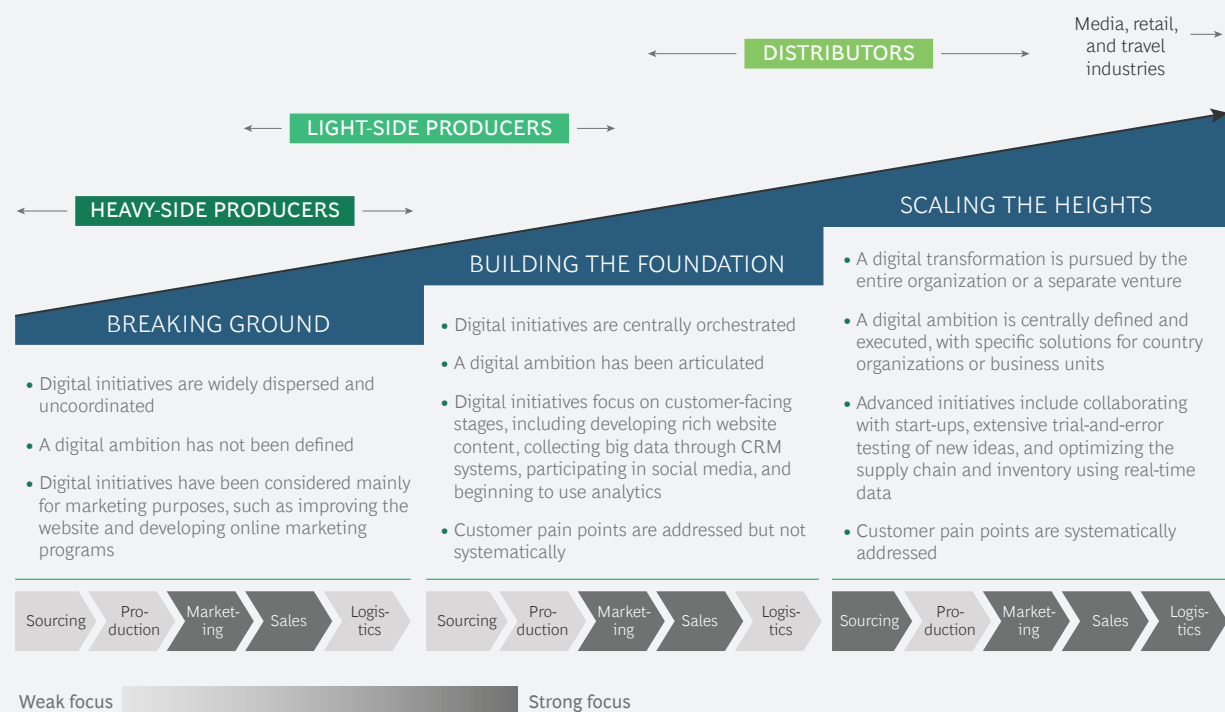
Sources: BCG interviews of executives at approximately 20 building-materials companies; BCG analysis.
Note: CRM = customer relationship management.

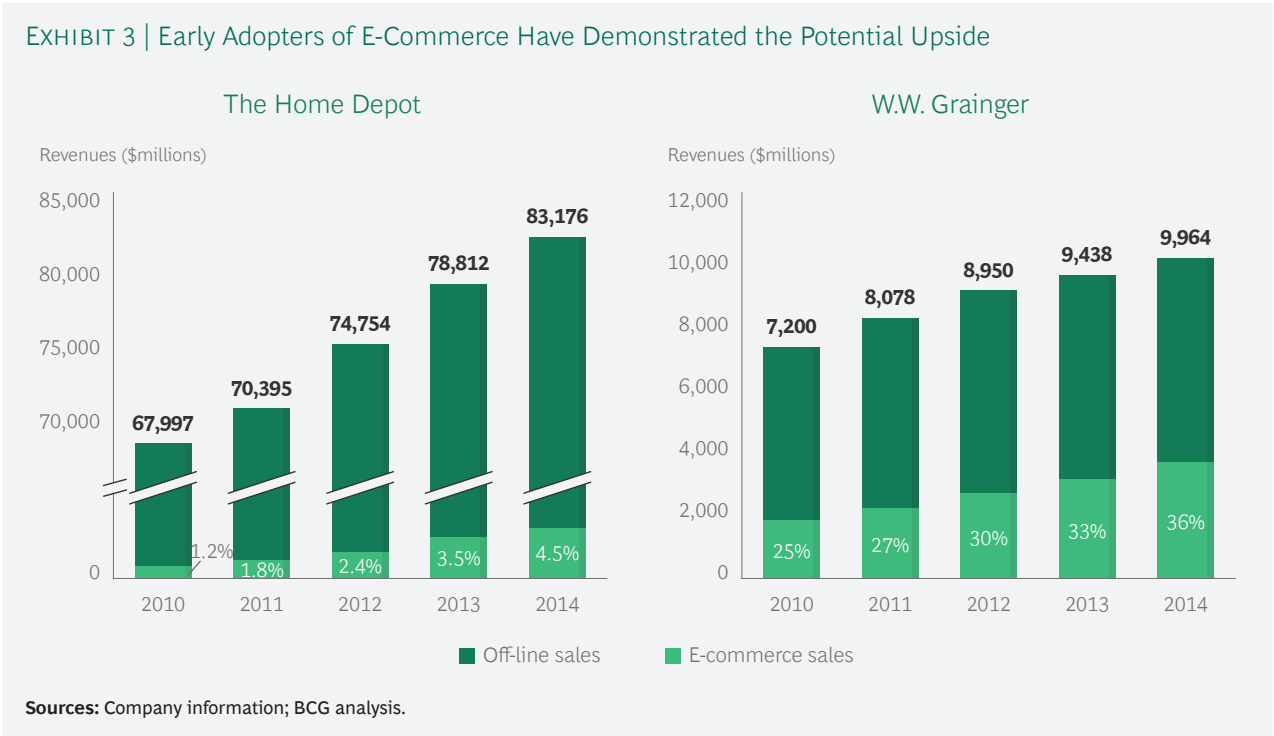These companies have also taken initial steps to apply analytics to big data.

Scaling the Heights. When building materials companies reach the advanced stage, the digital ambition has become integrated into the organization's DNA. In some cases, a separate venture has been created to carry out the digital transformation and systematically address pain points along the customer journey. Although the digital ambition is centrally defined and implemented, specific programs are tailored to the country organizations or business units. Advanced initiatives typically include collaborating with startups, extensive trial-and-error testing of new ideas relating to apps and mobile devices, and optimizing the supply chain and inventory through the use of real-time data. These companies typically still have opportunities to make more extensive use of big data and advanced analytics, however.

So far, distributors are the only building-materials players to reach the third stage of digital maturity. They have been motivated to aggressively pursue a digital transformation because they see that a strong e-commerce offering is essential to maintaining customer loyalty and growing revenues. Distributors' digital transformation has occurred rapidly.

Fletcher Building, for instance, recently launched an independent digital-innovation lab, only a few years after its first digital initiative.

The first companies to use e-commerce to sell and distribute building materials have demonstrated the potential for revenue growth. Both the Home Depot and W.W. Grainger have seen a steady increase in e-commerce revenues as a percentage of total revenues in recent years. (See Exhibit 3.) The Home Depot offers more than 700,000 items online, compared with 35,000 in typical stores. Customers can pick up their online orders at a nearby store, which has been critical to the initiative's success. In 2014, the retailer invested $1.5 billion in supply chain and technology improvements to integrate online and offline sales.

W.W. Grainger, which primarily supplies business customers, has also focused on integrating sales through its branches, catalog, website, and mobile app. It has sought to grow its base of business customers by introducing an online inventory-management solution and an app through which customers can make purchases. In the future, we expect that e-commerce sales through initiatives such as these will represent the largest source of revenue growth for building materials companies.

EXHIBIT 3 | Early Adopters of E-Commerce Have Demonstrated the Potential Upside

The Home Depot

Revenues ($millions)

Year	Total	E-commerce %
2010	67,997	1.2%
2011	70,395	1.8%
2012	74,754	2.4%
2013	78,812	3.5%
2014	83,176	4.5%

W.W. Grainger

Revenues ($millions)

Year	Total	E-commerce %
2010	7,200	25%
2011	8,078	27%
2012	8,950	30%
2013	9,438	33%
2014	9,964	36%

■ Off-line sales   ■ E-commerce sales

Sources: Company information; BCG analysis.

Four Themes Will Shape the Transformation

In our discussions with executives and customers, a consensus emerged that four themes will shape the industry's digital transformation. Companies will need to develop expertise on these topics and build their capabilities to execute initiatives related to each.

Mobile and Real-Time Information. Through the use of mobile and GPS technologies, producers will be able to give their customers access to information about products and services anywhere and anytime. Leading companies have already launched apps that address the unique needs of builders. For example, W.W. Grainger's KeepStock Secure app helps customers replenish stocks of products when they're at a job site and don't have access to a desktop computer. The app allows customers to order items by scanning bar codes on labels and has an automated reordering feature. Companies have also introduced apps that allow customers to track orders and deliveries using GPS-based updates.

Mobile and GPS technologies will be particularly important in emerging markets.

The use of mobile and GPS technologies will be particularly important in emerging markets, where mobile devices are the primary way businesses and customers access the internet. PPC, a leading supplier of cement in southern Africa, has launched an app that provides a product catalog, a store locator, a tool for determining the quantity and cost of products required, and updates on promotions.

Examples from other industries point to the disruptive potential of mobile technology. Consider how Uber has disrupted the taxi industry in New York City. During the past two years, it is estimated that Uber has taken away approximately 2 million rides from traditional medallion taxis in the city's central business district. And the total number of trips in medallion taxis declined by 10% in the first half of 2015, compared with the same period in the previous year. Not surprisingly, the value of a taxi medallion license has dropped steeply, from $1.3 million in 2013 to less than $900,000 in 2015.

A Multichannel Customer Journey. Producers will need to serve customers through multiple channels, including physical locations, call centers, the web, and mobile devices. Companies will be able to gain a competitive advantage by reaching customers through the full set of social media, including YouTube, Twitter, Facebook, Vine, and online communities. Innovative staffing models will allow sales personnel to split their time among several functions, such as interacting with customers face to face, providing remote assistance over the phone or internet, and creating content for social media.

Quick, Direct Access. Business customers will want the direct sales process to be as easy and fast as their consumer-shopping experiences. To address this need, producers must be able to provide customized content, product offerings, and recommendations and ensure that websites and apps are intuitive to use. Using GPS technology to offer products that are most relevant to customers on the basis of their locations will be essential to simplify the sales process. Producers should also make it easy for returning customers to purchase items quickly, such as by storing billing and shipping details and by automatically populating forms. Leading companies already offer customers simple and fast ways to provide feedback, so that the companies gain a better understanding of how to improve product and service offerings.

BIM in the Cloud. The building information modeling (BIM) platform allows architects and contractors to create digital representations of physical aspects of construction projects. These representations facilitate collaboration and decision making among stakeholders, including project owners, government agencies, and subcontractors. Cloud-based BIM enables real-time access to these models by organizations anywhere in the world and from various devices, including mobile ones. By facilitating real-time interactions among multiple parties, the use of BIM

in the cloud accelerates the planning and execution of project work and helps ensure that the correct materials are acquired. Adoption is expected to increase as these platforms become simpler to use. BIM has already become standard for some government projects in Denmark, Finland, Norway, South Korea, and the UK, with strong growth among projects to construct health care facilities, infrastructure, and large sports arenas. For building materials producers, the adoption of BIM increases opportunities for sales, because the use of cloud-based platforms makes it even easier for customers to order products directly from them.

Five Imperatives for Success

To capture the opportunities arising from digitally enabled direct distribution, building materials producers will need to embrace five interrelated imperatives.

Make digital transformation a C-level priority. Top management must be involved in defining the overall digital ambition and tracking the company's progress toward achieving it. The head of the digital program should report directly to C-level executives and meet with them regularly (for example, every six weeks) to provide updates and discuss developments. The company's leadership should commit to hiring digital experts and earmark a portion of the corporate budget specifically for pursuing digital innovation. The CEO should approve the digital roadmap that guides the organization's initiatives and communicate regularly, through vehicles such as a monthly newsletter and investor presentations, about the importance of digital opportunities. As Clayton M. Christensen observed in The Innovator's Dilemma, disruptive change within established business models can only succeed if the CEO is fully committed to achieving it.
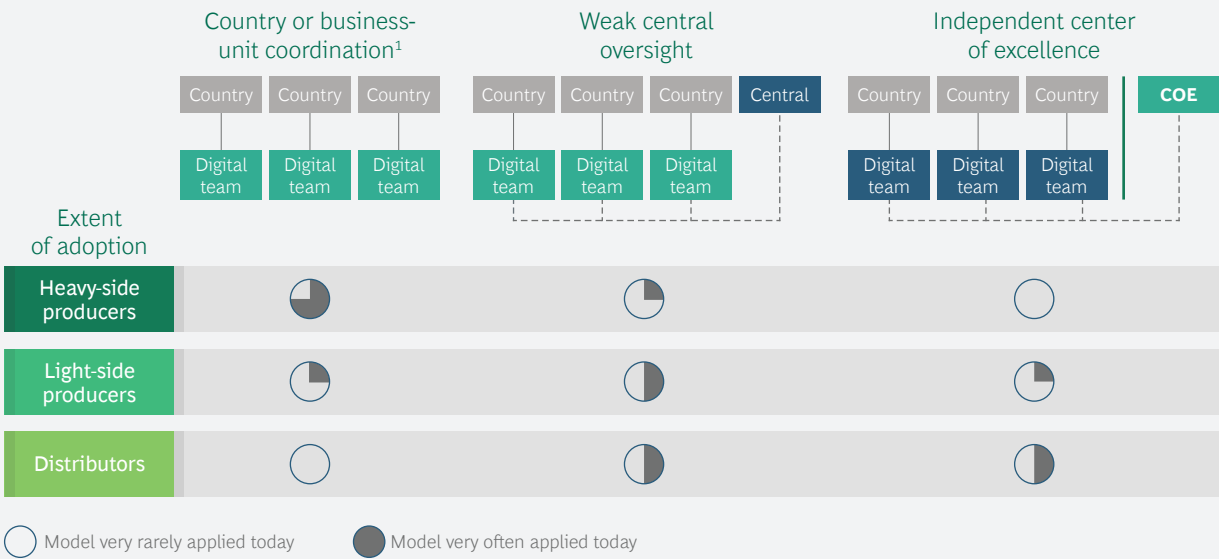
Establish an independent digital unit. To encourage risk taking and independence from country organizations and business units, producers need to establish a center of excellence (COE) to define the digital strategy and manage the digital transformation. The COE should have its own budget and the authority to centrally coordinate the digital initiatives pursued at the country and business-unit levels. The company's top leaders should explicitly require all stakeholders in the organization to respect the COE's independence, so that it can fulfill its mandate to advise on digital disruptions, stimulate idea generation, and challenge the current way of doing business. Capabilities to identify opportunities to collaborate with startups and universities will also be essential. Some distributors and a few light-side producers have set up a digital COE, while heavy-side producers have not yet done so. (See Exhibit 4.) It is more common in the industry today for companies to establish a hybrid model that entails weak central coordination of digital initiatives that are specific to country organizations or business units. In fact, most heavy-side producers have yet to set up any central coordination of the digital initiatives pursued by country organizations and business units.

Identifying opportunities to collaborate with startups and universities will be essential.

Become agile to innovate. Agility is essential for pursuing innovation opportunities. For example, a company can create a separate digital venture, or the marketing function or specific business lines can partner with startups to pursue their digital objectives. The company culture must encourage innovation throughout the entire organization, so that it can proactively launch new ideas and respond quickly and effectively to competitors' moves. The company should search for innovative opportunities continuously and be open to collaborating with startups, universities, and venture capital firms. A startup called Building Radar, for instance, has simplified producers' research into sales leads by maintaining a global database of construction projects and the related contacts. Producers can use the database to identify projects in the markets they serve and then proactively reach out to the right people at existing or prospective clients to discuss sales opportuni-

	Country or business-unit coordination[1]			Weak central oversight				Independent center of excellence			
	Country	Country	Country	Country	Country	Country	Central	Country	Country	Country	COE
	Digital team	Digital team	Digital team	Digital team	Digital team	Digital team		Digital team	Digital team	Digital team	

Extent of adoption

Heavy-side producers	◔	◔	○
Light-side producers	◔	◑	◔
Distributors	○	◑	◑

○ Model very rarely applied today   ◑ Model very often applied today

Sources: BCG interviews of executives at approximately 20 building-materials companies; BCG analysis.
Note: COE = center of excellence.
[1]Companies generally employ a country-based model or a business-unit model. We use the former for illustrative purposes only.

ties. Producers that look outside the four walls of their organization for such innovative players to work with are likely to capture major advantages as the distribution model evolves.

The COE should serve as the central point of contact for sharing innovative ideas generated throughout the organization, and the company's top experts should be readily accessible to challenge and prioritize the ideas. The company also needs capabilities to rapidly test ideas using prototypes and to capture feedback from all relevant operational units. Some companies have successfully established a venture capital subsidiary to assess an extensive portfolio of digital opportunities.

Implement digital ideas effectively. To capture competitive advantages, producers will need to bring their digital ideas to the marketplace effectively. Leading building-materials companies have already established practices that can serve as inspiration for other companies seeking to raise their game in digitally enabled distribution:

- **Cloud-Based Analytics.** Saint-Gobain, a global building-materials producer, has conducted a pilot program in Denmark to assess how cloud-based marketing and analytic resources can be used to tailor promotions to customers' needs. These resources have enabled the company to obtain detailed information about the performance of promotional programs and compare the results with those of similar programs used in the past. The company has applied the insights to better tailor its offerings to specific customer classifications and increase company-wide knowledge about marketing practices. This effort has contributed to a more than twofold increase in the conversion rate for online shopping (from 10% to 22%).

- **Augmented Reality.** To address the disparity that often exists between actual products and the photos that appear on screens, leading retailers, such as Lowe's, are experimenting with using augmented reality to provide 3D representations. The technology allows customers to visualize even the complex features of products such as bathroom fixtures. The use of augmented reality "showrooms" promises to increase customer satisfaction and reduce the costs associated with replacing materials that fail to meet customers' requirements.

- **Tracking Technology.** Leading heavy-side producers are testing ways to use tracking technology to gain better visibility into the timing of deliveries and respond faster to customer demand. Hines, for instance, is testing technology that allows contractors to track their orders in real time on mobile devices. The tracking system is a single repository for all information relating to truck locations and product specifications. By reducing the need to respond to customers' requests for information, the program has allowed the company's sales staff to spend more time on revenue-generating activities. Cemex uses customer data to forecast the areas where demand is likely to be highest during a specific time period. By proactively loading trucks to serve customers in these areas, the company has been able to reduce its fleet size by 35%.

Measure the results. Tracking the company's progress toward achieving its digital goals is essential for determining the return on investments and continuously improving the initiatives. Best practices entail having stakeholders across marketing, sales, and IT agree on a holistic set of digital KPIs linked to broader business goals, such as the growth of sales and profits. By providing insights into how performance has changed over time, these KPIs facilitate the central management and continuous refinement of initiatives that promote specific goals, such as higher conversion rates. Some distributors have made progress toward achieving this level of maturity, but heavy- and light-side players have yet to effectively track the performance of digital initiatives and prove their benefits.

Creating a Digital Roadmap

Taking action to address these imperatives requires a clear roadmap that sets out the responsibilities, milestones, and timelines for achieving the goals of the company's digital strategy. Creating a digital roadmap entails a multistep process.

Conduct a health check. A company should start by determining where it stands today. A standardized "health check" can be used to both assess the maturity of the company's

digital capabilities and identify gaps relative to those of competitors. The company can gather relevant information by surveying and interviewing key stakeholders in the marketing, sales, IT, and business intelligence functions, as well as leaders of external partners. The company may find that it needs to improve digital capabilities at each stage of the customer journey, such as capabilities to identify customers' needs at the ordering stage, introduce new functionalities at the payment step, or make better use of real-time data to help customers manage their inventory.

A company should gather a fact base for assessing the value of customer segments.

Identify potential digital pathways. The health check's findings should be applied to identify potential opportunities, or pathways, for creating a digitally enabled customer journey. The opportunities to achieve competitive advantages can become evident by identifying customer needs, assessing and benchmarking internal capabilities, and understanding the best-in-class digital offerings of competitors and, even more important, companies in other industries. Using surveys, focus groups, and interviews, the company should gather a fact base that allows it to assess customer segments with respect to their potential value and the benefits that could be unlocked through digital pathways. Discussions with external experts can also aid in understanding which approaches will yield the greatest impact for the company.

Prioritize and closely evaluate selected pathways. The company should focus its efforts on a prioritized set of digital pathways. Pathways should be ranked on the basis of their potential to create value and how well they fit with the company's other strategic priorities. The company should conduct an in-depth analysis of the top-priority pathways, so as to determine how they can be applied to design the ideal customer experience. The

results of this analysis should position the company to select which pathways to pursue first, determine a testing approach and timeline, and create a detailed execution plan.

Develop the roadmap. The execution plan for pursuing the pathways should be set out in a clear roadmap that provides the basis for determining resource requirements (including technology platforms) and establishing the required external partnerships. The roadmap should also apply the results of the health check in specifying the company's plan for building an organization with best-in-class digital capabilities.

ALTHOUGH building materials producers have thrived in the past by following a conservative strategy that did not chase the latest trends, such an approach could become a recipe for failure in the near future. Simply put, sticking with the traditional distribution model is no longer an option in the digital economy. Even companies that choose not to make the first moves into digitally enabled

direct distribution cannot afford to take a wait-and-see attitude. Producers must start taking steps immediately to understand the digital trends and opportunities reshaping their industry and develop digital strategies and capabilities that will allow them to remain competitive in the fast-changing market.

Arne Burfeind is a partner and managing director in the Zurich office of Boston Consulting Group. You may contact him by email at burfeind.arne@bcg.com.

Urs Rahne is a partner in the Berlin office of BCG Digital Ventures. You may contact him by email at urs.rahne@bcgdv.com.

Philipp Heck is a principal in BCG's Zurich office. You may contact him by email at heck.philipp@bcg.com.

Ian Gross was formerly a senior knowledge analyst in the firm's Chicago office.

NOTE TO THE READER

Health Care Leadership

Adam Farber
Global Leader—Health Care Practice
BCG Boston
+1 617 973 1200
farber.adam@bcg.com

Sanjay Saxena
Global Sector Leader—Payers, Providers & Services
BCG San Francisco
+1 415-732-8000
saxena.sanjay@bcg.com

Ulrik Schulze
Global Sector Leader—Biopharmaceuticals
BCG Zurich
+41 44 388 86 66
schulze.ulrik@bcg.com

Torben Danger
Global Sector Leader—Medical Devices and Technology
BCG New York
+1 212-446-2800
danger.torben@bcg.com

Contact the Authors

Alexander Aboshiha
Partner and Managing Director
BCG Los Angeles
+1 213-621-2772
aboshiha.alex@bcg.com

Elias Baltassis
Director
BCG Paris
+33 1 40 17 10 10
baltassis.elias@bcg.com

Akash Bhatia
Partner and Managing Director
BCG San Francisco
+1 415-732-8000
bhatia.akash@bcg.com

Arne Burfeind
Partner and Managing Director
BCG Zurich
+41 44 388 86 66
burfeind.arne@bcg.com

Rodolphe Charme di Carlo
Project Leader
BCG Dubai
+971 4 448 0300
charmedicarlo.rodolphe@bcg.com

Karalee Close
Partner and Managing Director
BCG London
+44 20 7753 5353
close.karalee@bcg.com

Sylvain Duranton
Senior Partner and Managing Director
BCG Paris
+33 1 40 17 10 10
duranton.sylvain@bcg.com

Lars Fæste
Senior Partner and Managing Director
BCG Hong Kong
+852 2506 2111
faeste.lars@bcg.com

Philipp Gerbert
Senior Partner and Managing Director
BCG Munich
+49 89 231 740
gerbert.philipp@bcg.com

Antoine Gourévitch
Senior Partner and Managing Director
BCG Paris
+33 1 40 17 10 10
gourevitch.antoine@bcg.com

Nayel Hakim
Senior Knowledge Analyst
BCG Boston—CKA
+1 857-206-8500
hakim.nayel@bcg.com

Gerry Hansell
Senior Partner and Managing Director
BCG Chicago
+1 312-993-3300
hansell.gerry@bcg.com

Philipp Heck
Principal
BCG Zurich
+41 44 388 86 66
heck.philipp@bcg.com

Nicolas Hunke
Partner and Managing Director
BCG Munich
+49 89 231 740
hunke.nicolas@bcg.com

Amy Hurwitz
Consultant
BCG Los Angeles
+1 213-621-2772
hurwitz.amy@bcg.com

Nipun Kalra
Principal
BCG Mumbai
+91 22 6749 7000
kalra.nipun@bcg.com

Ashish Kaura
Partner and Managing Director
BCG Chicago
+1 312-993-3300
kaura.ashish@bcg.com

Stefan Larsson
Senior Partner and Managing Director
BCG Stockholm
+46 8 402 44 00
larsson.stefan@bcg.com

Lise Lørup
Consultant
BCG Oslo
+47 21 04 68 00
loerup.lise@bcg.com

Julien Marx
Principal
BCG Paris
+33 1 40 17 10 10
marx.julien@bcg.com

Stéphanie Mingardon
Senior Partner and Managing Director
BCG Paris
+33 1 40 17 10 10
mingardon.stephanie@bcg.com

Urs Rahne
Partner
BCG DV Berlin
+49 30 300 13 7500
urs.rahne@bcgdv.com

Martin Reeves
Senior Partner and Managing Director
BCG New York
+1 212-446-2800
reeves.martin@bcg.com

Michael Rüßmann
Senior Partner and Managing Director
BCG Munich
+49 89 231 740
ruessmann.michael@bcg.com

Michael Ruhl
Partner and Managing Director
BCG Düsseldorf
+49 2 11 30 11 30
ruhl.michael@bcg.com

Sanjay Saxena
Senior Partner and Managing Director
BCG San Francisco
+1 415-732-8000
saxena.sanjay@bcg.com

Florian Schmieg
Principal
BCG Munich
+49 89 231 740
schmieg.florian@bcg.com

Emily Serazin
Partner and Managing Director
BCG Washington DC
+1 301-664-7400
serazin.emily@bcg.com

Sebastian Steinhäuser
Principal
BCG Munich
+49 89 231 740
steinhaeuser.sebastian@bcg.com

Zia Yusuf
Partner and Managing Director
BCG Silicon Valley
+1 650-282-8650
yusuf.zia@bcg.com