The Most Innovative Companies 2018

Innovators Go All In on Digital

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CONTENTS

INNOVATION IN 2018

AT LEADING INNOVATORS, R&D and new-product development have become digital endeavors. Eleven of the fifty companies named in BCG's 2018 ranking of the most innovative companies—including seven of the top ten—are digital natives and thus digital innovators by definition. Most, if not all, of the others on the list have built digital technologies into their innovation programs. The trend is pervasive across industries, penetrating what were heretofore the most stolid and conservative businesses.

A shift to digital innovation requires big changes in strategy, operations, and organization.

Like other aspects of digitally driven change, the shift to digital innovation is difficult. It requires executing big changes in strategy, operations, and organization, which affect the entire enterprise. Little surprise, then, that an innovation digital divide has opened up—and threatens to widen—between leaders and laggards. While 79% of strong innovators reported that they have properly digitized innovation processes, only 29% of weak innovators made the same claim. More than one-third of survey respondents said that digitized processes aren't really doing much for their

company—a sign that they haven't yet found a way to embrace the new possibilities.

In this year's report on the most innovative companies, we examine the state of digital innovation and what it takes for companies to refocus their innovation programs around this aspect of the digital imperative.

The 50 Most Innovative Companies

Exhibit 1 ranks the 50 most innovative companies for 2018. The companies at the top of the list changed only slightly from those in our last report. (See *The Most Innovative Companies 2016: Getting Past "Not Invented Here,"* BCG report, January 2017.) Two digital natives pushed their way into the top 10 this year: Alibaba Group, which joined the top 50 for the first time, and Uber. Among the top 20, Tencent is also new to the list, and Airbnb, SpaceX, Cisco Systems, Orange, and Marriott moved up—some significantly. Overall, 12 companies either joined the list or returned to it.

While North America remains the most highly represented region, with 27 companies, Europe strengthened its showing substantially with 16 entrants, up from 10 in 2016. The travel and transportation sector has expanded its presence as some companies—including Uber, Airbnb, and SpaceX—demonstrate the disrup-

Exhibit 1 | The Most Innovative Companies of 2018

1	Apple	11	Airbnb	21	Siemens	31	Intel	41	3M
2	Google	12	SpaceX	22	Unilever	32	NTT Docomo	42	SAP
3	Microsoft[1]	13	Netflix	23	BASF	33	Daimler[3]	43	DuPont
4	Amazon	14	Tencent	24	Expedia	34	AXA	44	InterContinental Hotels Group
5	Samsung[2]	15	Hewlett-Packard	25	Johnson & Johnson	35	Adidas	45	Disney
6	Tesla	16	Cisco Systems	26	JPMorgan Chase	36	BMW	46	Huawei
7	Facebook	17	Toyota	27	Bayer	37	Nissan	47	Procter & Gamble
8	IBM	18	General Electric	28	Dow Chemical	38	Pfizer	48	Verizon
9	Uber	19	Orange	29	AT&T	39	Time Warner	49	Philips
10	Alibaba	20	Marriott	30	Allianz	40	Renault	50	Nestlé

Source: 2017 BCG global innovation survey.
[1]Includes Nokia.
[2]Includes all Samsung business groups (electronics and heavy industry).
[3]Includes Mercedes-Benz.

tive potential of digital technologies and digital business models wielded in combination.

Digital Innovation Takes Over

Since 2014, only four types of innovation—all related to digital—have grown in importance and are being pursued by more companies: big data analytics, the fast adoption of new technologies, mobile products and capabilities, and digital design. (See Exhibit 2.)
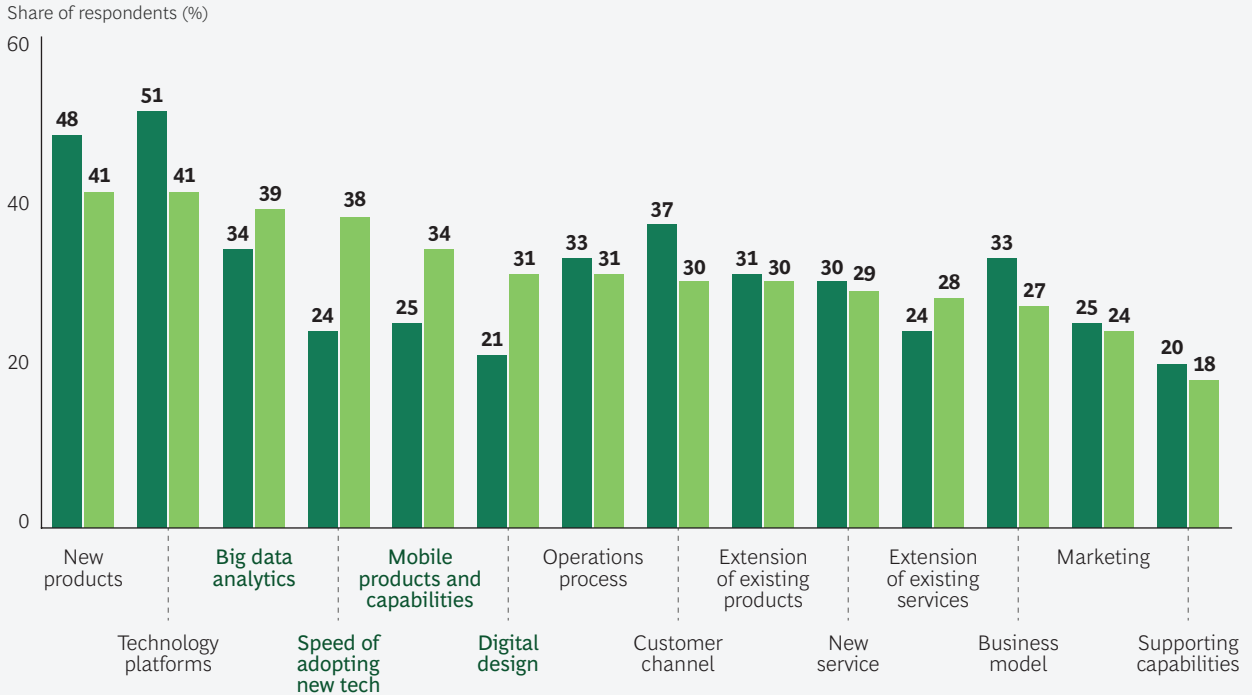
Big data analytics has risen from eighth in importance to third; it is now, along with new products, the most pursued type of innovation. More than half of respondents said that their companies use data analytics for a variety of purposes connected with innovation, including identifying new areas for exploration, providing input for idea generation, revealing market trends, informing innovation investment decisions, and setting portfolio

priorities. Energy, media and entertainment, financial services, and the public sector all saw large increases in terms of the number of companies or organizations pursuing big data in innovation. Recent BCG research has shown that companies across all sectors are still struggling with their data analytics capabilities, and that one capability in particular—the ability to prioritize—is especially concerning, because it is so fundamental to success. (See *Are You Set Up to Achieve Your Big Data Vision?*, BCG Focus, June 2017.)

The importance of speed in adopting new technologies has gone from near last place to fourth. Speed also used to be last in terms of the number of companies pursuing it as an innovation strategy; it is now tied for third. The percentage of companies targeting fast adoption increased significantly in manufacturing, insurance, metals and mining, and the public sector. Strong innovators understand

WHICH OF THE FOLLOWING AREAS OF INNOVATION AND PRODUCT DEVELOPMENT WILL HAVE THE GREATEST IMPACT IN YOUR INDUSTRY OVER THE NEXT THREE TO FIVE YEARS?

Share of respondents (%)

WHICH OF THE FOLLOWING AREAS OF INNOVATION AND PRODUCT DEVELOPMENT ARE YOU ACTIVELY TARGETING?

Share of respondents (%)

2016   2017
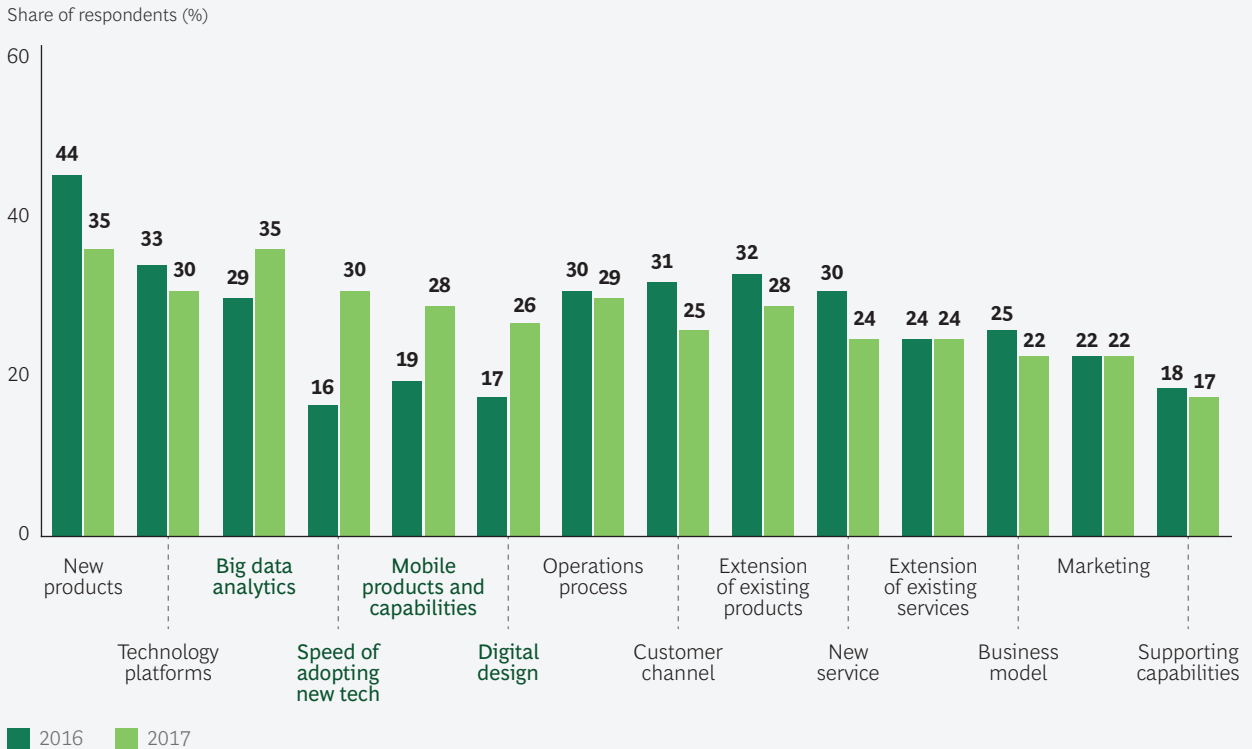
Sources: 2016 and 2017 BCG global innovation surveys.

that successful digital transformation requires excelling in three fundamental areas: speed, scale, and value. (See "Acting on the Digital Imperative," BCG article, September 2016.)

About a third of all respondents said that mobile products and capabilities, along with digital design, will have a significant impact in their industries over the next three to five years. About a quarter said that their companies are actively targeting these areas. The use of mobile technology is growing significantly in chemicals, financial services, manufacturing, and health care. Digital design is receiving greater attention in consumer products, media and entertainment, manufacturing, insurance, health care, and the public sector.

A Digital Innovation Divide

There are significant gaps in many areas between companies that describe themselves as strong in innovation and those that think they are weak, but the divide in the digital aspects of innovation is particularly striking. It indicates that companies with effective digital innovation programs are getting stronger while the weak are falling further behind. For example, strong innovators attach much greater importance than weak ones to the four types of digital-related innovation discussed above, as well as to technology platforms in general. There are even bigger chasms with regard to how aggressively companies are pursuing these innovation avenues. (See Exhibit 3.)

Strong innovators are far more likely to use big data and advanced analytics throughout the innovation process than weak innovators, which struggle to leverage data analytics effectively. Strong innovators also consistently use multiple sources of data, originating both internally and externally. Almost three-quarters of strong innovators, compared with less than 20% of weak innovators, reported that new projects or ideas for growth come from social media or data mining.

Strong innovators are more than twice as likely to use outsourcing to access the right capabilities, something that is frequently necessary for companies that do not have all the requisite digital skills in-house. They are also more likely to have properly digitized innovation processes. And it comes as no surprise that far more strong innovators than weak ones are satisfied with their return on investment (90% versus 24%).

Digital Change

In our work with companies that span the digital innovation continuum, we've found that organizations wanting to raise their digital game often face a variety of functional challenges. These businesses need to answer questions in three areas:

- **Strategy.** How do we apply technologies that expand the horizons of the possible in terms of new products, services, and business models?

- **Operations and Processes.** How do we apply digital technologies to drive innovation, leveraging new tools, platforms, and processes (such as agile) in order to turn insights into new products and services?

- **Organization.** How do we transform ourselves into digitally capable organizations and cultures that can bring digital innovations to market and make them work?

WHICH OF THE FOLLOWING AREAS OF INNOVATION AND PRODUCT DEVELOPMENT WILL HAVE THE GREATEST IMPACT IN YOUR INDUSTRY OVER THE NEXT THREE TO FIVE YEARS?

Share of respondents (%)

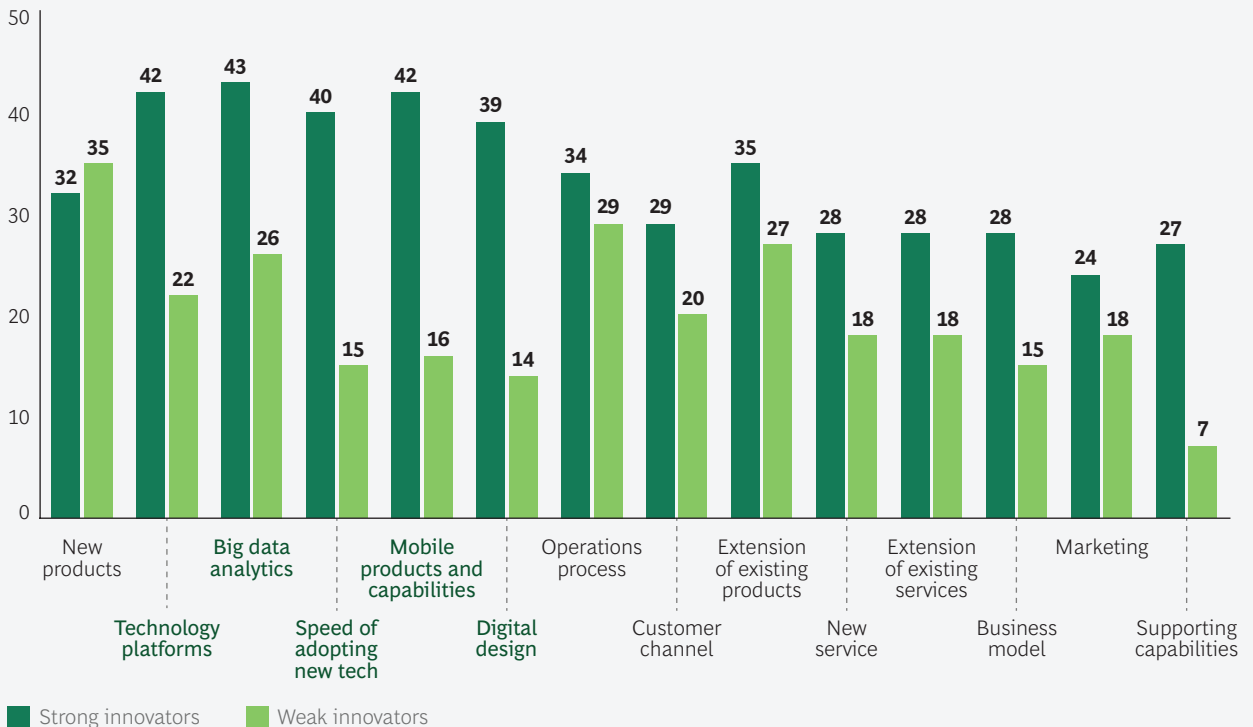| Category	Strong innovators	Weak innovators
New products	40	40
Technology platforms	45	32
Big data analytics	44	31
Speed of adopting new tech	40	28
Mobile products and capabilities	41	27
Digital design	41	29
Operations process	38	33
Customer channel	31	28
Extension of existing products	38	31
New service	35	23
Extension of existing services	35	21
Business model	31	24
Marketing	26	14
Supporting capabilities	28	10

WHICH OF THE FOLLOWING AREAS OF INNOVATION ARE YOU ACTIVELY TARGETING?

Share of respondents (%)

Category	Strong innovators	Weak innovators
New products	32	35
Technology platforms	42	22
Big data analytics	43	26
Speed of adopting new tech	40	15
Mobile products and capabilities	42	16
Digital design	39	14
Operations process	34	29
Customer channel	29	20
Extension of existing products	35	27
New service	28	18
Extension of existing services	28	18
Business model	28	15
Marketing	24	18
Supporting capabilities	27	7

■ Strong innovators   ■ Weak innovators

Source: 2017 BCG global innovation survey.

HOW DIGITAL TRANSFORMS INNOVATION STRATEGY

DIGITAL TECHNOLOGIES CHANGE INNOVA-TION strategy by expanding the horizon of the possible in terms of new products, services, business models, and the internal processes that enable the new offerings. This shift both raises the stakes and accelerates the pace of the innovation game.

Business leaders today need to think differently about innovation strategy. They should take into account the following five questions as they rethink—if not revamp—their innovation strategies for the digital age.

What's Possible?

Just about anything—and at lightning speed. Companies can develop and test new products—for example, through digitally enabled simulations, 3D printed prototypes, or minimally viable products released in the actual marketplace—much faster and more cheaply than ever before. Plenty of digital disruptors began with a beta test, among them Airbnb, Spotify, and Zappos.

At the same time, besides adapting to a faster tempo of competition, innovation strategists need to engage on a broader playing field. For example, competitive advantage increasingly is driven less by products and more by the digitally enabled services that surround them. From today's predictive maintenance offerings for industrial goods to tomorrow's Inter-

net of Things (IoT), strategists need to explore and master new innovation domains. Already, connected cars have drawn automakers into the software business, and autonomous vehicles are bringing tech companies into transportation and mobility. As more advanced technologies, such as artificial intelligence, enter the mainstream, the stakes keep climbing.

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Expanding the horizon of the possible raises the stakes of the innovation game.

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This boundary blurring also means that innovators need to expand their competitive set as digital-native companies seek to bring their own advantaged capabilities to more traditional markets. If you're a traditional insurer or credit rating agency, for example, it's worth considering whether Google or Facebook could use their data and machine-learning expertise to create new approaches to underwriting and assessing credit risk. Less speculatively, if you're a traditional grocer, it's important to determine how to counter the innovations that Amazon's acquisition of Whole Foods will inevitably unleash.

Traditional companies are increasingly trying to innovate more expansively and digitally. In

financial services, for example, it's hard to find a company that is not investing heavily in digital innovations. Global insurer AXA put €100 million into its venture lab, Kamet, with the goal of developing disruptive new insurance tech businesses. Citibank set up Citi Ventures to accelerate work on disruptive products that are based on such technologies as the IoT and blockchain. Allianz has created a digital lab to work with startups in such areas as data analytics, mobile, and social media. And Santander Group formed InnoVentures, a $100 million fund to make strategic investments in fintech products and services.

How Do We Use Data and Software?

Data (including mobile data) and software are essential to the identification and delivery of many digital innovations. At digital retailer Stitch Fix for example, data-driven algorithms perform hundreds of functions, including matching products to clients, pairing stylists with clients, calculating how happy customers are with the service, and figuring out how much and what kind of inventory the company should buy.

Data and software enable idea generation and exploration. When combined with human intelligence and creativity, natural language processing and network analytics make it possible to gain valuable insights about customer trends and competitor moves from information stored in huge, unstructured databases. Companies can explore patterns in patenting, venture capital funding, scientific literature, and customer data. They can also develop new value propositions, such as personalized offers, and new capabilities for traditional products, such as autonomous vehicles.

The wealth of data served up by mobile devices—much of it location-specific—is another powerful fuel for R&D and product and service development. Starbucks has built a personalization program largely around mobile data. Insurance companies are using mobile data to develop new products and services for transportation.

Software adds value to physical products. But software development often occurs in much

faster cycles than hardware innovation, creating management challenges for innovation programs. Digital natives have used speed as an advantage, establishing a new product or service (often exclusively online), gaining popularity through digital channels, and then scaling up fast. The need to accelerate innovation and shorten R&D and go-to-market cycles has big implications for how companies manage innovation programs and think about innovation strategy.

How Do We Access the Capabilities We Need?

Digital innovation generates a host of questions. What new strategic capabilities must be developed or acquired? How can a company create a competitive advantage in data and in gaining insight from that data at an accelerated pace? Is it possible to go it alone, or are partners required?

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The need to accelerate innovation and shorten R&D cycles has big implications for strategy.

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Technical skills are an obvious need, but they are both technology-specific and in short supply. Every company looking to take advantage of data analytics, not to mention artificial intelligence, needs data scientists. However, data scientists are not experts in mobile devices or mobile engagement. Neither are they software engineers. Furthermore, industry knowledge is critical: consumer goods companies need people with e-commerce experience, and industrial manufacturers need people with expertise in Industry 4.0 and the IoT. Complicating matters further is the need to train technical talent in what makes the business tick and business talent in what technology and the techies can help them achieve. And then there is the issue of digitizing legacy IT and the supply chain so they can support digital processes at digital speeds.

Even the largest organizations find that they can't do everything themselves; they need

partnerships and alliances, which open up all kinds of issues related to their place in the innovation system, ownership of intellectual property (IP), and the like. BCG research shows that the number of digital joint ventures has increased by almost 60% in the past four years. Some traditional companies—such as auto OEMs, which have long collaborated closely with multiple suppliers—may be better positioned to adapt to this new paradigm than others. But even for those companies with prior collaboration experience, differences between digital and traditional companies in approaches and cultures, as well as in ways of working, may be challenging to navigate.

What Are the Risks of Not Moving Fast Enough?

The biggest risk, of course, is finding that your company's product or technology no longer has a market; think about what happened to Kodak and Wang Laboratories, for example. The more immediate challenge is simply to avoid being left behind by those that invested sooner or more heavily in digital innovation. Our research shows that strong innovators assign much greater importance than weak innovators to big data, speed of technology adoption, mobile products, digital design, and technology platforms generally. There are even bigger gaps in how aggressively companies are pursuing these innovation avenues.

For traditional companies seeking to embrace digital, IP is a critical potential obstacle. Companies that want to embrace the IoT, for instance, must confront the fact that four of the top ten IoT patent holders are licensing companies whose business model is built on collecting rent from companies that need their IP. The connected car provides another example: most dashboard patents are held by Microsoft, Apple, and Google—not by auto OEMs.

What Are Leaders Doing?

All of the foregoing has major implications for how companies approach innovation, from their allocation of resources to their measures of success. Companies and indus-

tries differ, of course, depending on individual circumstance—their starting point and the extent of disruption. Nonetheless, we see some common themes among those that are moving most aggressively to digitize their innovation programs. These leaders are opening a divide with those that are slower to adopt digital approaches, and this gap will only expand as more advanced technologies, such as artificial intelligence and blockchain, enter the mainstream. Laggards will be increasingly challenged to catch up.

Leaders dedicate resources. Leaders recognize the importance of digital, and they are shifting their investment allocations accordingly. Data analytics, rapid adoption, mobile products, and digital design are all rising in importance, and the number of companies pursuing them is also increasing, according to our 2017 innovation survey. Leaders are both digitizing internal processes and funding enablers, such as incubators and accelerators. They are also digitizing how they monitor and manage IP.

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Leaders are opening a divide with those that are slower to adopt digital approaches.

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They invest in speed. Leaders are revamping their innovation engines, looking to shorten cycles, move faster, and cut the time to market. They test more ideas earlier in development and use digital techniques for simulation and prototyping. They iterate rapidly until they find a good product-market fit. Development often focuses on producing a minimally viable product, rather than a fully finished version, that companies can launch, collect data on, adapt, and relaunch—all in an iterative, agile style. Product launches increasingly take place online using e-commerce or e-customer platforms.

They take smart risks. Leaders are willing to make big bets that have a high-risk, high-reward profile, in part because they understand that there is greater risk in doing nothing. Tesla has accelerated to the top of the auto

industry with big bets on technology, including batteries and autonomous driving. The company is not afraid to fail and to do so publicly. But it has also maintained its reputation, market capitalization, and willingness to push boundaries. Leading companies focus on what they are good at, too. Once they've established a viable product or service, they expand to other ideas. Amazon, for instance, built an innovation behemoth on one simple idea: selling books online. The cornerstone of Nike's success was a better running shoe.

Many larger, more established companies are averse to taking risks and reluctant to try out new approaches, technologies, and products. Indeed, our 2017 innovation survey found that the top two obstacles to generating a return on investment in innovation and product development were a risk-averse culture and overlong development times.

They invest in data. Leaders use their own data combined with data from industry sources and third parties (such as partner companies 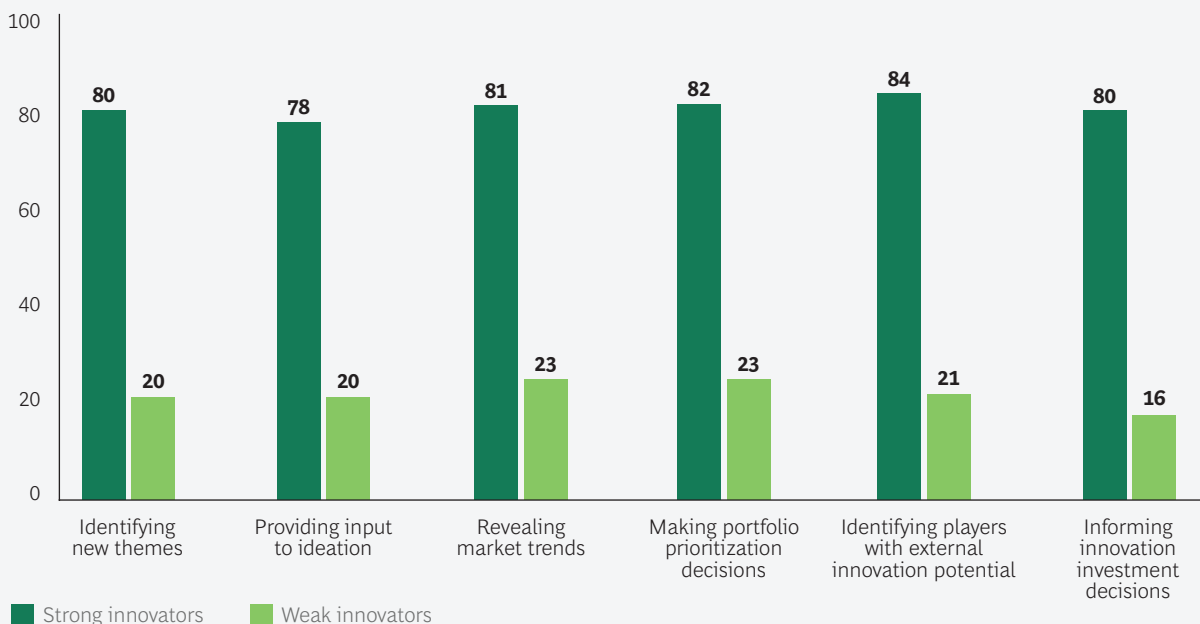and social media) at all stages of the innovation process—from idea generation to testing. They mine data for new ideas, and they connect with customers, suppliers, and partners using digital platforms to incorporate real-time feedback as they iterate new-product development. They use data throughout the innovation process. (See Exhibit 4.) Many use data to extend the capabilities of their products and services. For example, Schneider Electric, Deere & Company, and Schindler Group (a manufacturer of elevators, escalators, and moving walkways) all employ many types of new information-based services, analytics, and insights by adding internet-connected devices—such as sensors, microprocessors, radios, and GPS locators—to their products. In some cases, digital data has led to new disciplines, such as precision farming, and new forms of collaboration, such as communities of customers who develop answers to common questions.

They build advantaged capabilities. Leaders recognize the need to build and expand their skills and capabilities at many levels. They invest in acquiring and developing talent: technical, business, and cross-disciplinary.

EXHIBIT 4 | Strong Innovators Use Data Throughout the Innovation Process

HOW WOULD YOU RATE YOUR COMPANY'S SKILL IN LEVERAGING BIG DATA AND ADVANCED ANALYTICS TO HELP WITH EACH OF THE FOLLOWING ASPECTS OF INNOVATION?

Share of respondents grading themselves as "good" or "very good" (%)

Aspect	Strong innovators	Weak innovators
Identifying new themes	80	20
Providing input to ideation	78	20
Revealing market trends	81	23
Making portfolio prioritization decisions	82	23
Identifying players with external innovation potential	84	21
Informing innovation investment decisions	80	16

■ Strong innovators ■ Weak innovators

Source: 2017 BCG global innovation survey.

They establish cross-functional teams and seek to work in more agile ways. (See "Taking Agile Way Beyond Software," BCG article, July 2017.) And, as we explored in *The Most Innovative Companies 2016*, they are not afraid to incorporate external innovations through a variety of mechanisms, including acquisitions, partnerships, joint ventures, and licensing. As the technical basis of so many innovations increases, leaders access new technologies and capabilities from outside the company and use a variety of models for doing so, including corporate venture capital, accelerators and incubators, and innovation labs. They also overcome the not-invented-here mentality when bringing a new idea, capability, or model into their organizations.

A clear target product profile was the most important factor in creating value from innovation, R&D, and product development efforts in our 2017 innovation survey. Fully 85% of respondents from strong innovators said that their company has a clear target product

profile, compared with only 46% from weak innovators. Strong innovators also have clear portfolio management and digitized processes. (See Exhibit 5.)
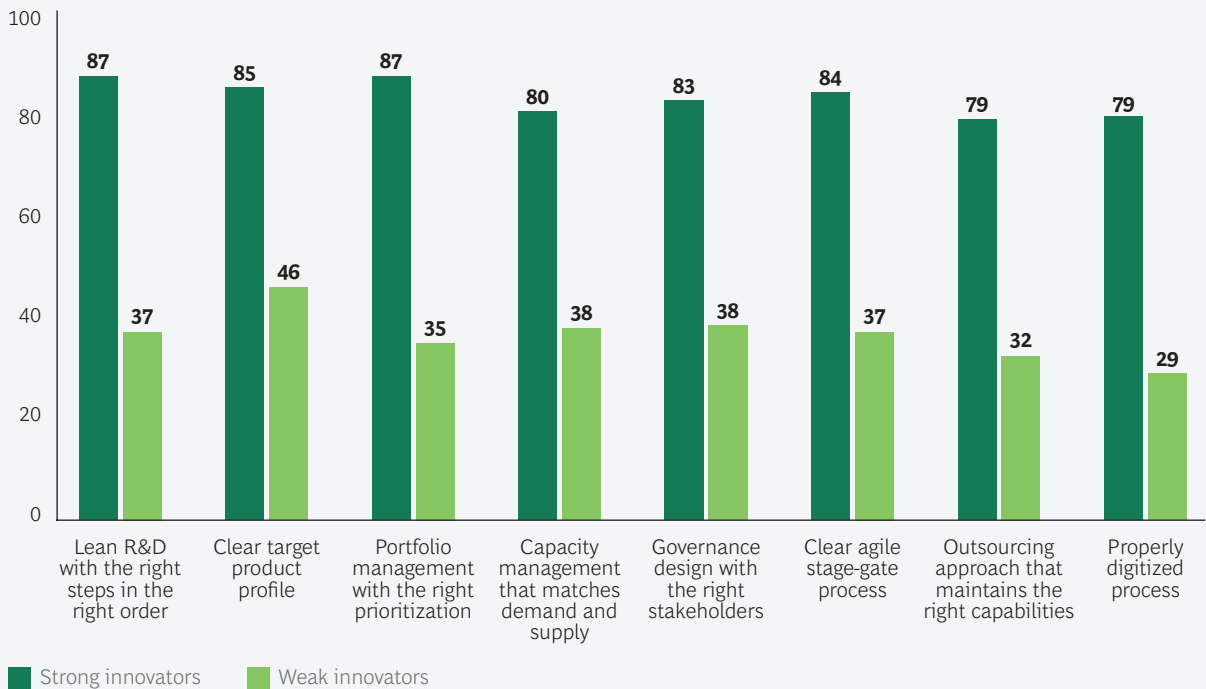
Playing by New Rules

Digital technologies present a trifecta of innovation challenges: they blur boundaries, raise the stakes, and up the speed at which new competitors with new ideas can seize sales and share. Traditional companies, no matter how large, can't afford to pursue innovation, R&D, and product development in traditional ways. To do so cedes competitive advantage to the disruptors. Companies need to determine their own digital strategies and start playing the innovation game by today's rules.

EXHIBIT 5 | **Strong Innovators Have Clear Target Product Profiles, Portfolio Management, and Digitized Processes**

PLEASE RATE THE DEGREE TO WHICH THESE STATEMENTS CHARACTERIZE
YOUR COMPANY'S INNOVATION, R&D, AND PRODUCT DEVELOPMENT ACTIVITIES

Share of respondents selecting "agree" or "strongly agree" (%)

	Strong innovators	Weak innovators
Lean R&D with the right steps in the right order	87	37
Clear target product profile	85	46
Portfolio management with the right prioritization	87	35
Capacity management that matches demand and supply	80	38
Governance design with the right stakeholders	83	38
Clear agile stage-gate process	84	37
Outsourcing approach that maintains the right capabilities	79	32
Properly digitized process	79	29

■ Strong innovators   ■ Weak innovators

Source: 2017 BCG global innovation survey.

A DIGITAL OVERHAUL FOR INNOVATION OPERATIONS

I N THE INNOVATION SURVEY for this report, 30% to 40% of respondents said that they expect big data analytics and digital design to have a significant impact in their industries over the next three to five years. About a third said their companies are targeting data analytics in their innovation and product development efforts, and about a quarter are targeting digital design.

These figures are significant increases over those in the last survey, but given the impact of digital disruption across multiple industries, one might ask why the numbers are not even higher. Our experience suggests that a big part of the answer lies in the scale of the undertaking. Digitizing processes such as innovation programs requires the ability to access large quantities of data from multiple sources, the technology and skills to analyze the data and extract insights, and the process acumen to work in nontraditional ways, such as agile—all of which changes how companies go about innovation. It's a daunting challenge, and most companies do not yet have the requisite capabilities.

High-Impact Innovation

The potential impact of data analytics and digital design on innovation strategy is a big deal. But the potential impact on operational processes, including R&D and new-product development, is just as significant.

Digital's impact on operations generally takes three forms. The first is streamlining and speeding up processes that traditionally have been handled manually or are still paper-based. In the pharmaceuticals industry, for example, think about the ways in which data, mobile technology, and blockchain can revamp how companies identify participants for, and conduct, clinical trials.

The second, more far-reaching, impact is digital's transformation of the process of innovation—in other words, R&D itself. Data analytics and other digital capabilities can handle tasks that humans cannot, such as processing massive amounts of data from disparate sources to find patterns that are otherwise hard to discern.

For example, medical researchers used data analytics to uncover the genetic patterns that underlie certain diseases. That information was then used to predict outcomes for drugs targeting the proteins associated with the relevant genes. This data-backed insight led to the discovery and development of PCSK9 inhibitors, a class of drugs that lower cholesterol. Or consider a financial services company that wants to shift from a products-and-process business model to one built on customer journeys. The company will need to adjust its products to create new digital offerings, such as online auto insurance, and digitize its systems and processes for effective product and service delivery.

These examples are just the tip of the iceberg. As capabilities improve, companies could end up reworking their entire R&D or product development value chains to take advantage of new ways of generating and evaluating insights—in many cases short-circuiting protracted, risky, and expensive steps in their current ways of doing business.

Digital natives often have the advantage of designing their digital innovation processes from scratch. This has led to disruptions in industries as varied as agriculture, consumer goods, manufacturing, and financial services, and it is requiring all companies to rethink their operational processes for innovation. For most established companies, the digitization of R&D and product development is a substantial task that needs to be approached with a transformational mindset.

Digitizing R&D and product development requires a transformational mindset.

One global automaker, which is at the forefront of using digital to reshape its R&D process, has established a digital center with the following mandate:

- Build competencies, through internal training and external recruitment, to increase the company's capacity to deliver projects.

- Digitize internal processes—such as in project validation, recruitment, and purchasing—to increase the speed of project delivery.

- Serve as a catalyst to create new ways of working that allow functions and regions to pool resources and share best practices.

- Fully leverage the value of data from such sources as R&D, production, and in-market car usage.

- Reinforce the company's attractiveness to digital talent and instill a digital mindset across the organization.

The third impact of digital on operations involves the tools that companies use to manage the portfolio of innovation opportunities. In our experience, more and more companies are adding automation to their portfolio management approach and digitizing their pipelines by using data and analytics to help prioritize ideas for development. It's not unreasonable to expect that more advanced innovators will soon employ predictive algorithms that will tell them which ideas have a higher likelihood of success.

A Foundation for Digital Design

Regardless of industry, digitizing a large company's product development processes takes time and effort. Companies need to start by harnessing data and adopting digital ways of working.

Data. Data is the fuel for the digital innovation engine. It can come from customers, processes, machine operations, testing, production plants, storage facilities, and delivery logistics systems, among myriad other sources. Companies need the ability to both access and process large amounts of disparate data—including data from third parties—on a continuous, reliable, and repeatable basis. But harnessing all that data is no simple task.

First, too much company data today is siloed. It belongs to the marketing, finance, or sales department, and that department is the only one that has access to it. Companies need to adopt an open-source approach so that the entire organization, including R&D and product development teams, can access data wherever it resides.

Second, old-style data warehouses limit the kinds of data that companies can collect and what they can do with it. Many companies are restructuring their data collection, storage, and usage approaches into data lakes— large repositories of data in a "natural," unprocessed state. Because of their flexibility and size, data lakes allow for substantially easier storage of raw data streams, which today include a multitude of data types. Data can be collected and then sampled for ideas, tapped for analytics and feedback loops, and

even potentially treated for analysis in traditional structured systems. While data warehouses typically provide backward-looking views, product development organizations need data to tell them not just what happened in the past but also what is likely to happen in the future. They want predictive and actionable insights to inform their R&D.

Third, companies have more opportunities to interact with customers and suppliers than ever before, opening up different ways to experiment with new products and services, learn what buyers want, and adapt accordingly. But most companies have so far not capitalized on this opportunity because they lack the capabilities to follow the customer's digital trail, and they have not established the kind of customer feedback loops that allow for experimentation and a test-and-learn approach. Moreover, customer data often remains locked up in the customer insight function, never making its way into business decisions or product development programs.

General Electric, a constant presence on our list of the 50 most innovative companies and number 18 this year, is an exception to this pattern. Its FastWorks program is modeled on many of the practices used by startups to move new products quickly to market, including building customer feedback into the R&D process. FastWorks involves customers early on in the process and uses frequent testing to confirm or disprove assumptions and to guide adjustments throughout the development process.

Ways of Working. Digital innovation processes are cross-functional and increasingly agile. Digital skills will neither thrive nor be particularly useful when used in solitude. Companies need to find ways to encourage, or even compel, collaboration among people with digital and traditional skills and expertise. But this means that, just as digital experts need a working knowledge of the business, business people need to understand the basics of digital. Some equipment manufacturers have developed new revenue streams from service businesses that use digital technologies to maintain and support capital equipment. Siemens's train engines are one example. The company's development of predictive mainte-

nance capabilities required more than digital knowledge of sensors, data, and the IoT; engineers also needed to know about the mechanics of train engines, how customers use them, and the economics of maintenance for complex machines.

Digital innovation processes are increasingly agile because agile ways of working are more collaborative and faster than traditional methods. Cross-disciplinary, collocated teams collaborate in innovative ways on the basis of insights gained from data and customer feedback. By working iteratively and incorporating feedback to improve continually, agile teams can transform innovation from the inside out. Because many companies are still organized around highly specialized functions, however, the shift toward agile often requires process redesign and organizational change—from large functional structures to small teams of cross-trained individuals.

Digital innovation processes are cross-functional and increasingly agile.

Agile ways of working are particularly conducive to a test-and-learn approach, which is the hallmark of innovation for many digital natives. Rather than spend months or years designing, testing, prototyping, and perfecting a new product, agile innovators move quickly to come up with a minimally viable product that they can put into the marketplace for real-life testing, feedback, and adaptation. They use such digital techniques and tools as advanced simulations, 3D printing, and set-based design to accelerate the design process. They employ tight feedback loops to test, learn, and test again. The goal becomes not only product excellence but also continuous improvement based on customer usage and feedback.

Models and Laboratories

Digital innovation presents traditional large organizations with multiple challenges. Technologies move fast; cycles times are short. The bets can be large and the uncertainties

larger still. Traps must be avoided. One pitfall is attempting to apply digital technologies to existing processes instead of developing digital processes. Another is looking at digital technologies primarily as enablers of automation and greater speed—which they certainly are—but missing the chance to marry these technologies with human capabilities in order to create new ways of working.

While there are no roadmaps for digitizing innovation, there are plenty of models and laboratories that smart companies can use to test new ideas before committing to development. Digital natives usually test multiple ways of doing things, especially with respect to the collection and use of data. Companies can access laboratories in the form of model digital production facilities—such as those run by some universities and BCG's own Innovation Center for Operations—which can be customized to illustrate the impact of assorted digital technologies and processes in various manufacturing, process, and production environments.

Companies can also make their own bets through M&A, partnerships, joint ventures, and participation in the digital ecosystems of organizations that spring up around emerg-ing technologies. As we observed in our last report, more and more big companies are setting up their own digital venture capital funds, incubators, and accelerators to further their own experimentation. And big companies with an interest in potentially proprietary technologies are considering a variety of arrangements with so-called deep-tech startups, which are often more than happy to have a big corporate partner. (See "What Deep-Tech Startups Want from Corporate Partners" and "A Framework for Deep-Tech Collaboration," BCG articles, April 2017.)

Whichever path they take, as they develop their digital innovations strategies and realign their organizations to function in a digital environment, companies will also need to digitize their innovation operations and processes. Those that try to produce digital initiatives with traditional approaches will soon find themselves mired in the old ways of doing things and frustrated over their inability to put digital technologies and ways of working into full operation.

ORGANIZING FOR DIGITAL INNOVATION

DIGITAL ORGANIZATIONS ARE DIFFERENT. Consider Tesla, a digital native that has been among the top ten companies on the last three BCG lists of the most innovative companies and that ranked number six in 2017. Tesla looks nothing like other auto OEMs. Its structure, rather than being functionally divided and hierarchical, is organized around small, agile-empowered teams that comprise a program executive who ensures cross-product integration; a product owner who is responsible for architectural definition, customer success criteria, and feature resource needs; feature developers; and end-to-end quality engineers.

Innovations today need a digitally capable organization to make them work.

The company's flat structure supports cross-functional teaming and communication. Each team works on one integrated project plan at a time with a clear owner. The project leader has the authority to set cross-functional resource levels. The teams themselves are organized to reduce coordination complexity, and they are accountable to a program, not a function. Customers are involved in testing and improving products; their feedback influ-ences feature changes and priorities. Incentives are designed to motivate cross-functional interaction.

With no legacy structures to constrain it, Tesla organized itself for innovation. The question for traditional companies in all sectors is how to transform their organizations in order to achieve the speed, agility, and success of native digital innovators.

Digital Organization Design Principles

Digital innovations take many forms—new products and services, more efficient and high-impact operations and processes, even radically different business models. But if such innovations are to take root and thrive, they will need a digitally capable organization to make them work. New products designed for customer journeys in financial services, for example, are meaningless if a company cannot engage customers and access data digital-ly. Features for connected cars will not oper-ate without a connected organization to make them function. Automated services for indus-trial equipment won't work unless the compa-ny is equipped to process digital data from the IoT. Digital innovation and digital organi-zations are codependent and intertwined.

Digital organizations are built on a set of de-sign principles. These organizations are:

- **Customer-Centric.** They focus all aspects of the business on customer needs and wishes.

- **Agile.** They adhere to short response and implementation times in both decision making and resource allocation.

- **Experimental.** Digital organizations' business models foster experimentation; they are built to try, fail quickly, and improve. When something works, they scale up fast.

- **Lean, Simple, and Standard.** They aspire to have standardized structures, units, and processes as well as clear roles and responsibilities. Simplicity is a central consideration in decision making.

- **Focused on Operational Excellence.** Digital organizations champion efficiency, lean techniques, competitive cost structures, and continuous improvement. They maintain a high degree of organizational discipline.

- **Empowered and Accountable.** They empower managers to take action; they monitor performance and hold managers accountable; and they focus on a small number of simple and clear KPIs.
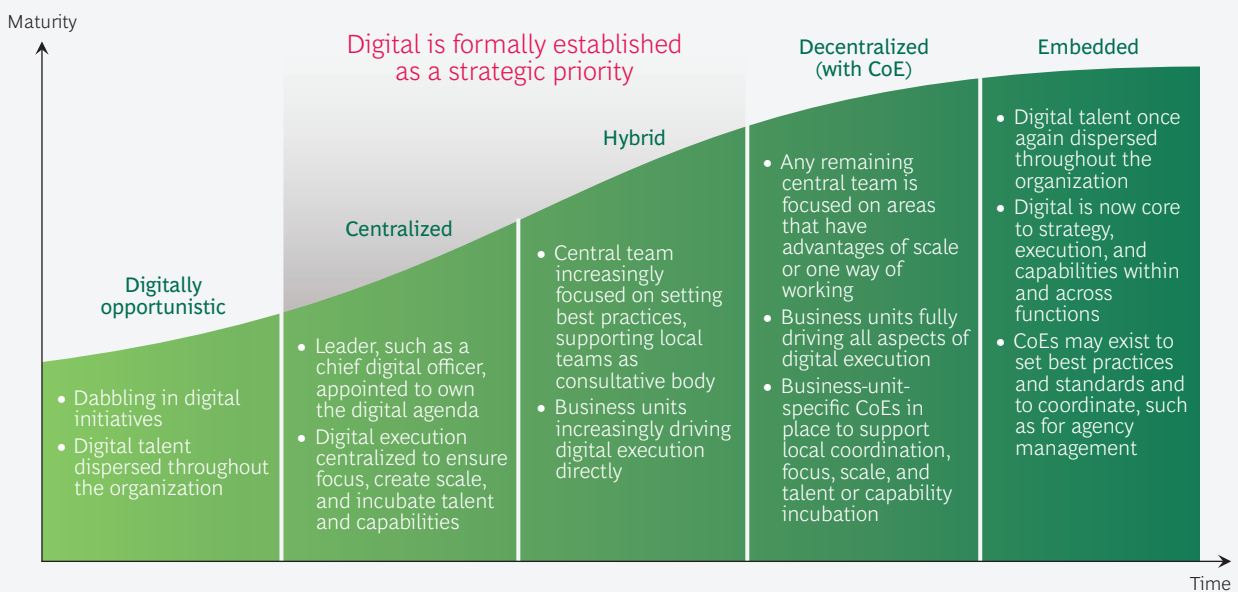
- **Cross-Functional.** Their teams purposefully combine all relevant types of expertise, both digital and business-specific. Digital organizations avoid functional silos so that ideas, expertise, and data can be easily shared and acted on.

From Principles to Practice

Digital's impact is still developing in many industries, and companies continue to wrestle with how to put digital principles into organizational practice, including with respect to innovation. Yet, in our work with clients, we are beginning to see a common pathway to maturity emerge. (See Exhibit 6.)

Initially, many companies are digitally opportunistic, experimenting with digital initiatives. Typically, they do so at the business unit level because these units are closest to customers and are often the first to feel the need for digital marketing and engagement, e-commerce, and the like. But the efforts typically are fragmented, lacking in resources, and conducted without an end-to-end corporate view of how the company should harness digital technologies.

EXHIBIT 6 | An Emerging Pathway to Digital Organization Maturity

Maturity

Digital is formally established as a strategic priority

Decentralized (with CoE)

Embedded

Hybrid

Centralized

Digitally opportunistic

- Dabbling in digital initiatives
- Digital talent dispersed throughout the organization

- Leader, such as a chief digital officer, appointed to own the digital agenda
- Digital execution centralized to ensure focus, create scale, and incubate talent and capabilities

- Central team increasingly focused on setting best practices, supporting local teams as consultative body
- Business units increasingly driving digital execution directly

- Any remaining central team is focused on areas that have advantages of scale or one way of working
- Business units fully driving all aspects of digital execution
- Business-unit-specific CoEs in place to support local coordination, focus, scale, and talent or capability incubation

- Digital talent once again dispersed throughout the organization
- Digital is now core to strategy, execution, and capabilities within and across functions
- CoEs may exist to set best practices and standards and to coordinate, such as for agency management

Time

Source: BCG analysis.
Note: CoE = center of excellence.

When companies realize that digital needs to be integral, if not central, to their strategy, they start to centralize digital development and execution to heighten focus, create scale, and incubate talent and capabilities. Often they appoint a leader, a chief digital officer (CDO), for example, to drive the digital agenda. The next phase of development involves a hybrid digital function with a central team focused on setting best practices and supporting local teams as a consultative body, while the business units drive digital execution. At first, the business units drive most aspects of digital execution with centers of excellence (CoE), which support local coordination, focus, scale, and incubation of talent and capabilities. At maturity, the role of the CoEs diminishes as digital capabilities are embedded throughout the organization and digital technologies and ways of working become core to both strategy and execution.

A Digital Innovation Unit

The split between centralized and decentralized digital development is reflected in how companies approach innovation generally. In our survey, almost 30% of all respondents said that a centralized organization controls and drives innovation at their companies; 35% reported that a centralized organization drives research and passes the results to the business units; and 29% said that the business units drive their own innovation with support from a centralized organization. A more pronounced preference emerged among strong innovators, where innovation tends to be more centralized. More than 70% of strong innovators (compared with 50% of weak innovators) reported that either a centralized organization controls and drives innovation or the centralized organization drives research and passes the results to the business units.

In our experience, a centralized digital innovation unit has a mix of several critical responsibilities. It creates a digital innovation roadmap that guides the digitization of the company's innovation function and monitors progress. It manages cross-functional digital projects. A chief data officer is responsible for using external and internal data for improved decision making, including developing tools, methodologies, and platforms; identifying and

prioritizing data sources; building a data engine to gain insights; and developing and managing data policy. A customer experience team seeks to create superior and seamless customer experiences across digital and non-digital channels. This includes mapping customer journeys, designing customer interfaces, and putting in place an e-commerce strategy, if needed. This team also helps business units implement digital tools and best practices.

A team responsible for driving digital innovation brings in the technology. It manages relations with the startup community, including seed investments; fosters internal innovation; oversees digital incubators, accelerators, and labs; and supports deployment of innovation initiatives. Finally, a partnerships team develops an ecosystem of business development ventures that can generate new sources of revenue.

Digital insurgents hire strong, committed people who relish experimentation.

Companies slot this type of unit into their organizations in different ways and places. In some instances, the unit reports directly to the CEO. At one global consumer goods company, a team under a vice president for digital transformation, reporting to the CMO, operates as a digital marketing CoE responsible for training and sharing best practices across the brand teams. A separate e-commerce team oversees an e-commerce CoE, as well as a big data and analytics operation. Another consumer company has a central digital acceleration team, to which top talent from the business units must apply. Successful candidates spend eight months executing projects, after which they return to their home markets and transfer the acquired capabilities to their business units. At Apple, the late Steve Jobs famously handpicked the top 100 employees to drive brainstorming and idea generation.

One hallmark of digital insurgents is talent: they hire strong, committed people who rel-

ish experimentation. These hires are also willing to work hard, giving the company their all for a possible successful outcome. Our research shows that strong innovators are much more likely than weak innovators to establish teams that are staffed with people who have the appropriate skills, to make sure that all relevant functional groups are represented, and to have people who are committed full-time. (See Exhibit 7.)

Renault's response to digital disruption in the auto industry has been to create its own "digital factory." This unit drives customer-centric product development, has agile teams working to accelerate and secure digital value (by developing proofs of concept, for example), coordinates digital activities across functions, leads the implementation of digital initiatives, and scouts the organization for digital innovation.
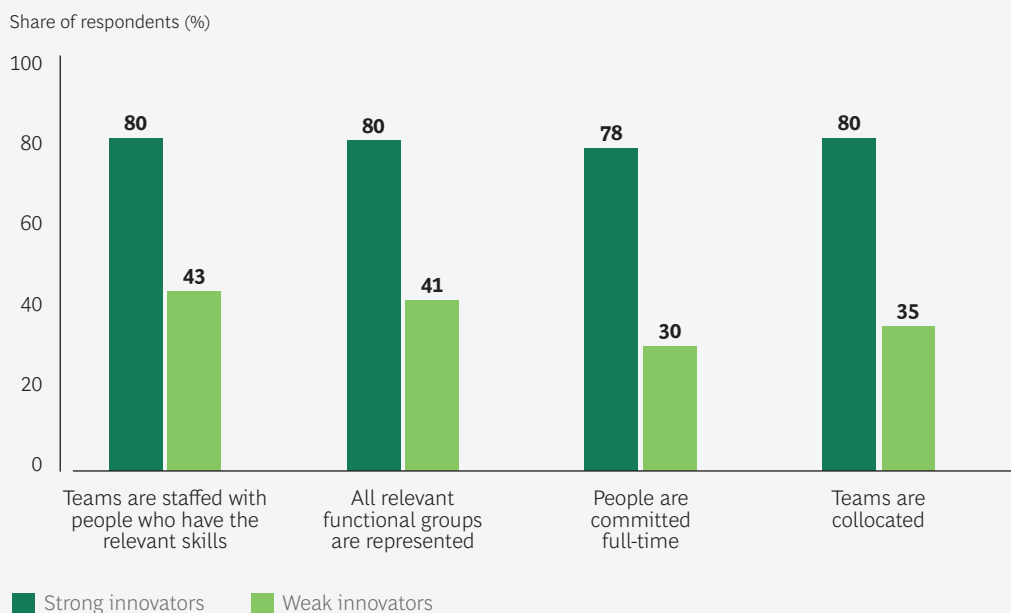
The Digital Leader

Many companies find that they need a CDO to oversee both digital innovation and the digital transformation of the organization. This digital leader can be pivotal to a compa-

ny's progress along the digital maturity curve. The CDO's key attribute is not a technical background, though that is certainly important. Rather, it is the ability to understand the power of the full range of digital technologies, from data to mobile to artificial intelligence, and the impact that they can have on products, services, and business models. More specifically, a digital leader should:

- Have breadth: a deep understanding of both technology and the business and a clear vision of how technology can affect the top and bottom lines.

- Have a vision: knowledge of the key technology and market trends and how they shape the need for technology capabilities and talent now and in the future.

- Be culturally adept: capable of managing cultural differences among digital and business teams and equipped to push a culture shift across the broader organization.

- Be adaptive and flexible: able to monitor the progress of the transformation and

EXHIBIT 7 | Strong Innovators Differentiate Themselves with Talent and Team Structure

HOW ARE INNOVATION AND PRODUCT DEVELOPMENT TEAMS STRUCTURED?

Share of respondents (%)

	Teams are staffed with people who have the relevant skills	All relevant functional groups are represented	People are committed full-time	Teams are collocated
Strong innovators	80	80	78	80
Weak innovators	43	41	30	35

■ Strong innovators   ■ Weak innovators

Source: 2017 BCG global innovation survey.

adjust digital efforts to changes in the environment, such as in technology development, competition, and consumer behavior.

- Be collaborative: capable of bringing together leaders from different business units and driving alignment on transformation priorities and timing, resulting in cooperation around a common vision.

The scope of the digital leader can vary from a targeted to a comprehensive transformation, depending on the company's digital strategy. Companies pursuing a targeted strategy concentrate on a few areas and on the enablers identified as most critical to the organization's digital strategy. This is a common model among large organizations because of the complexity of their existing operations, the need to prioritize resources, and the desire to see new capabilities deliver actual value before committing further resources to the effort.

Leapfrog companies accept the risk of initial culture clash as part of the price of change.

A comprehensive transformation focuses on all aspects of digital and ensures one coordinated strategy and execution across the enterprise (as opposed to each function pursuing its own priorities). We see this model being followed more commonly at smaller, newer companies that have employed digital technologies and approaches from the outset, as well as in industries where digital already has an established, proven track record.

A New Approach to Organization

Digital innovations can lead to the need for completely new organizational thinking. Consider, for instance, an athletic-shoe company that has long sought to produce a vast array of shoes for consumers to choose from at the lowest possible price, but which now seeks to offer personally customized shoes to every customer who wants them—because digital

technologies make that level of personalization possible.

Such a fundamental shift in strategy has big implications for every stage of the value chain, from sourcing materials and components through production and assembly to marketing, sales, shipping, and delivery. The assembly line may no longer work in a linear fashion, starting with raw materials and ending with finished products. Workers may no longer perform the same function repeatedly but instead do different things at different stages. Traditional cost considerations, such as labor, may no longer dictate factory location. There are opportunities for digital innovation at every step, but only if the organization and the people it comprises are educated to think in a very different way about how shoes are produced and sold.

Which Road to Take?

Generally speaking, we see companies taking one of two paths to digital transformation. One is the measured and deliberate transformation journey—in which digital initiatives and the transformation itself are developed by internal leaders and talent over time. The trouble is that changes in digital technologies—and the companies applying them—occur too quickly for this approach to be effective; even as companies transform, they are already falling behind. The other path is the leapfrog approach, in which companies aggressively search for external leaders and talent and scale up their in-house technology capabilities as quickly as they can. These companies accept the risk of an initial culture clash between new and existing teams as part of the price of change.

Data from our survey shows that support for a more radical approach to innovation is getting stronger. Moreover, by wide margins, strong innovators are much more likely to pursue disruptive or radical processes and cultures governing innovation projects. (See Exhibit 8.) These companies understand that technological advances, like time, wait for no one—and that the need to transform their innovation functions, as well as their broader organizations, for the digital world is urgent.

EXHIBIT 8 | Strong Innovators Are Much More Likely Than Weak Ones to Have Processes and Cultures Supporting Radical Innovation

HOW WOULD YOU DESCRIBE THE PROCESSES AND CULTURES GOVERNING
DISRUPTIVE AND RADICAL INNOVATION PROJECTS?

Share of respondents (%)

■ Strong innovators   ■ Weak innovators
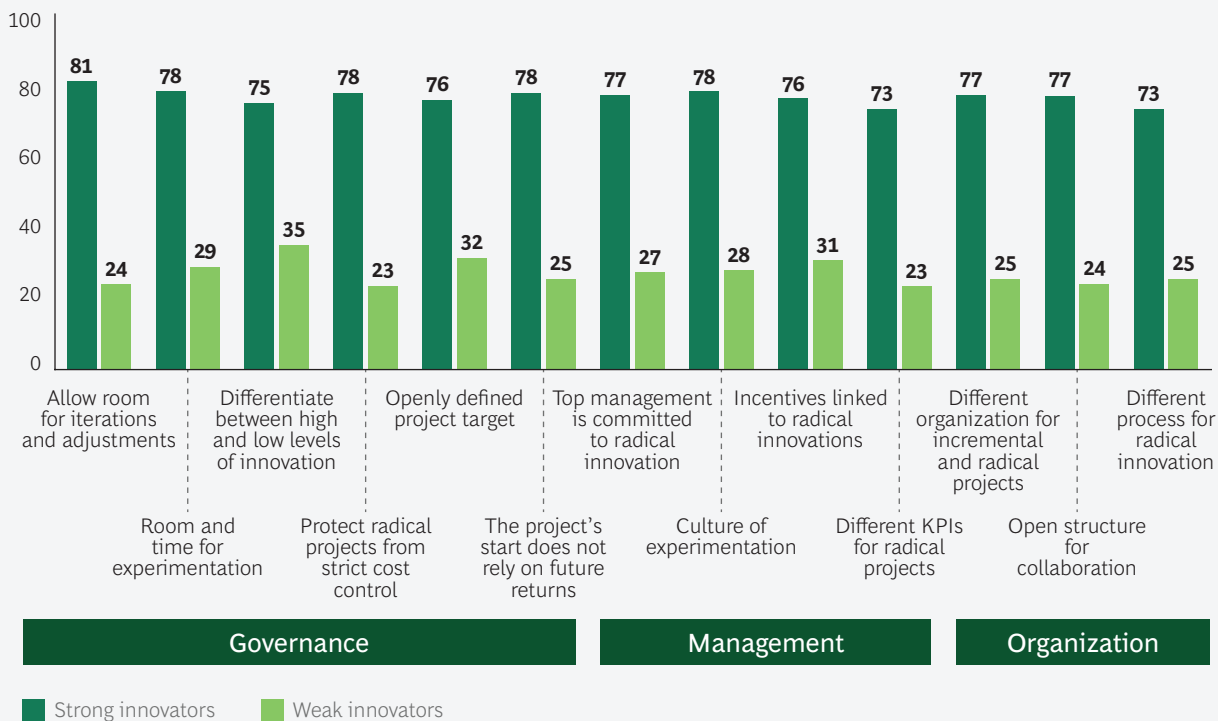
Source: 2017 BCG global innovation survey.

APPENDIX

BCG's annual ranking of the most innovative companies is based on a survey of senior executives who represent a wide variety of industries in every region worldwide and on an analysis of select financial metrics.

Before 2008, these rankings were based on a single criterion—respondents' picks. That year, we expanded the scope and assessed three financial measures over a three-year period: total shareholder return (TSR), revenue growth, and margin growth. TSR reflected stock price appreciation and dividends. Respondents' votes determined 80% of the ranking, TSR accounted for 10%, revenue growth determined 5%, and margin growth accounted for 5%.

In 2015, we revisited our methodology to make the results more robust and to reflect the top innovators across all industries. We asked respondents to rank the most innovative companies both inside and outside their industry. To create a better balance of subjective and objective measures, respondents' votes for companies within their industry accounted for 30% of the ranking, their votes for companies outside their industry accounted for 30%, and—to simplify the financial inputs—three-year TSR accounted for 40%.

In 2016, we assigned nonpublic startups a notional three-year TSR for the top-50 analysis to avoid disadvantaging those with high valuations that promised strong returns. We defined startups as private companies founded after 2001. The TSR we used was the average three-year TSR for companies that had a market capitalization of more than $1 billion, had an initial public offering between 2010 and 2012, and were founded after 2001.

NOTE TO THE READER

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1/18

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