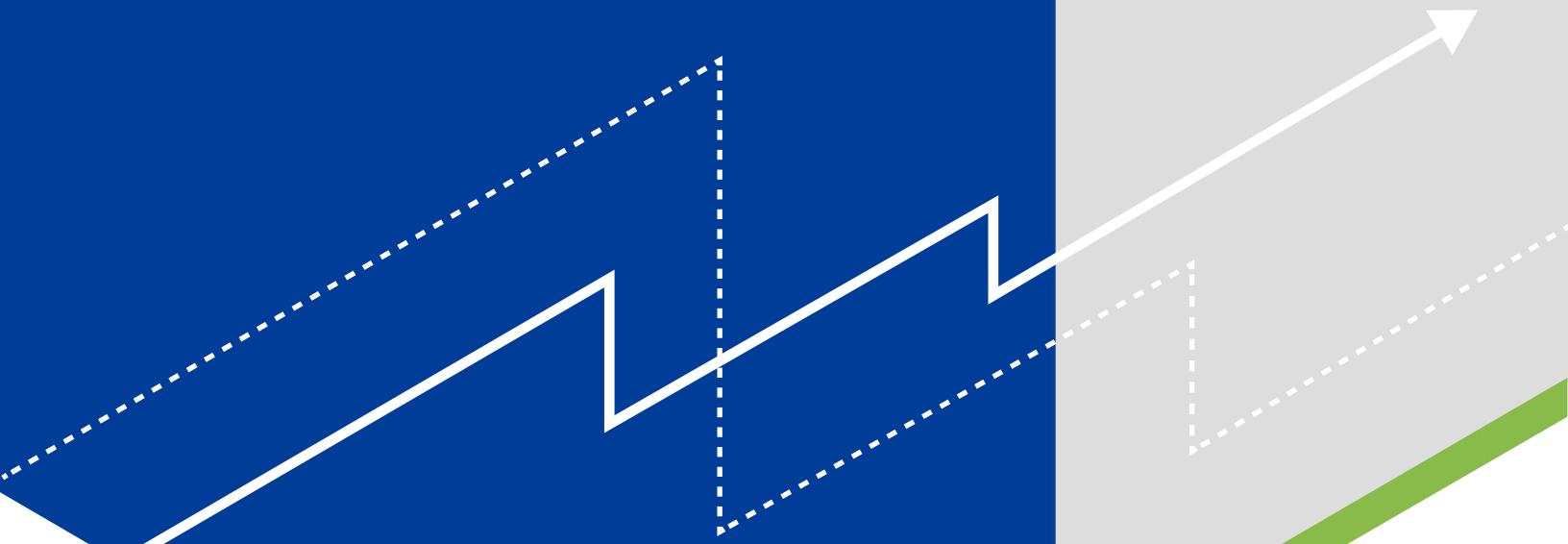
A Forrester Consulting
Thought Leadership Paper
Commissioned By Cognite

February 2020

Contextualized Data And Digital Twins Amplify Digitization Value

Operationalize And Scale Models And Applications With Trusted Industrial Data



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Data contextualization is becoming crucial to make informed business decisions.

Executive Summary

Industrial firms are forced to change the way they engage with customers. These new operational considerations are driving investment in early industrial internet of things (IoT) and digital manufacturing.

To thrive in today's business environment, firms must move beyond just automating existing and siloed business operations and become software-proficient, if not software-native. This hinges on providing data scientists, professional and citizen developers, and engineers with access to contextual, meaningful data at their moment of need.

Leaders in industrial firms must encourage shared responsibility across IT and OT teams, fostering collaboration and shared responsibility for both physical and digital experiences. Solutions need to transcend the organizational silos and legacy systems on which they're built in support of clearly articulated customer outcomes.

Digital twin functionality offers an approach to ensure data and insights from multiple systems are shareable and can be acted on. Digital twins rely on tools and services that fuse data, leverage advanced analytics, improve visualization, and enable machine learning (ML) to support new use cases that drive agility and value.

In October 2019, Cognite commissioned Forrester Consulting to evaluate adoption of contextualized data and digital twin in heavy asset industries. To explore this topic, Forrester conducted an online survey with 160 decision makers in IT and operations roles at global industrial companies in oil and gas, manufacturing, transportation, and utilities. We found that as digitization is increasing, data contextualization is becoming crucial to make informed business decisions. But firms struggle due to a shortage of digital skills, silos, and lack of expertise.

KEY FINDINGS

- **Data is key to digitization, but extracting insights remains challenging.** Over 80% of firms recognize the importance of industrial data in driving their business decisions and innovation. Despite this, 83% experience challenges with using data to deliver insights across the organization.
- **Lack of data skills and IT/OT separation hinder firms' digitization progress.** Unavailability of qualified digital talent is slowing down the pace of digital transformation. This is a reality for 75% of IT and OT decision makers in our study. To make matters worse, available resources (IT and OT) struggle to collaborate, creating further hurdles to achieving digital initiatives.
- **Artificial intelligence (AI) and machine learning boost innovation.** Firms show high interest in leveraging tools with advanced analytics, visualization, and ML to support new digital use cases that drive agility. Digital twin initiatives attempt to combine new techniques from ML with established physics-based modeling and simulation.[1]

The Digitization Of Industrial Firms Is Underway

Economic uncertainty and political change are constants in today's world. This sort of market volatility has implications far and wide. For almost 80% of industrial firms, it means changing how they engage with customers and how they operate. In turn, that drives early industrial IoT and digital manufacturing investment.

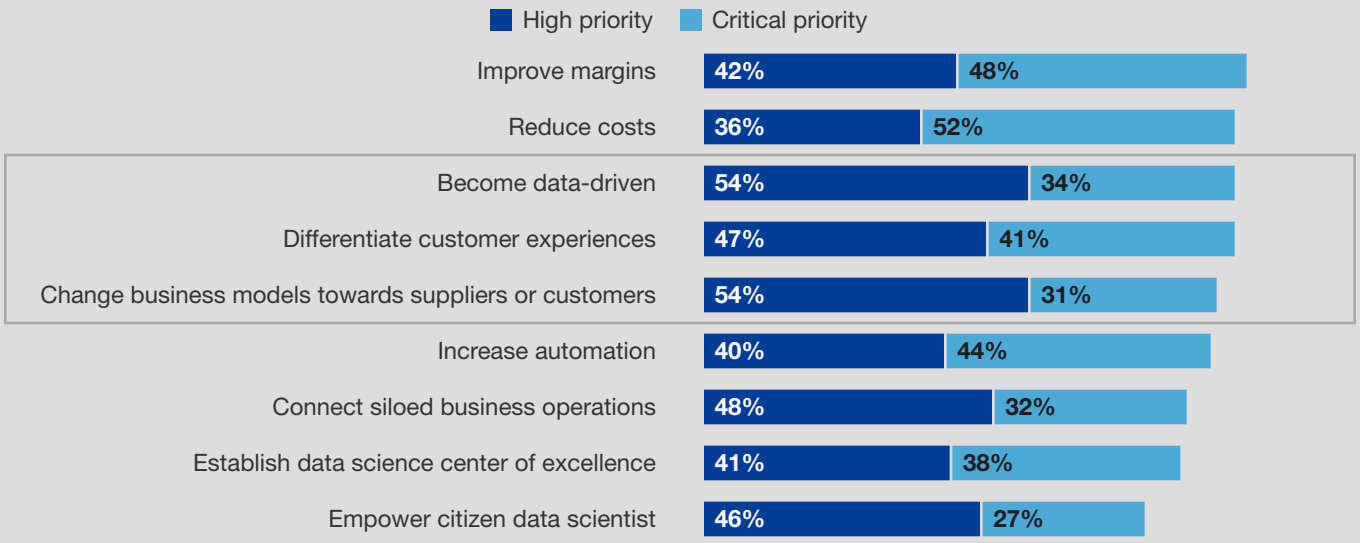
By surveying 160 decision makers in IT and OT roles at global industrial companies, we found that firms are:

- **Thinking strategically about their priorities.** Most industrial firms have expanded their top priorities beyond just operational (improving margins and reducing costs) to also include strategic initiatives like becoming data-driven (88%), differentiating customer experiences (88%), and changing business models towards suppliers or customers (85%) (see Figure 1).
- **Ramping investment in digital.** Whether it's automating plant processes, improving data tools for data scientists or app developers, investing in connected products (new and old), or optimizing operations with ML and AI, industrial firms are actively investing across digital initiatives (see Figure 2).
- **Recognizing the value of advanced analytics.** Three-quarters of IT and OT decision makers report that data is critical or important in achieving their digital initiatives. More specifically, over 80% highlight the importance of industrial data in driving business decisions and innovation, and using ML and data science to power future competitiveness.

Industrial firms are focusing on more strategic priorities, investing in digital initiatives, and utilizing advanced analytics.

Figure 1

"How much of a priority are the following for your company?"



Base: 160 decision makers in IT and operations roles at global industrial companies
Source: A commissioned study conducted by Forrester Consulting on behalf of Cognite, October 2019

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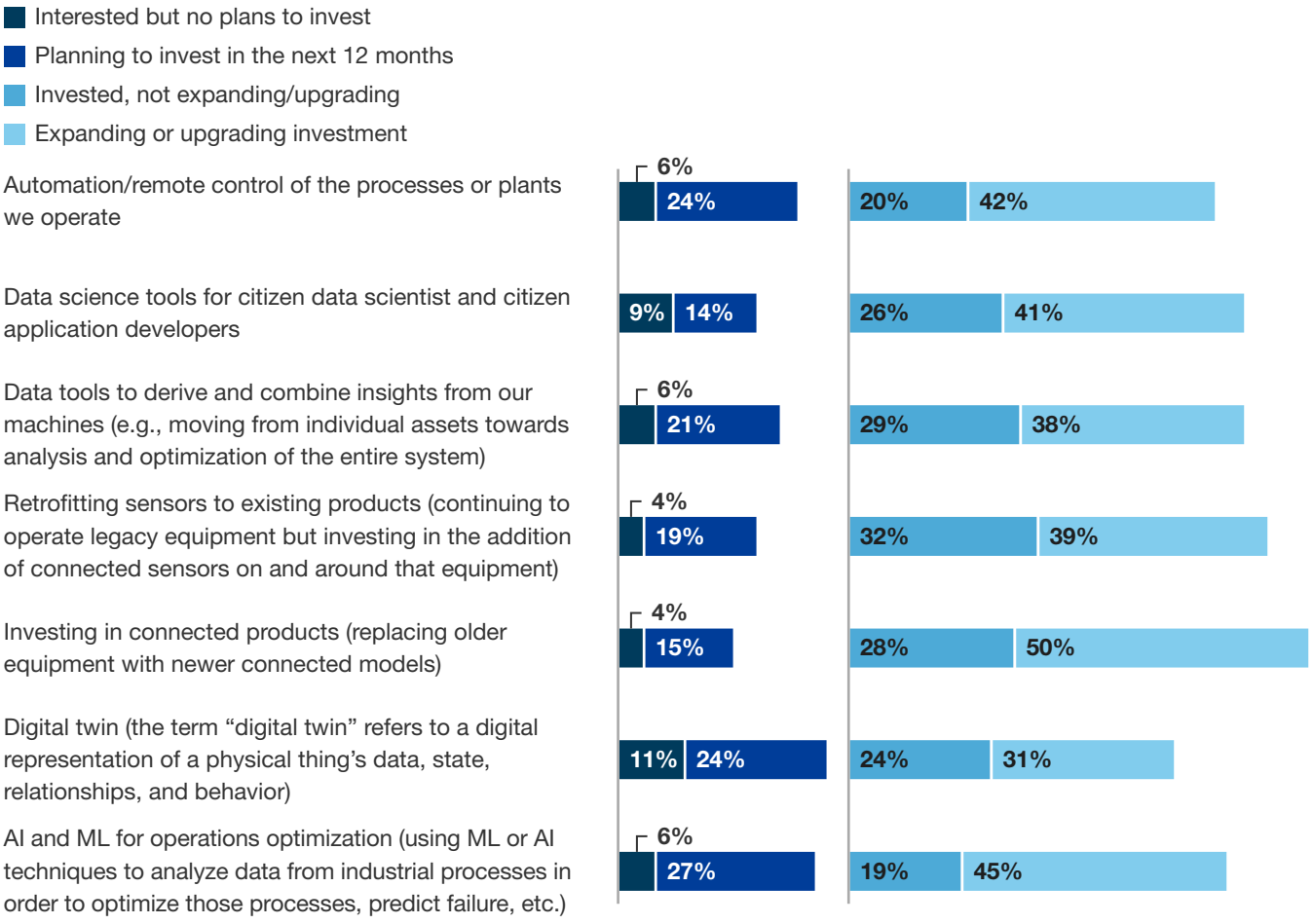
Figure 2

"What are your company's plans to invest in the following digital initiatives?"



Base: 160 decision makers in IT and operations roles at global industrial companies
Source: A commissioned study conducted by Forrester Consulting on behalf of Cognite, October 2019

DIGITIZATION REQUIRES PEOPLE, PROCESS, TECHNOLOGY

Digitization in the industrial world means "doubling down on industrial excellence while adding prowess in software and services."[2] To succeed in this environment, industrial firms must take a holistic approach that accounts for people, processes, and technology. Firms will require:

- **IT/OT alignment.** As industrial firms become digitally augmented, they will need prompt and actionable insight from the OT teams that run critical industrial equipment and the IT teams that run mainstream enterprise hardware, including hybrid cloud environments and software.
- **Automated processes.** As firms automate plant processes, they look to replace legacy systems (65%), integrate previously separated processes in legacy systems with robotic process automation (RPA) (59%), and invest in hardware robots (51%). By putting in place remote control for the processes or plants they operate, adding connected sensors to existing legacy equipment, or replacing older equipment with newer connected models, firms acquire rich data that can lead them to faster innovation, and therefore greater success (see Figure 3a).

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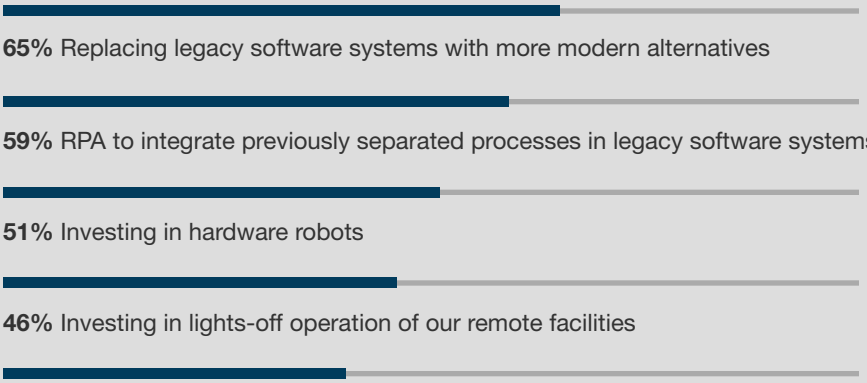
- **Digital twin capabilities.** The digital twin, which Forrester defines as a digital representation of a physical thing's data, state, relationships, and behavior, offers an approach to ensure data and insights from multiple systems are shareable and can be acted on.[3] These twin models use new tools and services that leverage contextualized data, advanced analytics, visualization, and ML to support new use cases that drive agility and value. We found that 24% of IT and OT decision makers at global industrial companies have already invested in some form of digital twin with no plans of expanding investment, 31% plan to expand or upgrade their investment, and 24% plan to invest in the next 12 months. Digital twins have many use cases, but firms primarily use them to improve product quality (55%) and optimize activities between business units (48%). Integrating data from suppliers and partners, as prerequisite for new business models, also rates highly (43%) (see Figure 3b).
- **Contextual data.** Digital twin simulations depend on data from a range of sources, including real-time streams of sensor data from machines operating in the field, historical data on their past behavior, and synthetic data from physics-based simulators and virtual sensors. For an organization to benefit from a digital twin of its products and assets, it needs easy ways to find, use, and share the data behind them. This success hinges on providing data scientists, developers, and engineers with access to contextual data (adding context to data to improve usability and insight) at their moment of need. Most industrial companies (49%) risk full value capture because they take a retrospective approach to contextualizing data, instead of doing so automatically as the data is captured (30%).

Figure 3a

"Which of the following are/will be part of your company's efforts to automate or remotely control plant processes?" (Select all that apply.)



Base: 139 decision makers in IT and operations roles at global industrial companies
Source: A commissioned study conducted by Forrester Consulting on behalf of Cognite, October 2019

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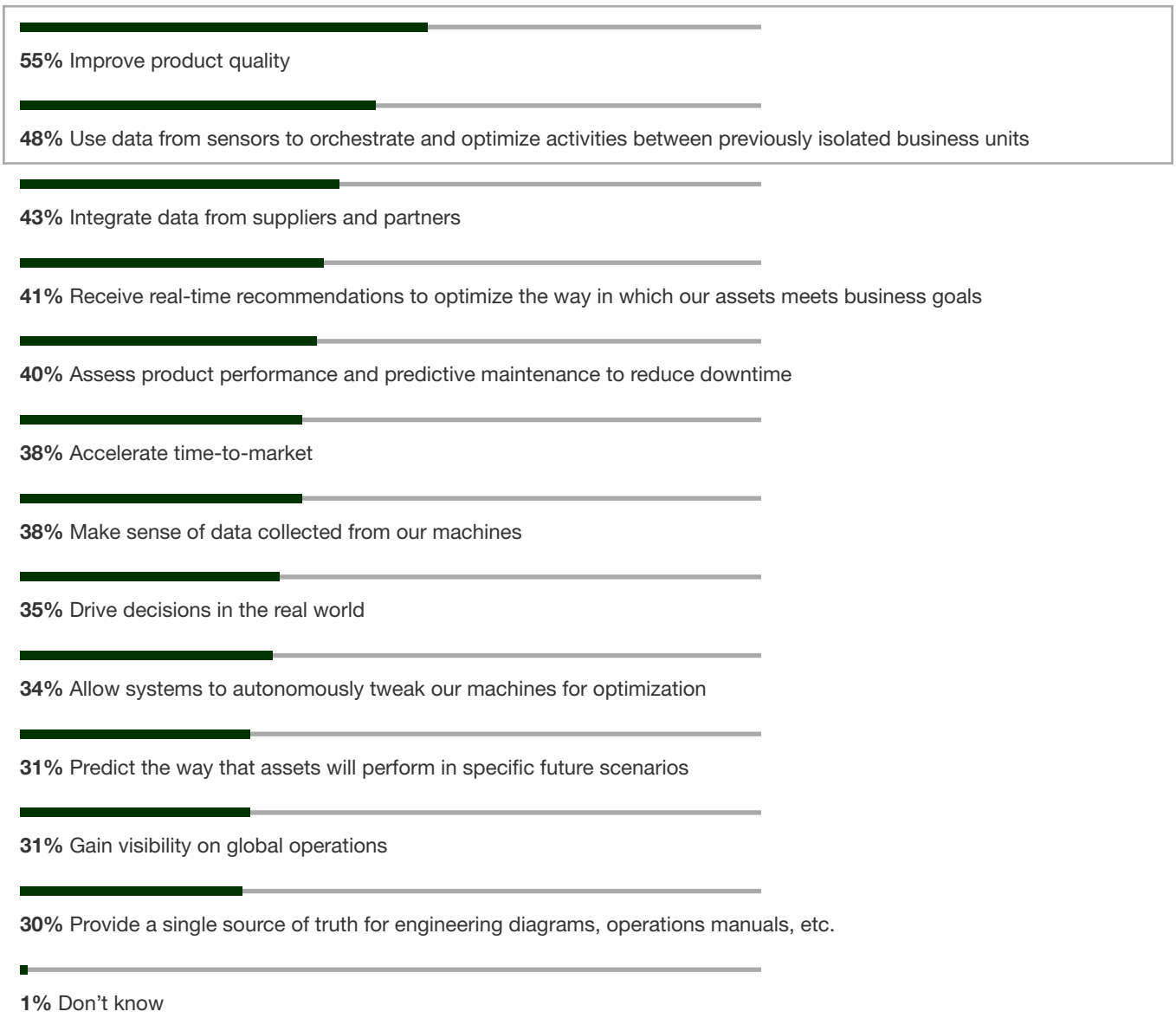
Figure 3b

"How does your company use/intend to use digital twin functionality?" (Select all that apply.)



Base: 128 decision makers in IT and operations roles at global industrial companies who are planning to invest, have invested, or are expanding investment in digital twin
Source: A commissioned study conducted by Forrester Consulting on behalf of Cognite, October 2019

Inexperience, Poor Data Quality, And The IT/OT Divide Hinder Digitization Progress

While industrial firms have taken steps to innovate around their processes, the road to digitization is filled with hurdles. Nearly 90% of IT and OT decision makers report experiencing challenges with achieving their digital initiatives, primarily due to:

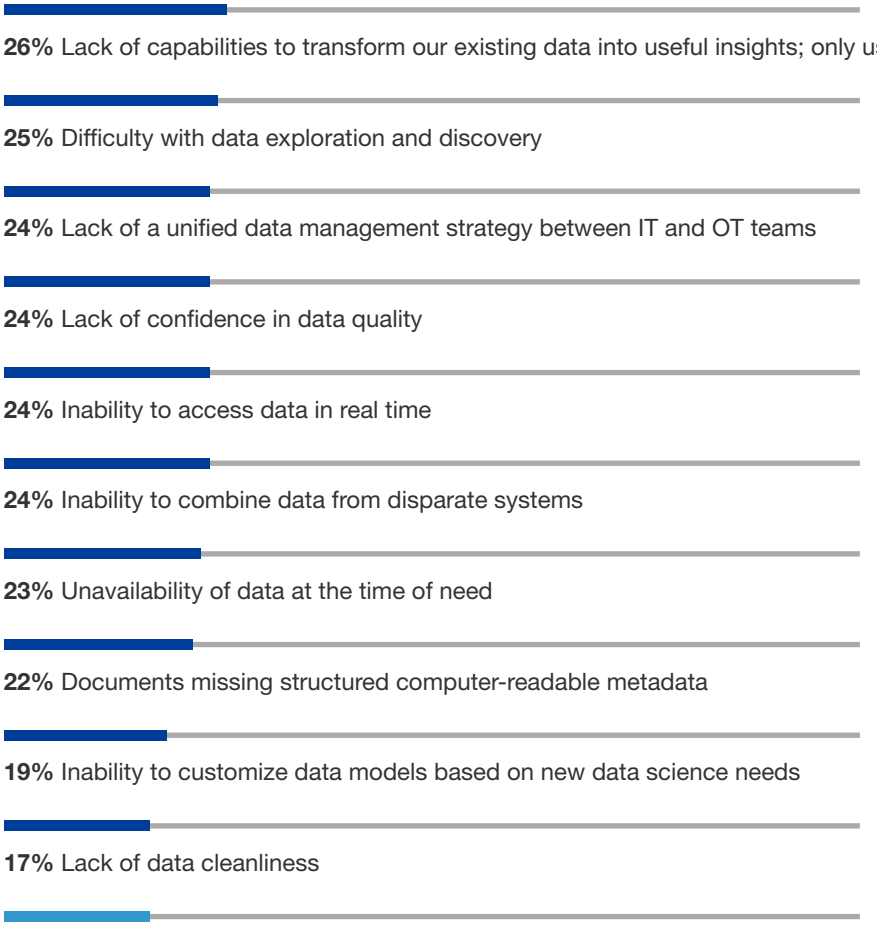
- **Lack of digital skills.** A shortage of digital skills is the biggest barrier firms face with digitization. Whether it's a general lack of skills inside the organization or misdistribution of existing skills, 75% of IT and OT decision makers say that unavailability of qualified digital talent is slowing the pace of their digital transformation. The aging workforce in industrial organizations adds insult to injury. Over 70% of respondents say that as their workers retire, their firms will face significant challenges ensuring safe and efficient operations. When combined, these hurdles will result in serious operational implications, especially as the use and upkeep of capital-intensive machinery is critical to industrial firms' survival (79% agree). Firms must address this challenge head-on, building partnerships with companies that can help them while also investing in upskilling existing workers and attracting new recruits.[4]
- **Poor data quality and insights.** It's well-accepted that data fuels business. However, the jump from intent to commitment holds back firms from becoming insight-driven. Firms struggle to integrate, manage, govern, and activate data.
  - Eighty-three percent experience challenges with using data to deliver insights across the organization, ranging from lack of capabilities to derive insights from data, data exploration difficulties, disparate data management systems between IT and OT, lack of data quality or cleanliness, and inability to access data in real time or the time of need. No singular challenge stands out from the rest, which is an indication that firms struggle across the board to use data to deliver insights across the organization (see Figure 4).
  - Data is abundant, but it's what organizations do with it that matters. Adding context to data improves usability and insight across business units. But 85% of firms in this study face issues as a result of not providing contextually enriched data to data scientists, engineers, citizen developers, and citizen data scientists. As a result, firms wade through avertible inefficiencies because it takes too much time to locate, access, use, or make sense of data (see Figure 5).
  - When it comes to data governance strategy for new advanced analytics applications in production optimization and predictive maintenance, half say their firms are not yet addressing this because their digital applications remain in proof-of-concept phase, not in production. For those that are, only 29% apply the same principles of data lineage/quality monitoring to all their applications. Individual data projects may be well-managed, but without common controls and procedures, it will be either risky or impossible to pull data from multiple sources to power the enterprisewide view that decision makers increasingly need. Data governance and maturing digital from proof-of-concepts to production at scale go hand in hand.

Almost 90% of industrial firms struggle to achieve their digital initiatives because they lack skills, data insights, and cross-collaboration.

› **Separation of IT and OT.** The IT/OT divide adds to the pain. For 56% of firms, most digital projects sit inside the IT organization, leaving OT teams in the dark on these initiatives. What spurs this divide? Up to 82% of respondents cite conflicting interests and perceived lack of technical capability, strategy, and will or acceptance as the top barriers for IT and OT collaboration. However, as industrial firms make the transition to digitization, "this separation between IT and OT has graduated from minor inconvenience to potential dealbreaker" (see Figure 6).[5]

Figure 4

"What challenges, if any, does your company experience with using data to deliver insights across the organization?" (Select all that apply.)



Base: 160 decision makers in IT and operations roles at global industrial companies
Source: A commissioned study conducted by Forrester Consulting on behalf of Cognite, October 2019

Figure 5

"What difficulties do you encounter as a result of not providing contextually enriched data to data consumers (e.g., data scientist, citizen developers, and citizen data scientists)?" (Select all that apply.)

31% It is difficult to assess the accuracy and health of our data catalog.

30% Data consumers spend too much of their time locating relevant data.

29% Data science work is significantly slower because of reliance on scarce subject matter experts.

28% It is difficult to scale citizen data scientist and citizen developer initiatives because data is difficult to understand and use.

25% Digital application development teams are reliant on scarce subject matter experts.

22% Data from operational systems is difficult to access and remains underutilized.

19% We cannot programmatically query complex data, but we always need to involve subject matter experts.

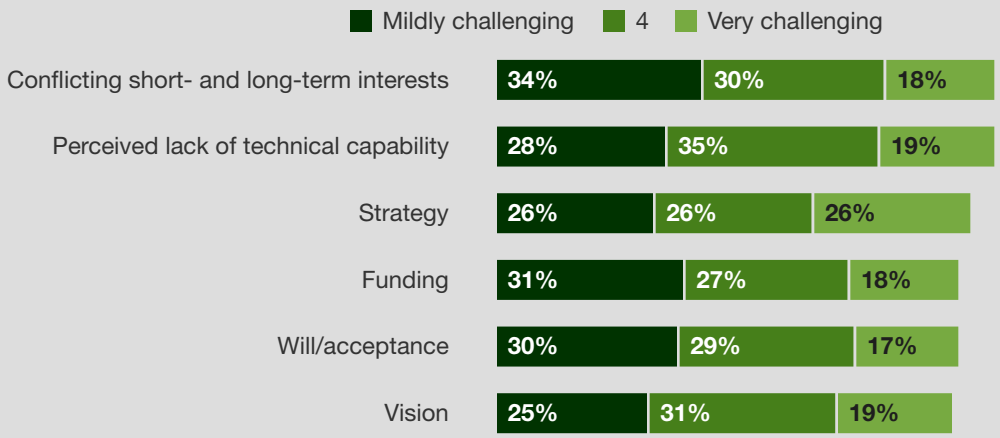
19% It is difficult to understand the connections between IT data and OT data.

15% None of these; we don't experience any challenges with providing contextually enriched data to data consumers.

Base: 160 decision makers in IT and operations roles at global industrial companies
Source: A commissioned study conducted by Forrester Consulting on behalf of Cognite, October 2019

Figure 6

"How much of a challenge are the following for your company's IT and OT collaboration?"



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Source: A commissioned study conducted by Forrester Consulting on behalf of Cognite, October 2019

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Secure Your Digital Future With A Top-Down Approach From Senior Leaders

The best industrial firms have grown to success through meticulous product testing and iterations over many years. This methodical approach to improvement has worked in the past, but it's limiting in the fast-paced, agile environment that businesses face today. Keeping this pace undermines firms' nimbleness to deal with unexpected market changes, responsiveness to customer needs, and the ability to thrive in the digital era.[6]

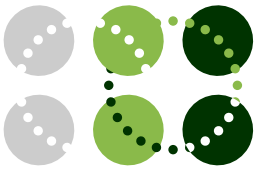
To be successful, solutions for moving forward must transcend the organizational silos and legacy systems on which they're built. From a cultural perspective, leaders in industrial firms must encourage shared responsibility between IT and OT teams, fostering collaboration and shared responsibility for both physical and digital experiences. From a solutions perspective, industrial firms must leverage contextualized data, advanced analytics, physics-based modeling, visualization, and ML to support new digital use cases that drive agility.

Industrial firms are taking steps to drive transformation forward by:

- **Acknowledging the need for advanced analytics.** Seventy-three percent agree that in order to successfully digitize their companies, they need prompt, actionable, and contextually relevant insights from both IT and OT in one place. Close to 80% agree that data needs to become self-explanatory to data consumers without needing subject matter expert support. And a company will only achieve digital maturity when data scientists, engineers, and citizen developers feel empowered to do more with advanced data and analytics by themselves.
- **Leveraging expert support.** The preferred approaches to delivering industrial AI are to buy packaged AI software applications (41%) or to outsource it to a systems integrator partner (24%). In both cases, firms are recognizing that it doesn't make sense for them to attempt to duplicate skills and solutions already available on the open market. Instead, it makes more sense to use them, and to differentiate by using the resulting insights more smartly than competitors.
- **Increasing investment in tools that enable cross-team collaboration.** Almost all (96%) express an interest in industrial data and AI platforms.

  An industrial data and AI platform is a single place to extract insight and build advanced analytics applications from data that includes AI and ML capabilities.

  Unsurprisingly, 98% expect benefits from using such a platform to consolidate and contextualize data from disparate IT and OT systems (see Figure 7).



98% expect an industrial data and AI platform to consolidate and contextualize data from disparate IT and OT systems.

Figure 7

"What benefits would you expect as a result of using an industrial data and AI platform that consolidates and contextualizes data from disparate IT and OT systems?" (Select all that apply.)

39% Improve relationship with suppliers and partners as a result of insight sharing

39% Provide strong data governance (e.g., data lineage and data quality monitoring)

39% Enable predictive maintenance

39% Provide common data architecture for IT and operations

39% Enable efficient data science workflows

38% Innovate new digital products and services

36% Unlock production optimization opportunities

34% Move ML applications from proof of concepts to production

30% Scale ML applications from one piece of equipment to full fleet of similar equipment

26% Empower citizen data scientists

21% Enable rapid/low code analytics application development

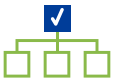
2% None of these; we don't expect any benefits from an industrial data and AI platform that consolidates and contextualizes data from disparate systems

Base: 160 decision makers in IT and operations roles at global industrial companies
Source: A commissioned study conducted by Forrester Consulting on behalf of Cognite, October 2019

Key Recommendations

Forrester's in-depth survey of IT/OT decision makers about industrial digitization yielded several important recommendations:

Bridge IT/OT divide to deliver on digital promises. IT and OT teams hold a wealth of expertise, but a historic, rigid division of roles stifles collaboration. At its worst, it normalizes ducking of responsibility and assigning of blame. Senior leaders must communicate loud, clearly, and often that the company needs and values both IT and OT, but that it's no longer acceptable for them to operate entirely independently. Establish joint projects in which success requires shared ownership and shared action. Assign shared goals and compatible KPIs. Encourage temporary reassignments and bottom-up ideas for new cross-cutting projects. Then get out of the way.



Integrate and contextualize data from across the organization to support decision making. Effective decision making requires insights based on data from a wide range of sources: real-time operational data from IoT sensors, historic behavioral data from historians and data warehouses, synthetic data from physics models simulators and virtual sensors, order and supply chain data, and information from third parties on external factors such as the weather. As customers demand that companies become nimbler and more agile, it becomes increasingly important to ensure that relevant data can be — and is — available when, where, and in the formats needed to support effective decision making. Invest to unlock the organizational and technological silos within which most of your data is currently locked. Make contextualized data available and understandable to all data consumers within and outside the industrial enterprise.

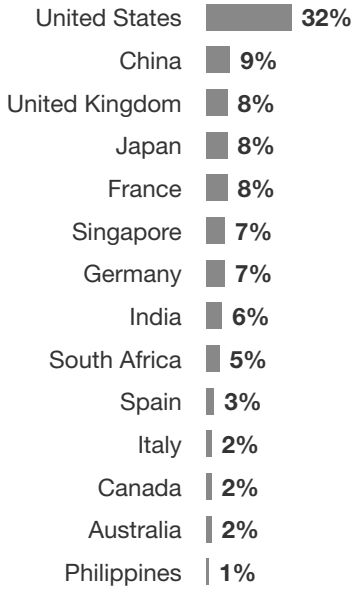
Invest in both skill building and partnership nurturing to succeed. Few industrial organizations have the skills to plan, implement, and sustain their own digital transformations. Fewer could credibly argue that such a capability would be sufficiently differentiating for them to justify the investment required to deliver it. Instead, these organizations must find and nurture partnerships with the software companies, data scientists, and systems integrators that are already well-placed to take on the bulk of this work. By all means, invest in building an internal team with the skills and mandate to understand what's happening, to experiment for the future, and to oversee the work of others. But, for most, it makes sense to let your capable partners do the bulk of the work at your direction.

Appendix A: Methodology

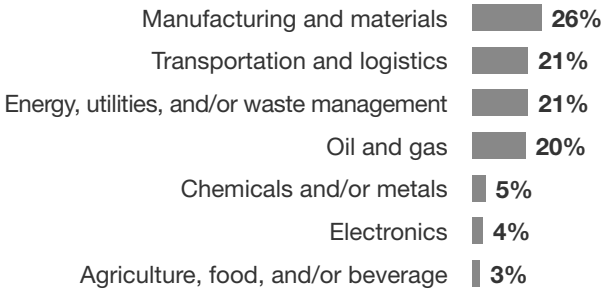
In this study, Forrester conducted an online survey of 160 IT and OT decision makers from industrial companies across the world to evaluate their use of digital twin functionalities and contextual data to drive forward digital transformation. Survey participants included decision makers in IT, operations, data science/digital, and executive management. Questions provided to the participants asked about their priorities, digital initiatives, challenges, and interest in solution to help them overcome their issues. Respondents were offered an incentive as a thank you for time spent on the survey. The study began and was completed in October 2019.

Appendix B: Demographics/Data

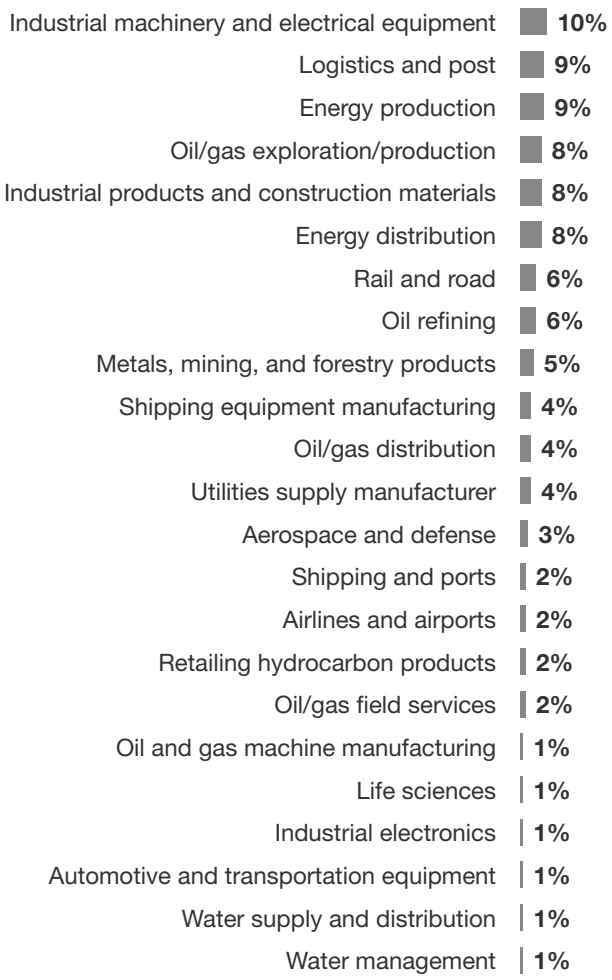
GEOGRAPHY



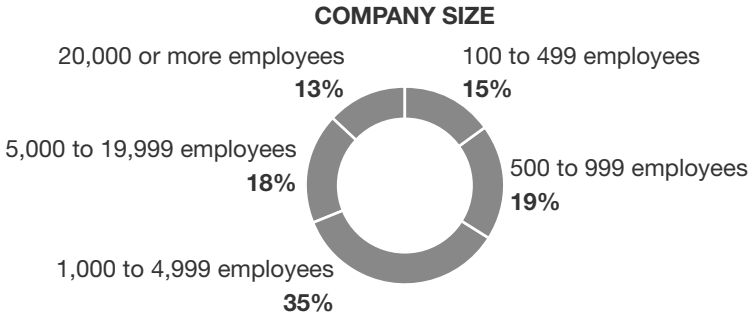
INDUSTRY



SECTOR



COMPANY SIZE



Base: 160 decision makers in IT and operations roles at global industrial companies
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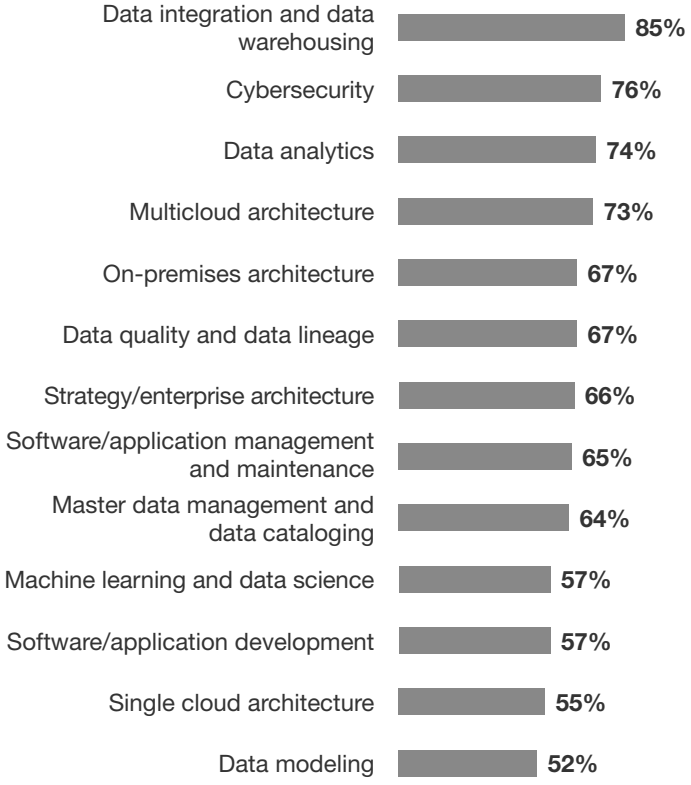
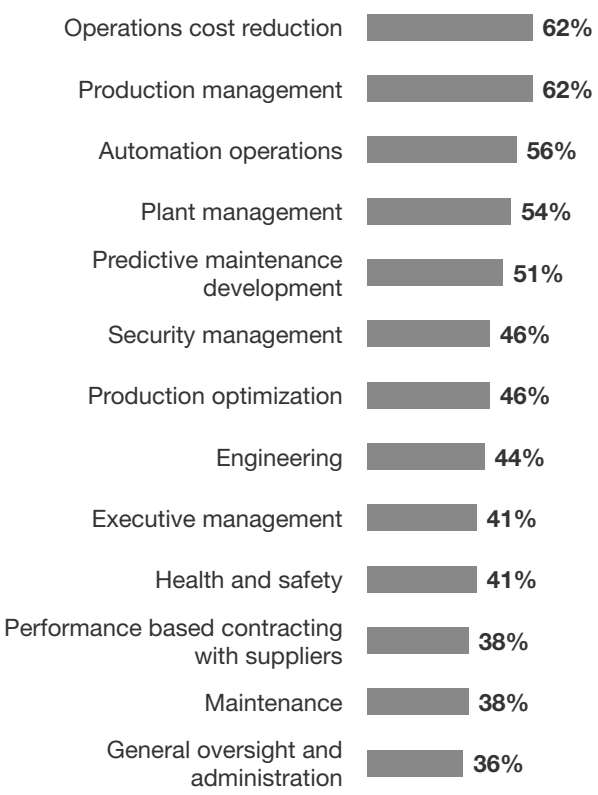
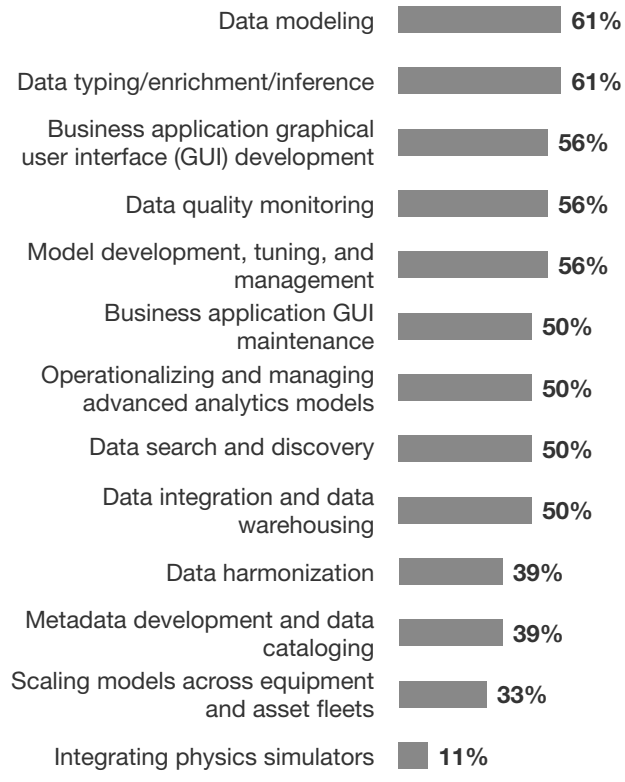
IT RESPONSIBILITIES



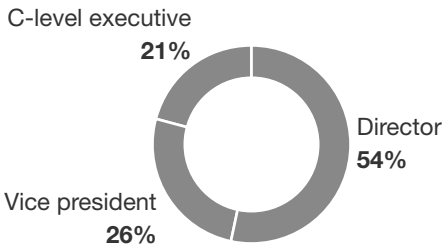
OPERATIONS RESPONSIBILITIES



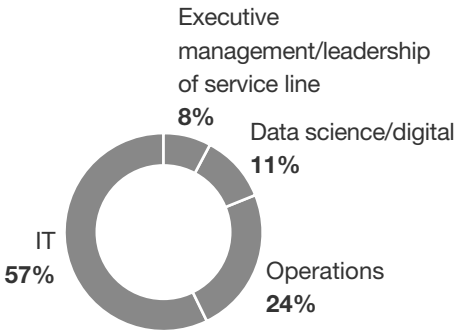
DATA SCIENCE RESPONSIBILITIES



RESPONDENT POSITION



DEPARTMENT



Base: 160 decision makers in IT and operations roles at global industrial companies
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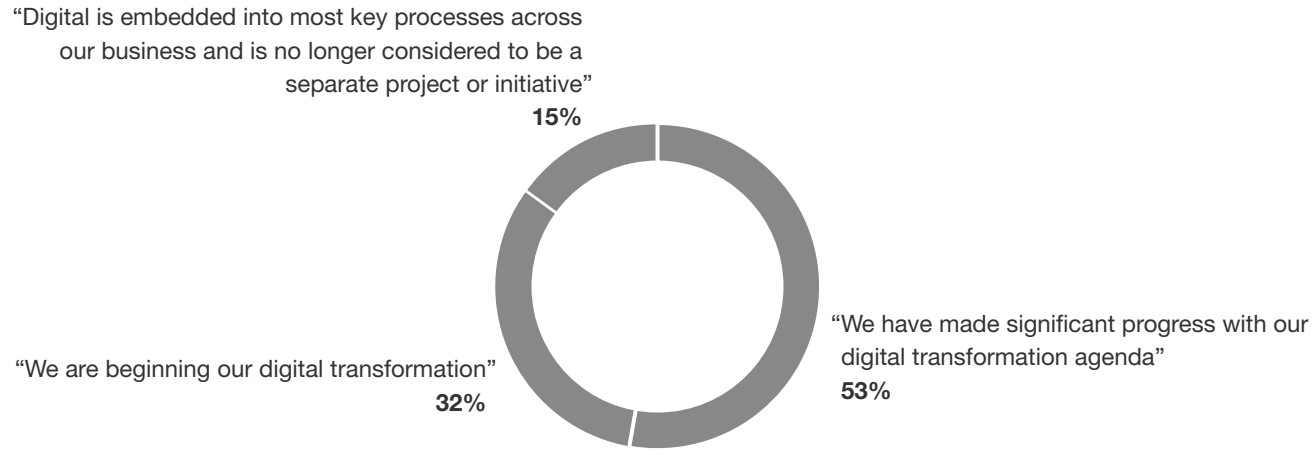
DIGITAL TRANSFORMATION EFFORTS



Base: 160 decision makers in IT and operations roles at global industrial companies
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Appendix C: Supplemental Material

RELATED FORRESTER RESEARCH

"Untangle The Digital Twin As Part Of Your Digital Product Strategy," Forrester Research, Inc., October 2, 2019.

"Bridge The IT/OT Divide To Win With Smart Manufacturing," Forrester Research, Inc., July 24, 2019.

Appendix D: Endnotes

[1] Source: "Untangle The Digital Twin As Part Of Your Digital Product Strategy," Forrester Research, Inc., October 2, 2019.

[2] Source: "Bridge The IT/OT Divide To Win With Smart Manufacturing," Forrester Research, Inc., July 24, 2019.

[3] Source: "Untangle The Digital Twin As Part Of Your Digital Product Strategy," Forrester Research, Inc., October 2, 2019.

[4] Source: "Offer A Deeper Purpose To Tempt Digital Talent Away From Silicon Valley," Forrester Research, Inc., August 6, 2018

[5] Source: "Bridge The IT/OT Divide To Win With Smart Manufacturing," Forrester Research, Inc., July 24, 2019.

[6] Ibid.