



## **The Industry 4.0 paradox**

Overcoming disconnects on the path to digital transformation

Deloitte Consulting LLP's Supply Chain and Manufacturing Operations practice helps companies understand and address opportunities to apply Industry 4.0 technologies in pursuit of their business objectives. Our insights into additive manufacturing, the Internet of Things, and analytics enable us to help organizations reassess their people, processes, and technologies in light of advanced manufacturing practices that are evolving every day.

## Contents

<b>Executive summary</b>		<b>2</b>
<b>The strategy paradox</b>		<b>5</b>
<b>The supply chain paradox</b>		<b>11</b>
<b>The innovation paradox</b>		<b>18</b>
<b>The talent paradox</b>		<b>28</b>
<b>Around the physical-digital-physical loop</b>		<b>33</b>
<b>Breaking the paradoxes</b>		<b>38</b>

# Executive summary

Industry 4.0 has both expanded the possibilities of digital transformation and increased its importance to the organization. Industry 4.0 combines and connects digital and physical technologies—artificial intelligence, the Internet of Things, additive manufacturing, robotics, cloud computing, and others—to drive more flexible, responsive, and interconnected enterprises capable of making more informed decisions.<sup>1</sup>

**T**HIS FOURTH INDUSTRIAL Revolution carries with it seemingly limitless opportunity—and seemingly limitless options for technology investments. As organizations seek digital transformation, they should consider multiple questions to help narrow their choices: what, precisely, they hope to transform; where to invest their resources; and which advanced technologies can best serve their strategic needs. Further, digital transformation cannot happen in a vacuum; it does not end simply with implementing new technologies and

transformation, we fielded a global survey of 361 executives across 11 countries. While its definition has expanded, Industry 4.0 has its roots in manufacturing. As such, our global survey focused on manufacturing, power, oil and gas, and mining companies and examined how and where they are investing—or planning to invest—in digital transformation; some of the key challenges they face in making such investments; and how they are forming their technical and organizational strategy around digital transformation.

**True digital transformation typically has profound implications for an organization—affecting strategy, talent, business models, and even the way the company is organized.**

letting them run. Rather, true digital transformation typically has profound implications for an organization—affecting strategy, talent, business models, and even the way the company is organized.<sup>2</sup>

As Deloitte sought to understand how companies are investing in Industry 4.0 to enable digital

The survey revealed a mix of enthusiasm and ambitious plans for future investment—as well as a series of disconnects between companies' plans and actions, which we explore in the following chapters. While digital transformation is taking shape in nearly every organization, paradoxes can be observed around strategy, supply chain transformation, talent readiness, and

drivers for investment. This suggests that the will for digital transformation remains strong, but organizations are largely still finding a path that balances improving current operations with the opportunities afforded by Industry 4.0 technologies for innovation and business model transformation.

**The strategy paradox.** Nearly all respondents (94 percent) indicated that digital transformation

## Organizations are largely still finding a path that balances improving current operations with the opportunities afforded by Industry 4.0 technologies for innovation and business model transformation.

is a top strategic objective for their organization. Just because respondents appear to understand its strategic *importance*, however, doesn't necessarily mean they are fully exploring the realm of strategic *possibilities* made possible by digital transformation. In fact, many fewer (68 percent) see it as an avenue for profitability.

**The supply chain paradox.** Executives identified the supply chain as a top area for both current and prospective digital transformation investments, indicating that supply chain initiatives are a top priority. However, supply chain executives and those outside of the C-suite who direct the actual day-to-day business operations—i.e., those with

presumably the most “touch and feel” involvement with the implementation of digital technologies—do not appear to have a seat at the table when it comes to decisions about digital transformation investments.

**The talent paradox.** In keeping with Deloitte's previous research on Industry 4.0,<sup>3</sup> executives report feeling quite confident that they have the right talent in place to support digital transformations—but also seem to admit that talent poses a vexing challenge. Indeed, only 15 percent of respondents indicated they need to dramatically alter the composition and skill sets. At the same time, however, executives point

to finding, training, and retaining the right talent as their top organizational and cultural challenge.

**The innovation paradox.** Executives report their digital transformation initiatives are driven largely by productivity improvement and operational goals—essentially, leveraging advanced technologies primarily to do the same things better. This finding has been borne out in previous Deloitte studies, suggesting a wider pattern around using advanced technologies for near-term business operations—at least initially—rather than truly transformative opportunities.<sup>4</sup> Yet innovative opportunities abound—and should not be discounted. Organizations driven by other factors, such as an

### ABOUT THE RESEARCH

To understand how companies are investing in Industry 4.0 to enable digital transformation, Deloitte fielded a global survey of 361 executives in 11 countries in the Americas, Asia, and Europe. The survey was fielded in association with GE Digital in the spring of 2018 by Forbes Insights, and captured insights from respondents in aerospace and defense, automotive, chemicals and specialty materials, industrial manufacturing, metals and mining, oil and gas, and power and utilities. All survey respondents were director level or higher, including CEOs (4 percent), CFOs (13 percent), COOs (9 percent), CDOs (5 percent), CIOs (7 percent), CTOs (5 percent), CSCOs (4 percent), business unit presidents (5 percent), EVPs/SVPs (7 percent), vice presidents (11 percent), executive directors/senior directors (9 percent), and directors (21 percent). All executives represented organizations with revenue of US\$500 million or more, with more than half (57 percent) coming from organizations with more than US\$1 billion in revenue.

increased desire for innovation and internal strategy focus, reported an equally positive return on investment.

**Around the physical-digital-physical loop.**

The ability to fully harness information from connected assets and use it to drive informed decisions is important to the full realization of Industry 4.0, and one which many organizations may not yet fully be able to execute in practice.

Our research suggests that executives in manufacturing, oil and gas, power and utilities, and mining are aware of the opportunities the Fourth

Industrial Revolution creates—and that they prize digital transformation as a way to harness that growth. At the same time, however, disconnects in different areas suggest that executives aren't quite sure how to get there—even as they plan more significant investments in the future. As they seek to transform their organizations into interconnected enterprises capable of operating in an increasingly digital age, executives have many opportunities to build more connected, responsive, and intelligent operations—and find a path that truly embodies the promise of the Fourth Industrial Revolution.

## Endnotes

1. Mark Cotteleer and Brenna Sniderman, *Forces of change: Industry 4.0*, Deloitte Insights, December 18, 2017.
2. Fabian Hecklau et al., "Holistic approach for human resource management in Industry 4.0," *Procedia CIRP* 54 (2016): pp. 1–6.
3. Punit Renjen, *The Fourth Industrial Revolution is here—are you ready?*, Deloitte Insights, January 22, 2018.
4. Ibid.

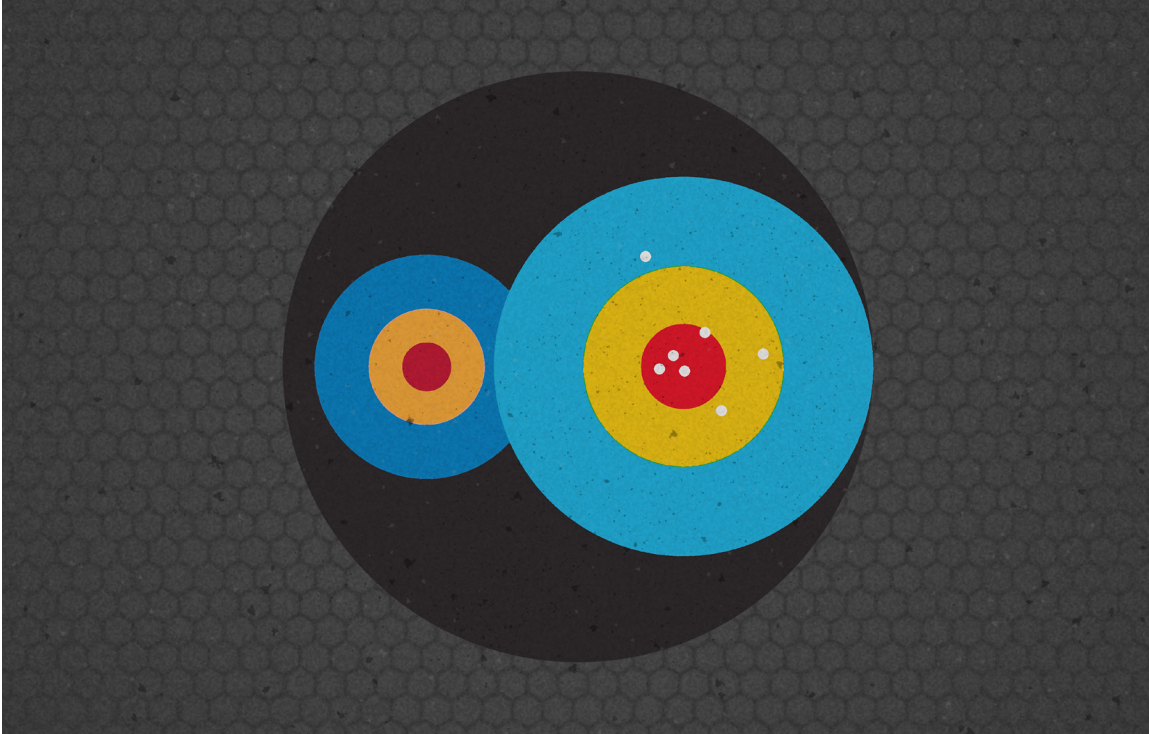
## About the authors

*Tim Hanley is the Global Industrial Products & Construction sector leader for Deloitte Touche Tohmatsu Limited (Deloitte Global) and a senior partner with Deloitte United States (Deloitte LLP). He is based in Milwaukee, WI.*

*Andy Daecher leads Deloitte Digital's Internet of Things practice. He is based in San Francisco, CA.*

*Mark Cotteleer is the research director of Deloitte Services LP's Center for Integrated Research. He is based in Milwaukee, WI.*

*Brenna Sniderman is a senior manager at Deloitte Services LP's Center for Integrated Research. She is based in Philadelphia, PA.*



# The strategy paradox

## A defensive position on digital transformation

INDUSTRY 4.0 TECHNOLOGIES continue to evolve both in technical capability and organizational reach. Simultaneously, many of these technologies, such as cloud computing and big data platforms, are becoming more affordable and therefore more accessible to organizations of all sizes.<sup>1</sup>

This combination of greater capability and lower cost has contributed to an environment that is perhaps more hospitable to digital transformation. And, in fact, our study reflects executives' positive view of the position digital transformation occupies within their organizations. For example, when asked to indicate which statements best aligned to their perspective, 94 percent of respondents agreed

that digital transformation is a top strategic priority for their organizations.

Just because respondents appear to understand its strategic importance, however, doesn't necessarily mean they are fully exploring the realm of strategic possibilities made possible by digital transformation. Our survey suggests that some leaders may be finding it difficult to keep up with the rapid pace of technological change, as well as the new rules and challenges that go along with it. We see this evidenced in a couple of ways:

- **Budgeting for today.** When it comes to digital transformation, most respondents reported

investing a significantly higher percentage of their operational and IT budgets, while spending a relatively lower proportion of the future R&D spending. On average, companies plan to invest a median of 30 percent of their operational/IT budget on digital transformation initiatives—and only 11 percent of their R&D budgets on the same.

- **Relatively lower emphasis on profitability.** When we asked respondents if these technologies are critical to maintaining profitability, only 68 percent agreed. In fact, this was the lowest-rated response of any of the statements presented. CEOs had an even more sobering view; only 50 percent indicated the importance of digital transformation to maintaining profitability.

This mindset—a focus on digital transformation for operational investments, coupled with a relatively smaller emphasis on profitability—suggests that, while most leaders may associate operational improvements with *strategic* growth, they do not necessarily associate them with *revenue* growth resulting from R&D-driven new products or business models. Even when executives are implementing digital transformations that result in significant time and cost savings through operational improvements, they may not intellectually translate that into higher profits. Instead, these may be viewed as “defensive” investments intended to protect, rather than grow, the business. Deloitte’s study *The Fourth Industrial Revolution is here—are you ready?* reinforces this mindset as many look to digital

**On average, companies plan to invest a median of 30 percent of their operational/IT budget on digital transformation initiatives—and only 11 percent of their R&D budgets on the same.**

technologies to “avoid” disruption rather than be the “cause” of it.<sup>2</sup>

**Even when executives implement digital transformations, they may be viewed as “defensive” investments intended to protect, rather than grow, the business.**

### The challenges to transcending a defensive mindset

A little over a decade ago, analytics was an emerging trend.<sup>3</sup> Now big data, robotic process automation, and sensor technology are a bigger part of an ever-proliferating list of technologies and capabilities organizations are seeking to adopt.<sup>4</sup> In this environment, it can be challenging to determine, prioritize, and invest in the tools that can best help organizations meet their strategic objectives. As such, many organizations remain frozen in place, fending off competitive pressures by isolating their technology usage to defending and maintaining their current positions. The behavioral concept of *choice overload* gives credence to this mindset.<sup>5</sup> That is, when we are faced with too many paths to choose from, oftentimes we defer making any new choices at all. To move past the defensive mindset, executives may face several key challenges:

**Trapped in organizational inertia.** Our recent study, *The Fourth Industrial Revolution is here—are you ready?* also showed that many organizations remain mired in inertia, wherein their future plans for digital transformation closely mirror their current objectives.<sup>6</sup> That is, they regard advanced technologies largely as a means of protecting their current offerings



rather than deploying them to build new business models and products (we explore this notion further in *The innovation paradox*). In our analysis, we see that many organizations are investing to enhance legacy systems. For instance, most organizations are using desktop productivity tools (87 percent) and ERP software analytics (85 percent) to analyze and leverage their data (figure 1). These are typically familiar and longstanding organizational tools that are enhanced by digital technologies. Other tools, like physical robotics (24 percent) and sensor technologies (26 percent), are both newer—and leveraged considerably less.

While certainly a practical approach to implementation, over-indexing on legacy improvements comes with risk. This is especially true as we see from figure 1 that cloud computing capabilities and big data platforms appear to be used by a large portion of respondents (with 60 percent or more indicating they currently apply the technologies). This suggests a real opportunity to integrate newer, future state technologies (like cloud computing) into legacy platforms (such as ERP and desktop tools) to leverage those capabilities.

In addition, the rise of disruptive competitors with fresh approaches to applying digital technologies can leave older, more accomplished organizations behind.<sup>7</sup> As such, organizations may want to transition from these defensive positions to more proactive, offensive uses that integrate future state technologies into legacy tools and applications.

**Still searching for a common focus.** When we asked respondents to identify their top three organizational challenges, “finding, training, and retaining the right talent” topped the list (figure 2). It can understandably be difficult for any individual to keep up with the pace of technological change (see *The talent paradox* for a detailed discussion); building a deep bench of adequately-prepared talent can be more difficult still.

Further, adapting to changes in the marketplace and reaching consensus on the best path forward constitute significant hurdles. The second most cited challenge is “lack of internal

alignment” about which strategies to pursue, closely followed by the “emergence of new business models.” These three concepts are linked: It can be difficult, if not impossible, to pursue new, unfamiliar business models without the right people in place—or a clear consensus on which strategies are the right ones.

**Technical complexity brings risks.** The shift to Industry 4.0 connectivity requires many organizations to confront unfamiliar, more nuanced risks. When polled about technology-related challenges, respondents highlighted cybersecurity (37 percent) and intellectual property risks (27 percent) as the top two issues. Absent a thorough understanding of these issues, many may feel it simply does not pay to pursue alternative uses of technology that can lead to new revenue streams—and new potential threats to face.

## Thinking strategically about digital transformation

These are exciting times. To quickly arrive at an era where organizations are embracing digital transformation as a top strategic objective is no small feat. However, with it come both increased complexity and opportunity. While organizations most certainly can benefit from deploying Industry 4.0 technologies for legacy operations, there are myriad paths to drive strategy and realize the full breadth of opportunities that digital transformation can bring. To move beyond a “defensive” approach to digital transformation strategy, organizations can consider the following steps:

- 1. Incrementally move beyond operational upgrades.** Digital transformation can lead to revenue growth in the form of improved products or services.<sup>8</sup> This does not require an

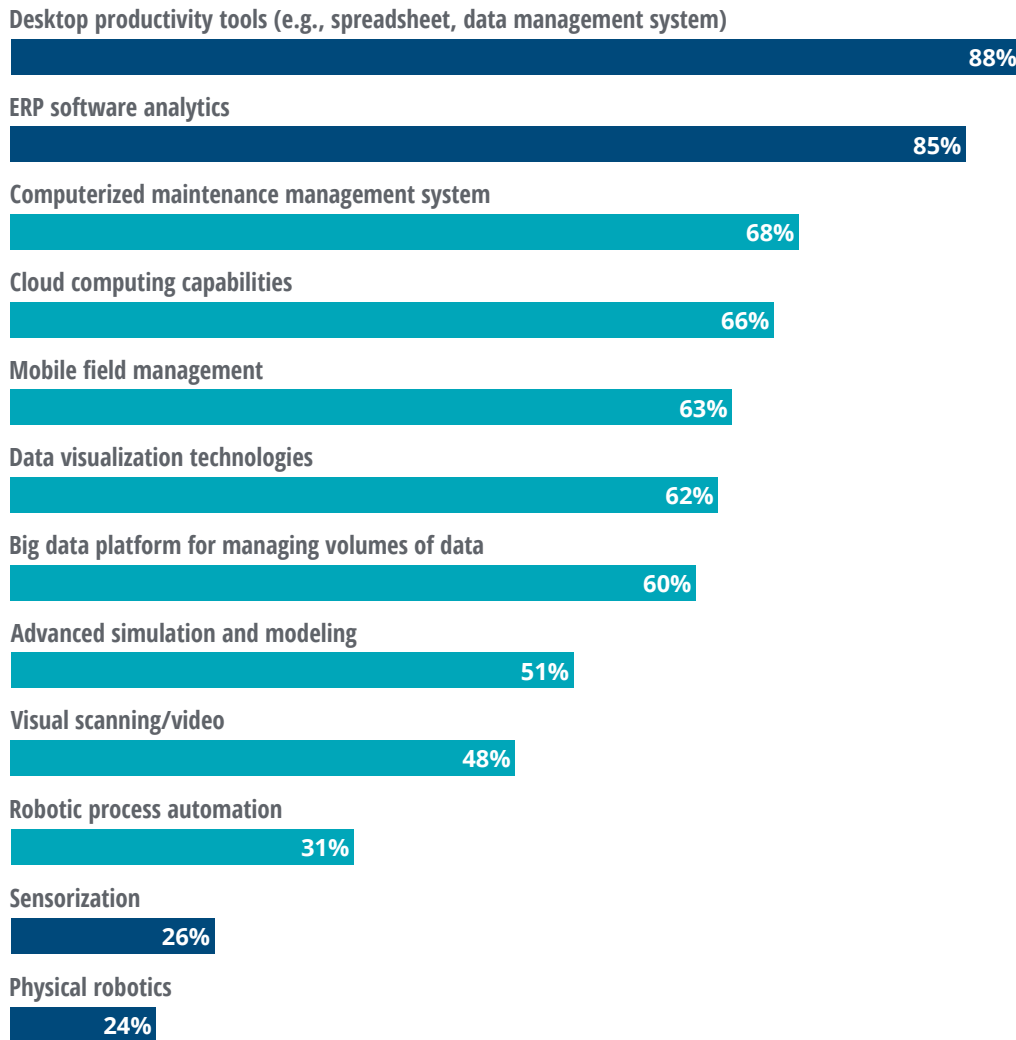
**Digital transformation can lead to revenue growth in the form of improved products or services.**

FIGURE 1

## Executives report using familiar tools more than newer technologies to analyze data

What tools and technologies are you currently using to access, analyze, and leverage the data from your assets?

■ Indicates greater focus on legacy upgrades versus the relatively newer toolsets



Source: Deloitte Industry 4.0 investment survey, 2018.

immediate overhaul of business models, but rather an evolution of current offerings.

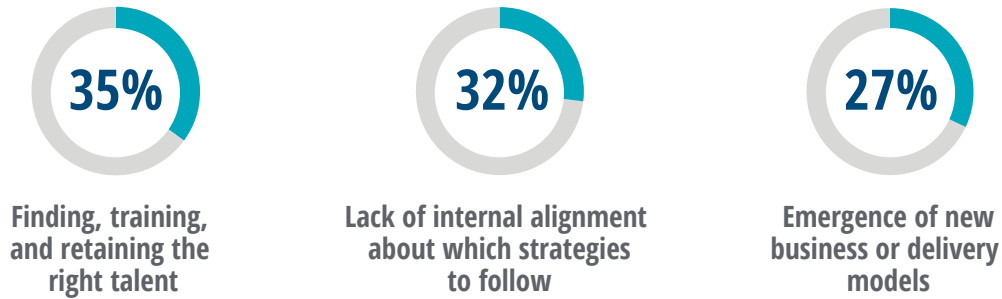
- 2. Invest in the long run.** Don't neglect longer-term opportunities in pursuit of shorter-term objectives. This mindset shift requires a

willingness to enact change whose impact may not be felt immediately—a challenge for many organizations. In fact, a large portion of digital transformation efforts start out well, plateau, and then fall flat; business is back to usual with

FIGURE 2

## The top three operational, cultural, and environmental challenges organizations face in their pursuit of digital transformation are closely interlinked

Which of the following are the most common operational, culture-related, and environmental challenges your organization faces as it seeks to pursue digital transformation initiatives?



Source: Deloitte Industry 4.0 investment survey, 2018.

just incremental improvements, even though research suggests that transformative benefits often take time to accrue.<sup>9</sup>

3. **Consider increasing time spent on R&D initiatives—as well as budget.** One area where this could be most prevalent is supply chain, where we see an increased future focus for organizations (see [The supply chain paradox](#) for a more detailed discussion). Here, opportunities

exist to pilot a number of digital technologies.

Starting small and expanding beyond “defensive” spending can unlock new organizational capabilities, and move an organization along the path toward innovation. Keeping implementations simple, and building upon the successes can pave the way for future business models—while also allowing your organization to grow with the technologies.

## Endnotes

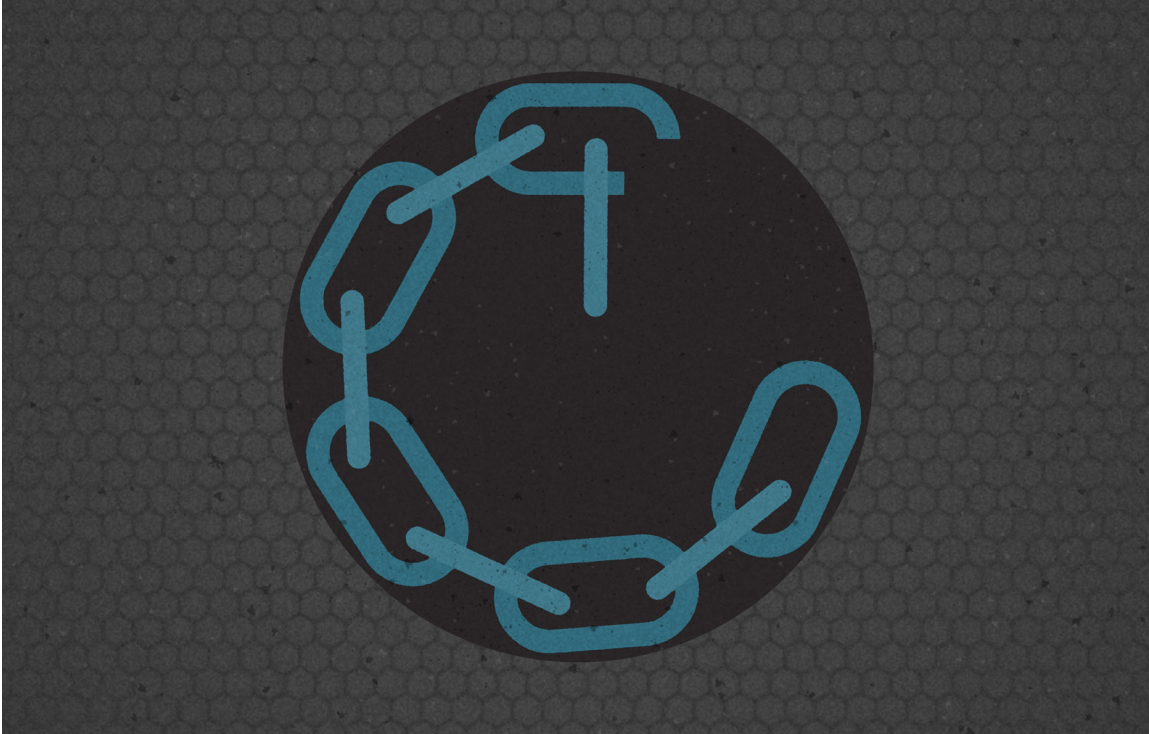
1. John Hagel, John Seely Brown, Tamara Samoylova, and Michael Lui, *From exponential technologies to exponential innovation*, Deloitte Insights, October 4, 2013.
2. Punit Renjen, *The Fourth Industrial Revolution is here—are you ready?*, Deloitte Insights, January 22, 2018.
3. Tom Davenport and Jeanne G. Harris, *Competing on Analytics: The New Science of Winning* (Harvard Business School Publishing Corporation, 2007).
4. Bill Briggs and Craig Hodgetts, *Tech trends 2018: The symphonic enterprise*, Deloitte Insights, 2017.
5. Ruth Schmidt, *Frozen: Using behavioral design to overcome decision-making paralysis*, Deloitte Insights, October 7, 2016.
6. Renjen, *The Fourth Industrial Revolution is here*.
7. Ibid.
8. Mark Cotteleer and Brenna Sniderman, *Forces of change: Industry 4.0*, Deloitte Insights, December 18, 2017.
9. Stephen Laaper, Glenn Yauch, Paul Wellener, and Ryan Robinson, *Embracing a digital future*, Deloitte Insights, March 21, 2018.

## About the authors

*Mark Cotteleer is the research director of Deloitte Services LP's Center for Integrated Research. He is based in Milwaukee, WI.*

*Monika Mahto is a research manager with Deloitte Services India Pvt. Ltd., affiliated with the Center for Integrated Research. She is based in Mumbai, India.*

*Timothy Murphy is a senior manager at Deloitte Services LP's Center for Integrated Research. He is based in Milwaukee, WI.*



# The supply chain paradox

High priority, low stakeholder engagement

LONG BEFORE THE digital era that we commonly associate with Industry 4.0, the supply chain has served as the lifeblood of the industrial organization. In recent decades, however, supply chains have grown increasingly global and complex, enabled in large part by advanced digital and physical technologies. These technologies have also allowed the supply chain to evolve into something less linear, more interconnected, and responsive to change. Known as the digital supply network (DSN), this new, networked supply chain has reshaped how stakeholders communicate and transact with each other. The emergence of the DSN

allows the supply chain to become a more strategically critical component of the organization—one that enables more informed decision-making and a more flexible, responsive organization.<sup>1</sup>

However, the question remains whether the reality of the organization has caught up with the new strategic role of the digitally connected supply chain and its potential to drive innovation. On the one hand, our survey results appear to affirm the strategic imperative of investment in the digital supply chain; on the other, results also show that the supply chain is not seen as a particularly strong driver of innovation. Further, our survey results

## A striking gap may exist: Organizations may consider the supply chain as relatively important in digital transformation efforts and yet not view it as a driver of digital innovation—nor involve its leaders in strategic decisions.

reveal that the chief supply chain officer (CSCO)—the ostensible leader of supply chain strategy and day-to-day operations—typically plays a relatively small role in shaping digital transformation investment decisions.

Thus a striking gap may exist: Organizations may consider the supply chain as relatively important in digital transformation efforts and yet not view it as a driver of digital innovation—nor involve its leaders in strategic decisions.

### The role of the supply chain in the digital organization

Our survey results suggest that the supply chain plays an important role in the digital organization (table 1). When asked, “What functions are you prioritizing for future [digital] investment?” the supply chain emerged as the top overall answer, with 62 percent among overall respondents—ahead of planning, product design, and substantially ahead of smart factories. Among just C-suite executives, that gap was even wider.<sup>2</sup>

Another indication that the supply chain plays an important role in the discussion on digital transformation resides in where most organizations *actually* have digital transformation efforts underway. In this metric, the supply chain received the highest response among C-suite respondents and third-highest overall (table 2).

### The supply chain is not seen as a driver of innovation

Despite its high standing for current and planned deployment of digital transformation

TABLE 1

#### Supply chain is the most frequently prioritized function for future digital investment

Which functions are you prioritizing for future digital investment?

	Total respondents
<b>Supply chain</b>	<b>62%</b>
Planning	61%
Product design	50%
Marketing	50%
Sales	43%
Talent/HR	39%
Customer/field asset support	38%
Inbound/outbound logistics	36%
Smart factories	35%
Shop floor production	30%

Source: Deloitte Industry 4.0 investment survey, 2018.

capital, the supply chain does not appear to be perceived as a center of innovation (table 3). When asked what functions respondents believe are driving the most digital innovation, supply chain ranked in the middle of the pack at 34 percent—far behind information technology and operations/production. This response is especially surprising given the close functional relationship that exists between the supply chain and operations/production within the overarching manufacturing value chain.

TABLE 2

### Supply chain is one of the top areas in which digital transformation efforts are underway

Where do you currently have digital transformation efforts underway?

	Total respondents
Planning	67%
Sales	64%
<b>Supply chain</b>	<b>63%</b>
Marketing	62%
Shop floor production	60%
Inbound/outbound logistics	60%
Product design	58%
Customer/field asset support	58%
Smart facilities	58%
Talent/HR	58%

Note: Above percentages based on highest two response choices (“4” and “5,” combined, on a 1-to-5 scale).

Source: Deloitte Industry 4.0 investment survey, 2018.

It is also worth noting that, while only 34 percent of overall respondents see the supply chain as a driver of innovation, of the respondents who are prioritizing the supply chain for future digital investment, only a slightly higher 38 percent say the same. One might have expected an even higher share given that this subgroup already places emphasis on the future supply chain digital investment. Further, those that prioritize the supply chain for future digital investment seem just as likely as overall respondents to view operations and production as leading drivers of innovation (59 percent vs. 57 percent, respectively).

TABLE 3

### While organizations appear to recognize the supply chain as a critical component of digital transformation, they may not yet fully appreciate its potential for digital innovation

In my organization, I am seeing the most digital innovation driven from ...

	Total respondents
Information technology	60%
Operations/production	57%
Finance	35%
<b>Supply chain</b>	<b>34%</b>
Engineering	33%
Marketing and sales	30%
Aftermarket/customer support	23%
Talent/HR	22%

Note: Respondents were asked to select up to three functions as exhibiting the most digital innovation.

Source: Deloitte Industry 4.0 investment survey, 2018.

So why does this gap exist between the high priority placed on supply chain digital transformation investments and the rather middling status of supply chains as a source of innovation? While most organizations appear to prioritize the supply chain as a critical component of digital transformation initiatives, they may not yet fully appreciate its potential for digital innovation, a finding we explore in greater depth in *The innovation paradox*. This suggests a missed opportunity, as the advent of the DSN enables innovative opportunities in a broad range of areas.<sup>3</sup>

### The curious case of the CSCO

The increasingly strategic role of the modern supply chain has spawned a new addition to the executive suite. This new role may go by slightly different names, but is often known as the chief supply chain officer (CSCO). The presumed charge of the supply chain leader includes both a tactical oversight of day-to-day supply chain operations, as well as the strategic vision of how the supply chain fits into the larger digital organization.

The presence of the CSCO (or its equivalent) in the senior ranks of the organization has risen commensurately with the growth in advanced, connected technologies. According to one survey, only 8 percent of Fortune 500 companies had a single executive in charge of the entirety of the supply chain in 2004. By 2016, that figure had risen to 68 percent.<sup>4</sup>

Given this seeming evidence that the supply chain figures prominently in respondents' digital

transformation priorities and activities, it would stand to reason that the CSCO should also figure prominently in any decision to invest in digital transformation technologies. However, the responses suggest otherwise (figure 1).

Only 22 percent of the overall respondents said that the CSCO was either a key decision-maker or highly involved in the decision-making process.

**Only 22 percent of respondents said that the CSCO was either a key decision-maker or highly involved in the decision-making process.**

In fact, respondents ranked the CSCO lower than any other C-suite officer, and comparable with the lowest among non-C-suite leaders of each business area, at 21 percent. Significantly, supply chain executives themselves also appear to perceive themselves as outside the decision-making process; *none* of the 15 respondents who identified as a CSCO said that the CSCO was either a key decision-maker or highly involved in the decision-making process.

Further, when asked to evaluate their respective *personal* involvement in digital transformation investment decisions, CSCOs ranked themselves far lower than other C-suite executives did (table 4). Slightly more than 90 percent of C-suite respondents (excluding CSCO respondents) said that they personally were either highly involved or key decision-makers; 37 percent of non-C-suite

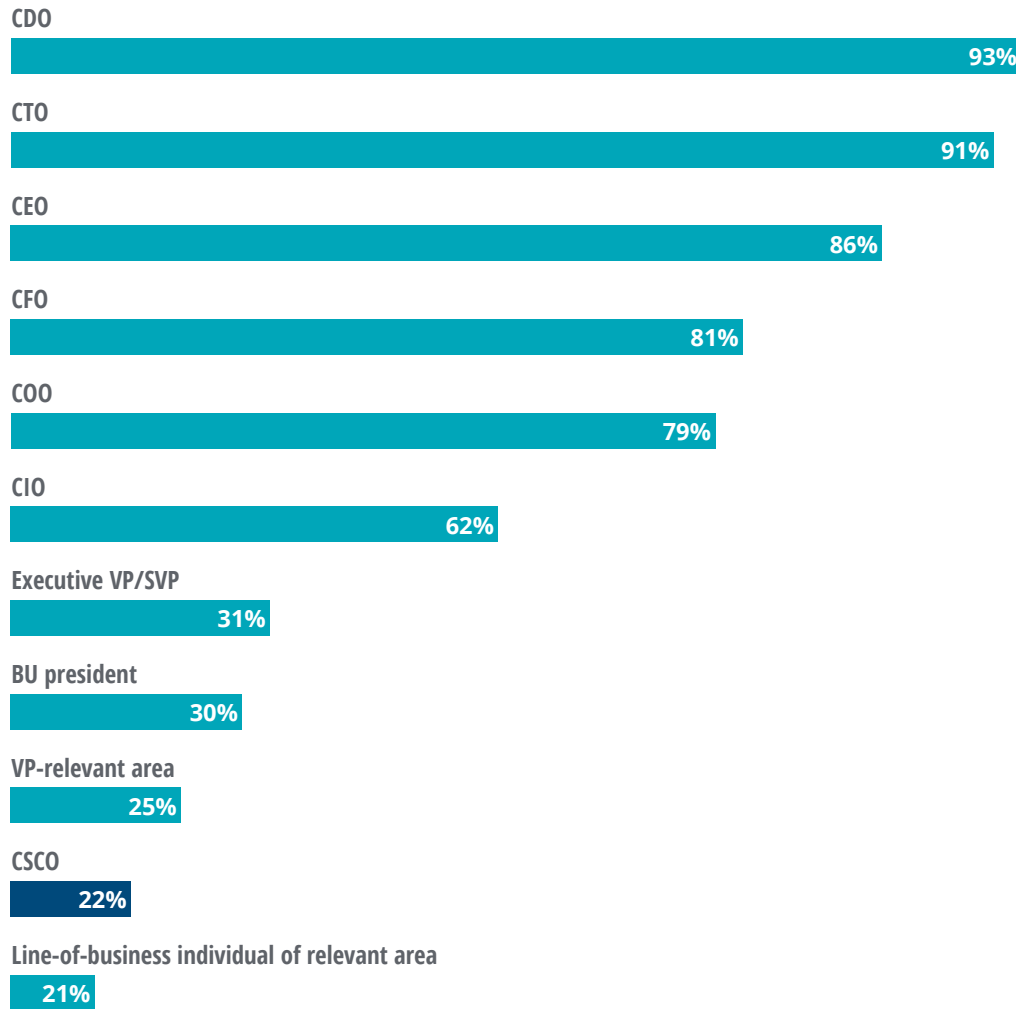
**CSCOs ranked themselves far lower than other C-suite executives when evaluating their *personal* involvement in digital transformation. In fact, no CSCOs indicated that they were highly involved in such investment decisions.**



FIGURE 1

## The chief supply chain officer does not have much say in decisions about digital technology investments

When it comes to investing in or acquiring new technologies or capabilities to aid in a digital transformation, who makes the decisions within your organization?



Note: Above percentages based on combined choices “highly involved” and “key decision-maker.”

Source: Deloitte Industry 4.0 investment survey, 2018.

respondents said the same. However, none of the CSCO respondents responded as such.

### The supply chain paradox

Herein lies the supply chain paradox: On the one hand, the supply chain appears to play an important

role in future digital investment priorities, and represents a top choice for where respondents have digital deployment initiatives already underway. But on the other hand, the supply chain is not widely perceived as a strong driver of innovation. And the CSCO—the single executive in charge of the entire supply chain—is by far the C-suite executive

TABLE 4

### No chief supply chain officer said they were personally involved in digital investment decisions

How involved are you personally in investment or purchasing decisions related to digital transformation within your organization?

	Key decision-maker/ highly involved in decision	Somewhat involved in decision	Play a role/ not at all involved
C-suite respondents (excluding CSCOs)	90%	8%	2%
Non-C-suite respondents	37%	63%	0%
<b>CSCOs</b>	<b>0%</b>	<b>93%</b>	<b>7%</b>

Source: Deloitte Industry 4.0 investment survey, 2018.

with the *least* involvement in the digital acquisition decision, and among the least overall.

So, why does this seeming paradox exist? A few possibilities come to the fore:

- **CSCO is a new role.** As a relatively new member of the C-suite, the CSCO may not yet have the profile that other, more established roles enjoy—even if the role is increasingly common and supply chain digital investments are a top priority. To this end, some executives, including the CSCO, may not yet understand or otherwise appreciate what the CSCO role is or what its purview should be.
- **Supply chain may have an image problem.** In the digital era, the supply chain has never been more integrated into the organization’s overall business strategy.<sup>5</sup> But image often lags reality, and some in the C-suite may not yet fully accept how the supply chain has evolved in recent years into an area riper for innovation, as the middling status of the supply chain makes clear (table 3). Such an image problem—to the extent it exists—may also make it more difficult for the CSCO to be heard on matters related to the organization’s strategic planning.
- **Like CSCO, like non-C-suite.** The CSCO does not appear to be perceived as critical to

the decision to invest in digital technologies, despite her day-to-day involvement in an area considered key to future digital investments. This may be part of an even larger paradox: Those with presumably the most “touch and feel” involvement with the implementation of digital technologies—i.e., those outside of the C-suite who direct the actual day-to-day business operations—reported being the least involved in making technology investment decisions (table 4).

### Elevating the supply chain and shrinking the paradox

Our survey results underscore the importance of the supply chain in future digital investment priorities, but also that the supply chain is not perceived as a strong driver of innovation, and the CSCO gets little say in the matter. Organizations can take several steps to help reconcile this disconnect:

- **Validate the increasing strategic importance of the supply chain—and, by extension, those who run it.** Our survey suggests that the supply chain figures prominently

in the implementation of digital technologies—both now and going forward. The company should say so, unambiguously. And, in so doing, the organization should formally elevate the status of the CSCO and give her—and those outside of the C-suite with day-to-day, touch-and-feel oversight of the implementation and operation of digital technologies—a seat at the decision-making table.

- **Train future CSCOs to think strategically.** The CSCO focuses on the care and feeding of the supply chain organization. If the company wants a strategic CSCO, it should train its supply chain organization to think strategically. Such action could translate to a supply chain culture in which professionals understand the bigger strategic implications of the decisions they make, and whose goals align with the broader strategic objectives of the organization.

- **Leverage the opportunities for digitally driven innovation inherent in a digital supply network.** While most organizations prioritize the supply chain as a top area for digital transformation investments, they are far less likely to recognize it as an area for innovation. Yet the DSN opens new opportunities for truly innovative—and transformative—uses of technology to guide end-to-end supply chain transparency, intelligent optimization, and flexible, intelligent decision-making.<sup>6</sup> Indeed, such uses extend beyond mere opportunities. In the digital era, they are imperatives.

These and other steps may go a long way in helping an organization diminish the inconsistencies that the supply chain paradox presents and, in so doing, realize so much more from its investment in supply chain connectivity.

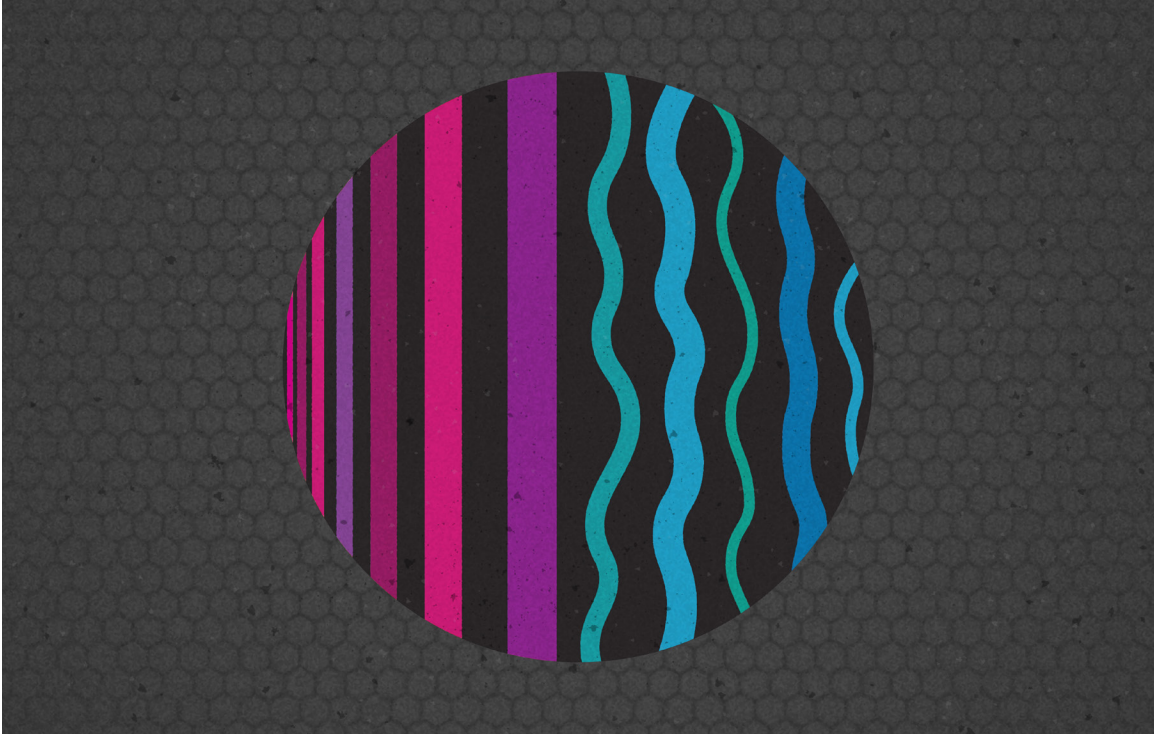
## Endnotes

1. Adam Mussomeli et al., *The rise of the digital supply network: Industry 4.0 enables the digital transformation of supply chains*, Deloitte University Press, December 1, 2016; Kevin O'Marah, "What's the point of a CSCO?," *Forbes*, May 26, 2016.
2. The supply chain appears to serve as a higher priority among larger companies—69 percent of respondents from large companies (US\$10 billion or greater in revenue) chose the supply chain as the top priority, compared with 61 percent of respondents from companies with less than US\$10 billion in annual revenue.
3. Mussomeli et al., *The rise of the digital supply network*.
4. Peter L. O'Brien, "Inside the mind of the chief supply chain officer," Russell Reynolds Associates, October 23, 2017.
5. Mussomeli et al., *The rise of the digital supply network*.
6. Ibid.

## About the authors

*Tim Hanley is the Global Industrial Products & Construction sector leader for Deloitte Touche Tohmatsu Limited (Deloitte Global) and a senior partner with Deloitte United States (Deloitte LLP). He is based in Milwaukee, WI.*

*Jonathan Holdowsky is a senior manager with Deloitte Services LP's Center for Integrated Research. He is based in Boston, MA.*



## The innovation paradox

A balance between optimization and uncharted waters

AS ORGANIZATIONS SEEK to invest in digital transformation initiatives, they can find themselves at something of a crossroads. Focused first on pursuing greater efficiencies in their current processes, most organizations are largely using Industry 4.0 technologies to improve what they're already doing. This is to say, organizations' digital transformation initiatives are primarily driven by productivity and operations goals: fulfilling current goals, but faster, and better.

This makes sense: Before blazing trails through uncharted terrain to seek Industry 4.0-driven innovation, organizations may first want to build a firm foundation and find and train the right talent

to propel them forward. *However*, opportunities also exist in innovation. Our survey found that high ROI is almost as likely to result from investments in innovation as from investments in productivity—suggesting many organizations may be leaving innovation-driven digital transformation opportunities untapped, even as they benefit from productivity- and operations-driven initiatives. Further, the self-reported maturity levels of respondents—coupled with the specific investments they are making, or considering making, in new, Industry 4.0-driven capabilities—suggest that executives are preparing for a more digitally advanced future. Making innovation a part of that future

**Executives are preparing for a more digitally advanced future. Making innovation a part of that future may be an important component of success. Not doing so may mean being left behind.**

may be an important component of success. Not doing so may mean being left behind.

### Drivers for digital transformation investment

When it comes to digital transformation, most respondents report that their companies are driven largely by improving their current processes, rather than innovating (table 1).

TABLE 1

#### Digital transformation is more likely to be driven by the desire to improve current processes than by the desire for innovation

What are the top factors driving digital transformation initiatives within your organization?

<b>Productivity goals (e.g., improved efficiency)</b>	<b>50%</b>
<b>Operational goals (e.g., reduced risk)</b>	<b>47%</b>
Customer requirements	36%
Internal strategy focus	29%
Competitive pressures	29%
<b>Increased desire for innovation</b>	<b>23%</b>
Employee demand	19%
Shareholder engagement/demand	19%
Supplier requirements	19%
Partner requirements	15%
Regulatory pressure	13%

Note: Respondents were asked to select up to three factors as driving digital transformation initiatives.

Source: Deloitte Industry 4.0 investment survey, 2018.

In fact, roughly twice as many respondents reported being driven by productivity and operations goals rather than by the desire for innovation, by competitive pressure, or even by customer requirements. Further, this trend shows no signs of slowing: Those who plan to significantly increase digital transformation investments in the next year are driven more by operational goals, at 52 percent, than those who plan to only moderately increase investments (45 percent) or keep them the same (36 percent).

This approach—starting with streamlining current efforts before moving on to innovation—is one that appears to hold true across industries and does not appear to be limited solely to those specific industries surveyed for this study. In fact, Deloitte’s global, cross-industry study *The Fourth Industrial Revolution is here—are you ready?* showed that many executives continue to focus on traditional business operations with respect to Industry 4.0 transformation, rather than focusing on new opportunities to create value.<sup>1</sup>

Even those whose organizations have realized significant ROI from digital transformation report being driven by productivity and operational goals—even more so than general respondents, suggesting that perhaps focusing on those initial areas for digital transformation can yield significant returns that encourage further investment (table 2).

However, changing the lens appears to reveal a new insight: Those driven by innovation are nearly as likely to report recognizing significant ROI from digital transformations as those who are driven by operations and production goals (table 3). Fifty-seven percent of those driven by productivity goals and 56 percent of those driven by operational goals report realizing significant ROI; 51 percent of those driven by innovation say the same.

This suggests that the innovation opportunities that exist may be as likely to result in significant

## Leaders driven by innovation are nearly as likely to report recognizing significant ROI from digital transformations as those who are driven by operations and production goals.

ROI as operations- and productivity-driven initiatives. To be sure, starting the shift to Industry 4.0 with improving current processes is a sound approach, and can create a firm foundation for future innovations. Moreover, doing so can illuminate key opportunities for innovation, by creating a clear map of what the organization currently does, highlighting adjacencies, and thus creating an informed, more targeted path for innovation.

TABLE 2

### Respondents who report having realized significant ROI from their digital transformation initiatives are more likely to report being driven by productivity and operational goals rather than innovation

What are the top factors driving digital transformation initiatives within your organization?

	Total respondents	Respondents who have realized significant ROI
Productivity goals (e.g., improved efficiency)	50%	58%
Operational goals (e.g., reduced risk)	47%	54%

Source: Deloitte Industry 4.0 investment survey, 2018.

TABLE 3

## Organizations driven to digital transformation by a desire for innovation report realizing almost as much ROI as those that are driven by productivity/operational goals

What are the top factors driving digital transformation initiatives within your organization?

<b>Productivity goals (e.g., improved efficiency)</b>	<b>57%</b>
<b>Operational goals (e.g., reduced risk)</b>	<b>56%</b>
Employee demand	53%
<b>Increased desire for innovation</b>	<b>51%</b>
Shareholder engagement/demand	51%
Supplier requirements	51%
Internal strategy focus	45%
Regulatory pressure	45%
Customer requirements	44%
Competitive pressures	41%
Partner requirements	32%

Note: Figures represent the percent of respondents in each category who reported realizing significant ROI.

Source: Deloitte Industry 4.0 investment survey, 2018.

We can see the success of this sort of progression already, as some manufacturers choose to begin a smart factory transformation by first understanding and analyzing the data their assets are already generating, to ascertain what data they will need and, by extension, where white spaces are for new investments and opportunities.<sup>2</sup> However, innovation should be a priority, as it can help organizations differentiate themselves in ways that are often difficult for competitors to respond.<sup>3</sup>

## Maturity and future innovation

Organizations are in different stages of building and scaling digital capabilities across their businesses. Respondents report the highest levels of maturity around operations-driven functions: supply chain (32 percent), planning (31 percent), and marketing (30 percent) report the highest levels of multiplant, scaled solutions (table 4).

TABLE 4

### Respondents report the highest levels of maturity around operations-driven functions

Where do you currently have digital transformation efforts underway within the organization, and how mature are those efforts?

	Initial stages 1	2	3	4	Multi-plant, scaled, and deployed solution 5
Supply chain	2%	10%	21%	31%	32%
Planning	5%	6%	21%	35%	31%
Marketing	3%	7%	24%	32%	30%
Inbound/outbound logistics	3%	10%	23%	33%	27%
Sales	4%	7%	23%	38%	25%
Shop floor production	6%	10%	20%	35%	25%
Product design	2%	9%	25%	34%	25%
Smart facilities	5%	9%	23%	34%	24%
Talent and human resources	2%	7%	29%	34%	24%
Customer/fielded asset support	4%	10%	24%	37%	21%

Source: Deloitte Industry 4.0 investment survey, 2018.

Functions that tend to drive productivity or innovation, however, are relatively less mature: shop floor production, product design, smart facilities, and customer/fielded asset support. These are areas that typically tend to leverage advanced technologies and capabilities on a broad scale. Further, they require that data be generated from many diverse physical assets and systems that may not have been connected in the past.<sup>4</sup>

### Current use of technologies—and future investment plans

When it comes to how organizations are using technologies, most of their focus tends to rest on more “traditional” technologies, which reiterates the theme of building a strong foundation for digital transformation before moving into uncharted territory. At the same time, however, investment in



more advanced, connected capabilities looks to ramp up in the future, suggesting the move toward innovation is on the horizon as part of a continued evolution, rather than a revolution (figure 1). Respondents appear to be preparing for an ever-more-connected future.

## Respondents appear to be preparing for an ever-more-connected future.

### Preparing for increased data loads.

Computerized maintenance management systems (CMMS) and cloud computing capabilities are used by two-thirds of respondents but are likely to be used by nearly all within the next one to three years. The same is true for mobile field management, data visualization, and big data platforms for managing volumes of data. This suggests a move toward connectivity and ongoing preparation for handling increased loads of data.

**Making the data user-friendly—and more usable.** Advanced technologies remain an investment priority. As noted in *The talent paradox*, however, the high prioritization in hiring for user-experience and user-interface positions suggests a shift of focus toward technology usability as well. Thus, most organizations may not only be preparing to offer digitally transformative capabilities but also to ensure people will be able to use them.

### High plans to invest in advanced technologies.

While some newer technologies remain relatively low on the list—advanced simulation and modeling, visual scanning, RPA, sensors, and physical robotics—plans to invest in them are high, suggesting that a goal of digital transformation may be waiting in the future.

### Industry-level differences in adoption.

Examining the data by industry revealed some noteworthy differences. Manufacturing respondents, for example, reported lower current use of many technologies than their counterparts in other industries: Eighty-one percent report using desktop productivity tools, compared with more than 94 percent of both mining and oil and gas respondents, while 61 percent report using CMMS, compared with more than 75 percent of mining and power and utilities respondents. Manufacturers, however, report significantly higher use of sensors. Power and utilities respondents reported higher current use of big data platforms (68 percent), advanced simulation and modeling (62 percent), cloud computing (72 percent), and mobile field management (72 percent). Use of these technologies is perhaps reflective of each industry's various complexities, whether the distributed nature of manufacturing or the remote monitoring needs of mining and oil and gas. In this way, a single path to digitally-transformative innovation does not exist; organizations can adopt the technologies that best suit the complex needs of their industry (table 5).

## Conquering the innovation paradox

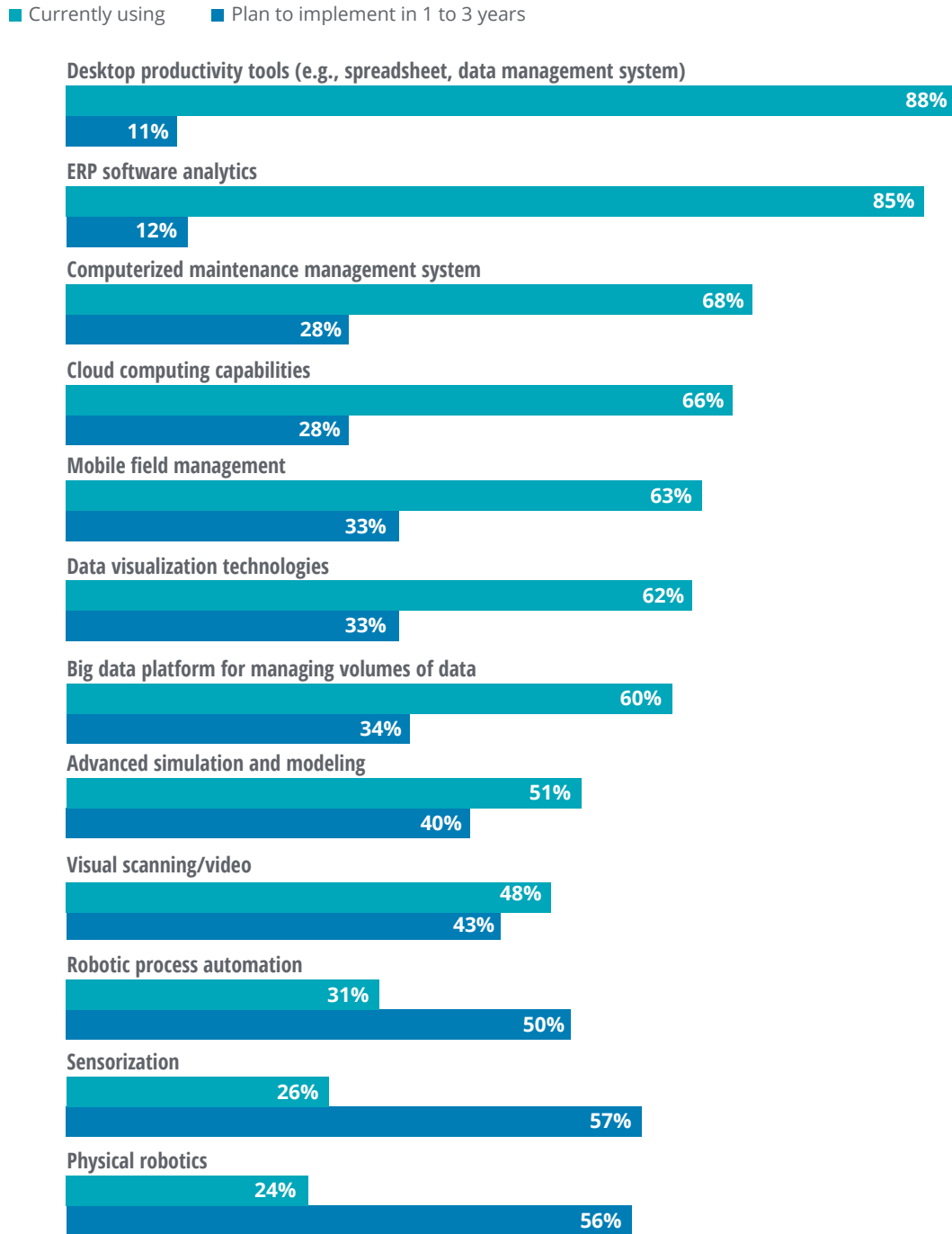
As organizations seek to adopt digitally transformative technologies within their organizations,

**As they continue to digitally transform, organizations should recognize that using technology to drive innovation, rather than just improve current processes, offers strong prospects for growth.**

FIGURE 1

## Investment in more advanced, connected capabilities looks to ramp up in the future, suggesting its use may begin to equal that of more traditional technologies

What tools and technologies are you currently using to access, analyze, and leverage the data from your assets? Which do you plan to implement in the next one to three years?



Source: Deloitte Industry 4.0 investment survey, 2018.

TABLE 5

### The use of different tools and technologies varies across industries, indicating that there is no single path to digital transformation

What tools and technologies are you currently using to access, analyze, and leverage the data from your assets?

	Mining	Manufacturing	Power and utilities	Oil and gas	Total respondents
Desktop productivity tools (e.g., spreadsheet, data management system)	94%	81%	89%	95%	88%
ERP software analytics	86%	83%	86%	89%	85%
Computerized maintenance management system	80%	61%	75%	67%	68%
Cloud computing capabilities	68%	64%	72%	65%	67%
Mobile field management	58%	61%	72%	60%	63%
Data visualization technologies	62%	60%	67%	59%	62%
Big data platform for managing volumes of data	56%	54%	68%	65%	60%
Advanced simulation and modeling	50%	47%	62%	48%	51%
Visual scanning/video	52%	47%	48%	48%	48%
Robotic process automation	28%	32%	24%	40%	31%
Sensorization	16%	32%	30%	19%	26%
Physical robotics	18%	25%	20%	31%	24%

Source: Deloitte Industry 4.0 investment survey, 2018.

the potential for innovation has never been greater. Respondents note that their companies are driven by—and currently prioritize—efforts intended to improve current operations and processes and build a strong foundation for future developments. As they continue to digitally transform, however, organizations should recognize that using technology to drive innovation, rather than just improve current processes, offers strong prospects for growth.

To make innovation a part of a digital transformation strategy, organizations can:

- **Get comfortable with the unknown.** While operations and processes are important, know that innovation-driven uses of digitally transformative technologies are equally likely to yield a strong ROI. Opportunities can exist in the innovations space. Organizations can focus not only on building out the strong foundation of technologies, but also include truly innovative new approaches and priorities.
- **Recognize the (perhaps reflexive) tendency to invest in productivity and operations.** This is not necessarily a bad thing, given the high satisfaction observed. While operations-driven digital transformation can yield success, sticking with the continued evolution of the tried-and-true can leave opportunities untapped.
- **Think about how foundational investment could lead to opportunities for true innovation.** A strong foundation of digital transformation for fundamental operational purposes can in turn help pinpoint key white space opportunities for innovation. Use the insight gained from these foundational investments to create a more informed, targeted path for innovation.
- **Get moving—because others are planning to.** Relatively lower maturity in more innovative areas, coupled with higher planned investments in tools to harness advanced technologies, suggests that many organizations are planning to invest in capabilities that they expect will help them move further along on the digital transformation maturity curve. Those that fail to invest risk being left behind.
- **Build a road map to greater ROI.** Consider not only the context of digital transformation and uses of Industry 4.0 technologies within your industry, but also the technology investments you have already made, to drive your organization toward a high-ROI future.

Leaders have many choices as they seek to grow their organizations. In considering the multitude of digital transformation options at their fingertips, innovation should hold a place at the top of the list.

## Endnotes

1. Punit Renjen, *The Fourth Industrial Revolution is here—are you ready?* Deloitte Insights, January 22, 2018.
2. John Ferraioli and Rick Burke, *Drowning in data, but starving for insights: Starting the digital supply network journey with legacy systems*, Deloitte Insights, April 11, 2018.
3. Donald Mitchell and Carol Coles, “The ultimate competitive advantage of continuing business model innovation,” *Journal of Business Strategy* 24, no. 5 (2011): pp. 15–21.
4. Rick Burke et al., *The smart factory: Responsive, adaptive, connected manufacturing*, Deloitte University Press, August 31, 2017.

## About the authors

*Andy Daecher leads Deloitte Digital's Internet of Things practice. He is based in San Francisco, CA.*

*Brenna Sniderman is a senior manager at Deloitte Services LP's Center for Integrated Research. She is based in Philadelphia, PA.*



## The talent paradox

Technically advanced, intuitively limited

IN AN AGE of digital transformation, it probably comes as a little surprise that individuals are constantly challenged to evolve or, at minimum, keep pace with the technologies their organizations look to implement. *Sloan Management Review* and Deloitte’s 2018 Digital Business Global Executive Study and Research Project reinforces this sentiment, as 90 percent of those surveyed see the need to update their skills at least annually—of which half see development as a year-round, continuous exercise.<sup>1</sup>

Operating in this “development-focused” climate makes our first talent finding so surprising: Of the 361 respondents, 85 percent are more likely

to agree that their organization has “exactly the workforce and skillset it needs to support digital transformation.” Yet, when we dig a bit deeper and ask participants what operational and cultural challenges are most commonly faced by their organizations, finding, training, and retaining the right talent is cited as the number one challenge (by 35 percent of respondents).<sup>2</sup>

Juxtaposing these responses presents an interesting paradox. How can individuals overwhelmingly state they have the exact workforce and skillsets in place but simultaneously recognize that finding and training the *right* talent as their number one challenge?

## The perceived accessibility of digital technologies seems to continually influence talent perceptions.

The answer may lie in the *perceived* accessibility to these digital technologies: How individuals view their personal interactions and ability to navigate these technologies carries significant weight in their organizational talent assessments. Whether differentiating between “power users” and novices or comparing high ROI organizations with the rest of the field, the perceived accessibility of these technologies seems to continually influence talent perceptions.

### Extending the reach of the “power user”

In the mid-1970s, the personal computer (PC) was reserved for hobbyists who enjoyed the technical nuances of hardware and coding. This was a technically savvy, niche group of enthusiasts. When computers began to feature more intuitive graphical user interfaces (GUI), the PC became a bit more personable.<sup>3</sup> From small businesses to classrooms, adoption skyrocketed.

The story of today’s digital technologies may parallel the early journey of the computer. In our analysis, we isolated talent views by self-perceived interaction with these digital technologies (figure 1). The results revealed, quite drastically, that the more respondents use these technologies, the more likely they are to be satisfied with their organization’s current state of talent. At its most polarizing, those who interact with these technologies on a daily basis (indicated by a “5” in figure 1) believe their organization has the proper talent in place 92 percent of the time, while those who have little to no interaction with

digital technology (a “1” or “2” in figure 1) see the greatest gap in talent and development (only 43 percent believe the right talent is currently in place).<sup>4</sup>

Through their own engagement with the technology, executives may perceive these technologies as something “regular people” can handle and implement on their own—perhaps with a little help from a more intuitive design. We see this manifest when assessing the greatest talent needs within the organization. When asking respondents where talent is required the most, overwhelmingly, people point to user interface design. Specifically, almost 17 percent of respondents recognize that user interface design talent is needed but not budgeted for (1.85 times higher than the next-highest need, machine-level controllers). In fact, only a third of respondents believe their organization is already equipped with enough user interface design talent. This is comparatively lower than the other three forms of talent: data science, software development, and machine-level controllers, where respondents indicated they have enough talent on hand, at minimum, 46 percent of the time.

## The more respondents use digital technologies, the more likely they are to be satisfied with their organization’s current state of talent.

Beyond talent, it appears that individuals yearn for more accessible technology investments as well. For instance, in our discussion in *The innovation paradox*, we see that many of the respondents are increasingly looking to invest in data visualization technologies and big data platforms—that is, digital technologies that make comprehending and acting upon insights easier. Coupled with the emphasis on user design talent, we see a relatively clear shift toward technology

FIGURE 1

## Respondents who consider technology to be a crucial part of their daily role are also more confident that their organization has the right talent in place

How involved are you personally in using or overseeing the use of digital transformation/Industry 4.0-driven technologies on a day-to-day basis?

My organization has exactly the workforce and skillset it needs to support digital transformation.

1 or 2: These technologies are not an integral part of my daily role



3



4



5: These technologies are a crucial part of my daily role



Source: Deloitte Industry 4.0 investment survey, 2018.

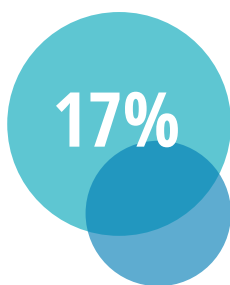
usability as an area of focus. Research shows that technology implementations fail rarely because the technology did not work but rather because people are not willing, or find it too difficult, to use them.<sup>5</sup> Thus, organizations could offer digitally transformative capabilities across a broader swath of their operations—and ensure people will be able, and willing, to use them.

### It takes talent to sustain success

Conventional thinking might suggest that the more successful organizations have been at

implementing digital technologies, the more likely they are to have the right talent in place. However, when we assess organizations that have achieved significant ROI through digital transformation against the rest of the field, we observe that talent concerns seem to rise with success (table 1).

If higher ROI signals greater digital transformation maturity, the next evolution could be accessibility for the user. In fact, a growing body of literature suggests that better, more intuitive design is the “last mile” to unlocking these capabilities.<sup>6</sup> Consider Deloitte’s 2018 *The Fourth Industrial Revolution is here—are you ready?*, where executives indicated that they mostly apply these technologies for operational goals, but that building



**Nearly 17 percent** of respondents recognize that user interface design talent is needed but not budgeted for—**1.85x higher** than the next-highest need.



TABLE 1

### Concerns about talent appear to grow as organizations realize greater return on investment due to digital transformation

	Respondents reporting moderate or lower ROI	Respondents reporting significant ROI
Total respondents that indicated finding, training, and retaining the right talent is a challenge	50	69
Percentage of total	31%	39%

Source: Deloitte Industry 4.0 investment survey, 2018.

an Industry 4.0 society—and ensuing workforce—requires a broader approach that facilitates better, more user-friendly collaboration between humans and machines.<sup>7</sup>

These high-ROI organizations may see talent as the means to both sustain and elevate their digital technologies to new levels of sophistication. As during the formative years of the PC, better design can unlock the technical capabilities already in place. Recently, GE has placed a premium on design as products such as jet engines and magnetic resonance imaging (MRI) machines are now part of digital ecosystems, and ease of assimilation and usage are paramount to successful adoption.<sup>8</sup>

## A clearer talent picture

Indeed, the ever-present need for better, more skilled talent isn't going away. Instead, the increased appetite for digital technologies is fueling a

demand for greater accessibility to these capabilities throughout the organization.

There is good news: Executives can help unlock these digital capabilities by collaborating directly with front-line leadership. In discussing your digital technology needs, consider these three facets of talent:

- **Build these capabilities *with*, not *for* your employees.** These technologies tend to work best when they are built collaboratively with their business users rather than for them.<sup>9</sup> Employees that are not fully immersed in the digital integration process may react with a level of skepticism (or confusion) to its benefits.
- **Hire for design.** Better user interface design can act as the channel to greater employee engagement with these digital technologies. Further, the more intuitive the design, typically the less need for finding new talent with greater technical skills. This is especially important as many of our respondents indicated that user design talent is an unbudgeted need.
- **Sustaining success requires continual investment in talent development.** If accessibility is the linchpin to adoption, leaders may need to continually ensure that their people have the right tools in place to use and interact with these enhanced features. Encouragingly, these trends in accessibility and design suggest that organizations may be better suited in investing in training and talent that make these technologies more engaging rather than opting for a wholesale change in personnel and skill sets. These upfront investments can extend the reach of these technologies throughout the organization—in a more sustainable manner.

With a focus on accessibility, organizations can better use and upskill their existing employee talent to interact with and unlock the full capabilities of Industry 4.0 technologies.

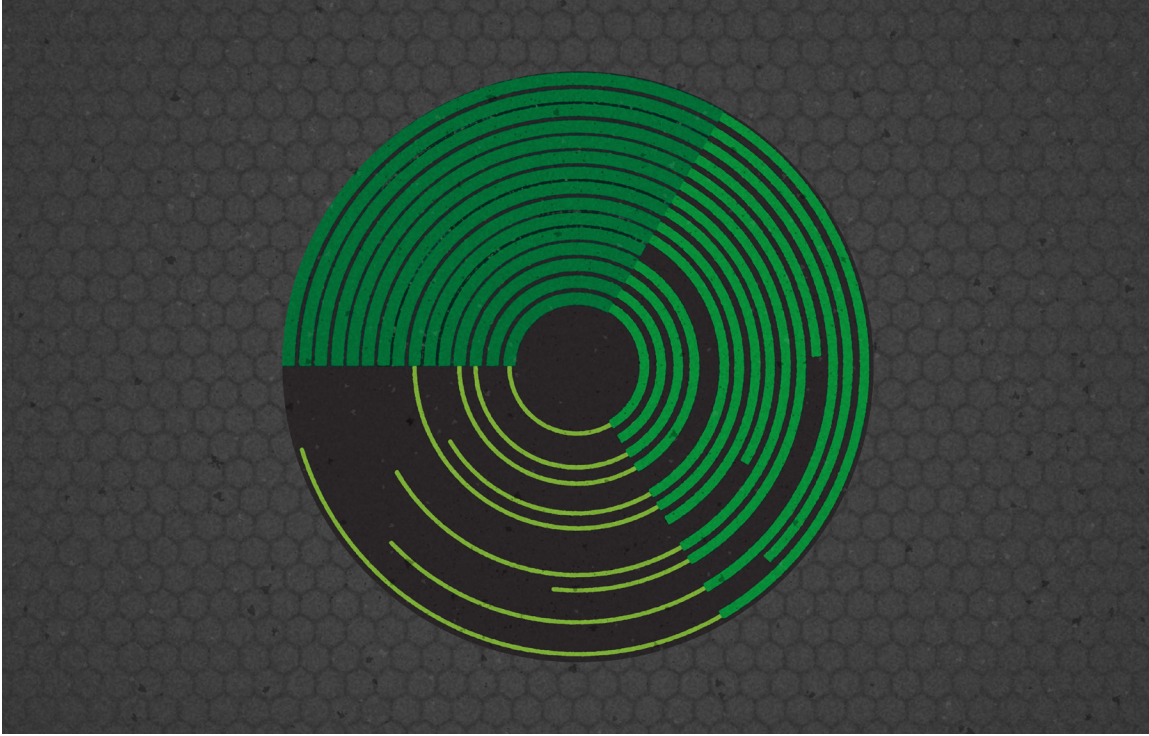
## Endnotes

1. Gerald C. Kane et al., "Coming of age digitally: learning, leadership, and legacy," *MIT Sloan Management Review* in collaboration with Deloitte Digital, June 5, 2018.
2. Individuals were given 12 different categories to choose from with an option of selecting up to three.
3. Jeremy Reimer, "A history of the GUI," *ArsTechnica*, May 5, 2005.
4. Nobody scored a "1", which indicates that all respondents at least have some interaction with these technologies.
5. Christopher A. Chung, "Human issues in technology implementation management simulator," *Development in Business Simulation and Experimental Exercises* 21 (1994).
6. Jim Guszczka, "The last-mile problem: How data science and behavioral science can work together," *Deloitte Review* 16, January 26, 2015.
7. Punit Renjen, *The Fourth Industrial Revolution is here—are you ready?*, Deloitte Insights,, January 22, 2018.
8. Cliff Kuang, "Why good design is finally a bottom line investment," *Fast Company*, April 17, 2015.
9. Gerald C. Kane et al., *Achieving digital maturity: Adopting your company to a digital world*," Deloitte University Press, July 13, 2017.

## About the authors

***Mark Cotteleer is the research director of Deloitte Services LP's Center for Integrated Research. He is based in Milwaukee, WI.***

***Timothy Murphy is a senior manager at Deloitte Services LP's Center for Integrated Research. He is based in Milwaukee, WI.***



## Around the physical-digital-physical loop

A look at current Industry 4.0 capabilities

WHEN BUSINESS LEADERS talk about digital transformation, they often use the term “Industry 4.0” in the same breath. In fact, it can be argued that these two concepts go hand in hand. Deloitte has described Industry 4.0 as the integration of digital information from many different sources and locations to drive the physical act of doing business, in an ongoing cycle. Throughout this cycle, real-time access to data is driven by the continuous and cyclical flow of information and action between the physical and digital worlds. This flow occurs through an iterative series

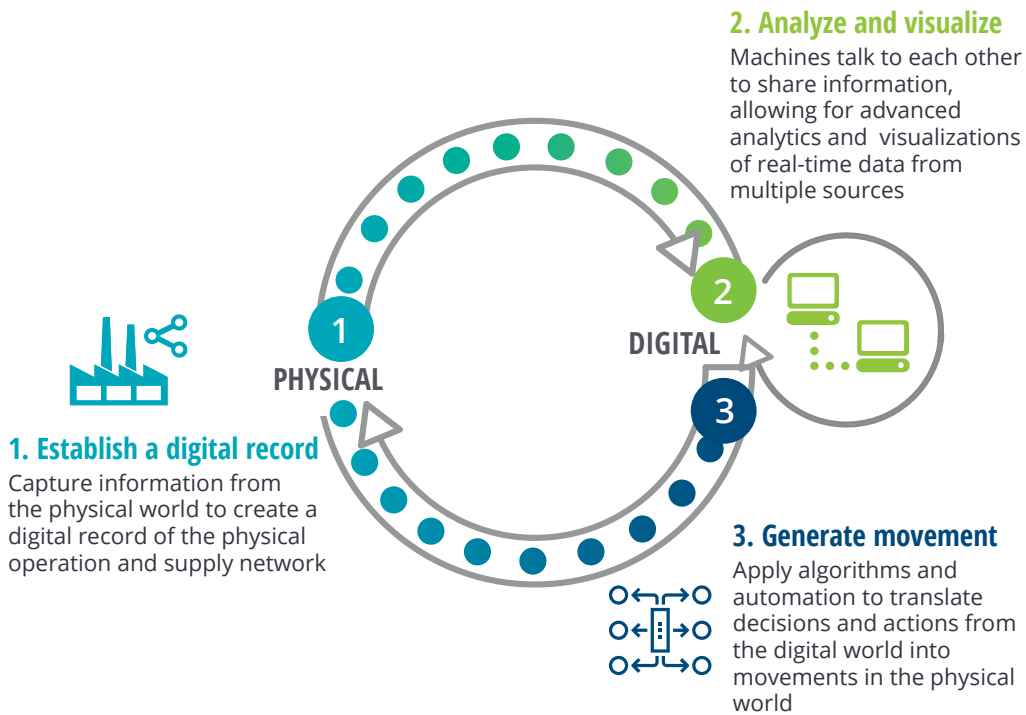
of three steps, collectively known as the physical-digital-physical (PDP) loop<sup>1</sup> (figure 1).

In the first stage, *physical-to-digital*, information is captured from the physical world to create a digital record. That data is then analyzed in the *digital-to-digital* stage to draw meaningful insights. In the final stage, *digital-to-physical*, those insights spur action and change in the physical world. The result is a more flexible system capable of adapting to and learning from changes in the environment.

Our digital transformation survey reveals both insights into what drives organizations to seek

FIGURE 1

## The physical-digital-physical loop and the technologies used



Source: Deloitte Center for Integrated Research.

## The ability to fully harness each stage of the physical-digital-physical loop is crucial to the full realization of Industry 4.0. Many organizations may not yet be able to execute this fully in practice.

digital transformation as well as a deeper story about how they are navigating this loop: the actual creation, use of, and—most importantly—ability to act upon data derived from connected technologies. This ability to fully harness each stage of the physical-digital-physical loop is crucial to the full realization of Industry 4.0—and many organizations

may not yet be able to execute this fully in practice.

### Traveling the loop—but not always finishing the journey

While most respondents have the first stage of the PDP loop in place, and many have the second, far fewer are yet able to harness the last, most important stage—

the ability to act on the data they have analyzed.

**Physical-to-digital.** More than 90 percent of respondents report gathering at least some data from the physical world via enterprise resource planning (ERP), customer relationship management (CRM), or product lifecycle management (PLM) systems,

## While most respondents have the first stage of the PDP loop in place, and many have the second, far fewer are yet able to harness the last, most important stage—the ability to act on the data they have analyzed.

or nontransactional internal systems such as email. More than half of respondents also report collecting data from some form of Internet of Things (IoT), whether field-based (57 percent) or facility-based (58 percent), while 51 percent utilize predictive model outputs.



**More than half** of respondents report collecting data from some form of IoT.

**Digital-to-digital.** When it comes to being able to analyze and extract value from the data—the digital-to-digital stage—confidence among respondents abounds. Those who have access to data report feeling fairly confident in how well they are able to use it. Seventy percent believe they use nontransactional systems extremely effectively. At the same time, however, just 50 percent believe they use ERP and PLM systems extremely effectively—a noteworthy drop from the 91 percent who use these tools.

However, as capabilities grow more advanced and expand to include connected assets, confidence declines: 41 percent report using facility-based IoT extremely effectively, while

40 percent say the same for field-based IoT, and 39 percent for predictive models. Respondents who rated their effectiveness in using the data “somewhat effectively” were at 41 percent, 39 percent, and 38 percent, respectively, for these three capabilities—suggesting that many executives are still

gaining familiarity with and ability to effectively use data from connected systems.

**Digital-to-physical.** Making that last leap back into the physical world is perhaps the most important step, and the one that truly classifies a process as “Industry 4.0.” In this regard, slightly more than half of respondents—54 percent—rated themselves as capable of using data to make decisions in real time, while 45 percent said that they don’t currently have that capability but are building it. This suggests that many organizations recognize that this capability is important, and harbor an active desire to be able to fulfill that last mile of the Industry 4.0 journey.

Interestingly, respondents who reported significant ROI from digital transformation initiatives, as well as those who noted that they plan to

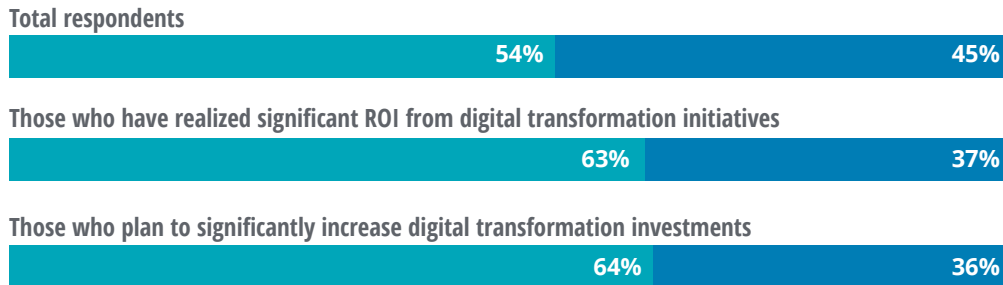
**Making that last leap back into the physical world is perhaps the most important step, and the one that truly classifies a process as “Industry 4.0.” In this regard, slightly more than half of respondents—54 percent—rated themselves as capable.**

FIGURE 2

## Respondents who reported realizing significant ROI from digital transformation initiatives and those who plan to significantly increase transformation investments were likelier to be able to use data to inform decision-making

Does your organization have digital technology in place that enables insights from data to be used to inform decision-making in real time?

■ Yes ■ No, but we are in the process of building that capability



Note: Less than 1 percent of respondents selected “No, and we are not in the process of building that capability.”

Source: Deloitte Industry 4.0 investment survey, 2018.

significantly increase their investments in digital transformation, were likelier to note that they are already capable of using data to make decisions, suggesting that those who invest in digital transformation can benefit from more informed

their capabilities, they are likelier to realize its benefits—and keep investing to further grow their expertise.

**As companies become more involved in digital transformation and build their capabilities, they are likelier to realize its benefits—and keep investing to further grow their expertise.**

## Getting around the loop

The impact of digitally transformative technologies on organizations will likely only continue to grow. These connected technologies make it possible for organizations to access data to drive action throughout their business. To do so, however, they should first be able to not only create information, but be able to derive insights from it—and act on those insights.

To fully leverage Industry 4.0, organizations can:

- **Focus on completing the PDP loop as a roadmap for technology investments**—particularly that last, most important step of being able to act upon the data generated by connected systems. The result can be a more flexible, adaptive organization. To be sure, the ability to

decision-making (figure 2).

This suggests that, as companies become more involved in digital transformation and build

generate and analyze data is highly valuable, but organizations should explore and invest in technologies, talent, and capabilities that can enable them to use it to drive their businesses forward.

- **Recognize that investment begets Industry 4.0 success, and increases the risk that those who haven't gotten started could be left behind.** Executives who report seeing significant ROI on their digital transformation investments are much likelier to report the ability to act on information and complete the PDP loop. Those who plan to significantly increase their investments responded similarly, suggesting that success begets success. But what this also means is that the gap between those organizations that have gotten started and those that are waiting to do so will likely only widen in the future, as those who see success continue to build upon it.
- **Consider the talent you'll need**—both to drive the loop and understand how to leverage

the information it generates. Leading talent will be needed, not only to implement Industry 4.0 technologies but also to produce data and drive responsive action.

- **At the same time, realize you may already have more tools than you think.** More than half of respondents already have tools at their disposal: IoT data collation, ERP systems, social media listening, and predictive modeling. Organizations may want to first build on their existing capabilities, enabling them to identify and make more targeted investments in what they actually need.

It can be difficult to keep pace with the changes brought about by the emergence of Industry 4.0. But by understanding and leveraging the PDP loop as a guidepost, leaders can better understand how to use connected technologies to drive value for their organizations.

## Endnotes

1. For further information about Deloitte's perspective on Industry 4.0 and the physical-digital-physical loop, see Mark Cotteleer and Brenna Sniderman, *Forces of change: Industry 4.0*, Deloitte Insights, December 18, 2018.

## About the authors

*Vincent Rutgers is a partner with Deloitte Consulting Netherlands. He is based in Amsterdam.*

*Brenna Sniderman is a senior manager at Deloitte Services LP's Center for Integrated Research. She is based in Philadelphia, PA.*

# Breaking the paradoxes

## The path to transformative change in the age of Industry 4.0

INDUSTRY 4.0 IS real and increasingly inhabits nearly every corner of the modern industrial organization. Our survey results appear to confirm the faith that leaders are placing in the promise of digital transformation—both in terms of human and financial capital. But any undertaking as profound as digital transformation may uncover what is often unforeseen (or unforeseeable), once the initial wave of investment activity takes hold and enthusiasm somewhat recedes.

In the preceding chapters, we aimed to highlight some disconnects, or paradoxes, that can emerge as organizations pursue digital transformation initiatives. Each of these paradoxes lays bare some of the gaps between where a digital organization currently is and where it may want to be. But these paradoxes can also be seen as opportunities for an organization to recognize the white space within their operations and potentially derive more value from their digital transformation investments.

There is no single way to successfully traverse the path of Industry 4.0, and no single paradox is necessarily more immediately pressing than any other. But the findings from our research suggest a few final high-level observations:

- **Digital transformation is not some abstract endeavor separate from core organizational strategy and purpose.** Once it is undertaken, it becomes central to the organization, touching upon every aspect of the

company—from profitability to supply chain management to the very ethos of the organization itself. Digital transformation is potentially so much more than simply a means to do something faster or more cheaply.

- **Digital transformation does not have a single definition.** It is, ultimately, what a given company uniquely makes of it and hopes to achieve from it. Digital transformation serves the needs of the organization; no two digital transformation initiatives are identical.
- **Digital transformation may profoundly affect talent.** It is imperative that the newly digital organization thoroughly understands and responds to its talent needs, including helping legacy talent understand how their roles may be reshaped.
- **The culture of the digital organization should be inclusive.** A full array of people throughout the organization—at all levels—drive digital transformation and ensure its viability on a daily basis. Their voices should matter.

The changes digital transformation may bring about in organizations will evolve, perhaps in ways no one could have anticipated. This is to be expected as the foundational technologies that comprise Industry 4.0 and drive digital transformation, themselves, evolve at an ever-faster pace. But it seems almost certain that, however that evolution unfolds, the era of Industry 4.0 is here.



## About the authors

*Tim Hanley is the Global Industrial Products & Construction sector leader for Deloitte Touche Tohmatsu Limited (Deloitte Global) and a senior partner with Deloitte United States (Deloitte LLP). He is based in Milwaukee, WI.*

*Andy Daecher leads Deloitte Digital's Internet of Things practice. He is based in San Francisco, CA.*

*Mark Cotteleer is the research director of Deloitte Services LP's Center for Integrated Research. He is based in Milwaukee, WI.*

*Jonathan Holdowsky is a senior manager with Deloitte Services LP's Center for Integrated Research. He is based in Boston, MA.*

## About the authors

**ANDY DAECHER**, a Deloitte Consulting LLP principal, leads Deloitte's Internet of Things practice in Deloitte Digital, focusing on helping industrial clients transform their businesses and generate value through the power of sensors, connected devices, real-time data, and predictive analytics. He helps clients develop and execute pragmatic strategies to innovate their businesses. Daecher is a senior principal in Deloitte's Technology, Media & Telecommunications practice and has led technology-enabled strategic transformations for clients in the hardware, software, semiconductor, and internet segments.

**BRENNA SNIDERMAN** is a senior manager and subject matter specialist at Deloitte Services LP's Center for Integrated Research. She focuses on cross-industry themes and trends, specifically as they relate to Industry 4.0, additive and advanced manufacturing, the Internet of Things, and other advanced technologies. Her research focuses on advanced and autonomous technologies and the intersection of digital and physical technologies in production, operations, the supply network, and broader organizational ecosystems. She works with other thought leaders to deliver insights into the strategic and organizational implications of these technological changes.

**JONATHAN HOLDOWSKY** is a senior manager with Deloitte Services LP and is affiliated with Deloitte's Center for Integrated Research. He has managed a wide array of thought leadership initiatives on issues of strategic importance to clients within the consumer and manufacturing sectors. Holdowsky's published research explores the promise of such emerging technologies as additive and advanced manufacturing, blockchain, the Internet of Things, and Industry 4.0. He is especially passionate about the larger public policy issues that emerge from the adoption of such technologies. Holdowsky is formally educated in the fields of engineering, economics, international business, finance, and law.

**MARK COTTELEER** is the research director of Deloitte Services LP's Center for Integrated Research, collaborating with other thought leaders to deliver insight for Deloitte clients. His research focuses on the application of advanced technology in the pursuit of operational and supply chain improvement. He is widely published in top management and academic journals, including *Harvard Business Review*, *Production and Operations Management*, and others. In Cotteleer's 25 years of consulting experience, he has led teams in technology-enabled reengineering, supply chain strategy, business analytics, and process design. His experience includes working with clients in the manufacturing, supply chain, business analytics, health care, and service industries.

**MONIKA MAHTO** is a research manager with Deloitte Services India Pvt. Ltd., affiliated with the Center for Integrated Research. Mahto has over 10 years of experience in developing in-depth research and high-impact thought leadership focused on digital innovations related to additive and advanced manufacturing, the future of work, Industry 4.0, the Internet of Things, and other advanced technologies. In her role, she collaborates with other thought leaders, industry executives, and academicians to deliver insights into the strategic and organizational implications of these technologies.

**TIMOTHY P. HANLEY** is the Global Industrial Products & Construction sector leader for Deloitte Touche Tohmatsu Limited (Deloitte Global) and a senior partner within Deloitte United States (Deloitte LLP). In his global sector leadership role, Hanley directs strategic initiatives and investments to grow Deloitte member firm market share within the global industrial products and construction sector. During his 38-year career in professional services, he has advised many multinational clients, especially in the industrial products and services, chemicals and specialty materials, and consumer products sectors. He also currently serves as the global lead client service partner or global advisory partner on a number of Fortune Global 500® companies.

**TIM MURPHY** is a researcher and analytical scientist with Deloitte Services LP, developing thought leadership for Deloitte's Center for Integrated Research. His research focuses on the managerial implications of the behavioral sciences within the workforce and the marketplace.

**VINCENT RUTGERS** is a partner with Deloitte Consulting Netherlands. He has been the global lead client partner for Royal Philips since 2013, and leads the Industrial Products and Services sector in the Netherlands, Northwest Europe and Europe, and the Middle East and Africa. Rutgers studied production process optimization and initially worked for global manufacturing companies. For the past 25 years, he has been working with major companies in the manufacturing, telecom, and utility sectors. Rutgers joined Deloitte in 2012 and led Deloitte Digital in the Netherlands before focusing on Royal Philips.

## Acknowledgments

The authors would like to thank **Bill Ribaud** of Deloitte & Touche LLP; **Mimi Lee, Joanna Lambeas**, and **Kristen Tatro** of Deloitte Touche Tohmatsu Limited; **Kevin D'Souza** and **Erin Lynch** of Deloitte Consulting LLP; **Brooke Lyon** of Deloitte Services LP; and **Hemnabh Varia** and **Abha Kulkarni** of Deloitte Services India Pvt. Ltd. They would also like to thank **Prasad Pai, Brad Goverman**, and **Liz Burrows** of GE Digital.

## About the Center for Integrated Research

Deloitte's Center for Integrated Research focuses on developing fresh perspectives on critical business issues that cut across industry and function, from the rapid change of emerging technologies to the consistent factor of human behavior. We uncover deep insights and look at transformative topics in new ways, delivering new thinking in a variety of formats, such as research articles, short videos, or in-person workshops.

## Contact



**Thomas M. Döbler**

German Energy, Resources & Industrials Leader

Deloitte

Tel: +49 (0)89 29036 7920

[tdoebler@deloitte.de](mailto:tdoebler@deloitte.de)

# Deloitte.

## Insights

Sign up for Deloitte Insights updates at [www.deloitte.com/insights](http://www.deloitte.com/insights).



Follow @DeloitteInsight

### **Deloitte Insights contributors**

**Editorial:** Aditi Rao, Junko Kaji, Blythe Hurley, Rupesh Bhat, and Abrar Khan

**Creative:** Anoop K R and Kevin Weier

**Promotion:** Shraddha Sachdev

**Cover artwork:** Kevin Weier

### **About Deloitte Insights**

Deloitte Insights publishes original articles, reports and periodicals that provide insights for businesses, the public sector and NGOs. Our goal is to draw upon research and experience from throughout our professional services organization, and that of coauthors in academia and business, to advance the conversation on a broad spectrum of topics of interest to executives and government leaders.

Deloitte Insights is an imprint of Deloitte Development LLC.

### **About this publication**

This publication contains general information only, and none of Deloitte Touche Tohmatsu Limited, its member firms, or its and their affiliates are, by means of this publication, rendering accounting, business, financial, investment, legal, tax, or other professional advice or services. This publication is not a substitute for such professional advice or services, nor should it be used as a basis for any decision or action that may affect your finances or your business. Before making any decision or taking any action that may affect your finances or your business, you should consult a qualified professional adviser.

None of Deloitte Touche Tohmatsu Limited, its member firms, or its and their respective affiliates shall be responsible for any loss whatsoever sustained by any person who relies on this publication.

### **About Deloitte**

Deloitte refers to one or more of Deloitte Touche Tohmatsu Limited, a UK private company limited by guarantee ("DTTL"), its network of member firms, and their related entities. DTTL and each of its member firms are legally separate and independent entities. DTTL (also referred to as "Deloitte Global") does not provide services to clients. In the United States, Deloitte refers to one or more of the US member firms of DTTL, their related entities that operate using the "Deloitte" name in the United States and their respective affiliates. Certain services may not be available to attest clients under the rules and regulations of public accounting. Please see [www.deloitte.com/about](http://www.deloitte.com/about) to learn more about our global network of member firms.