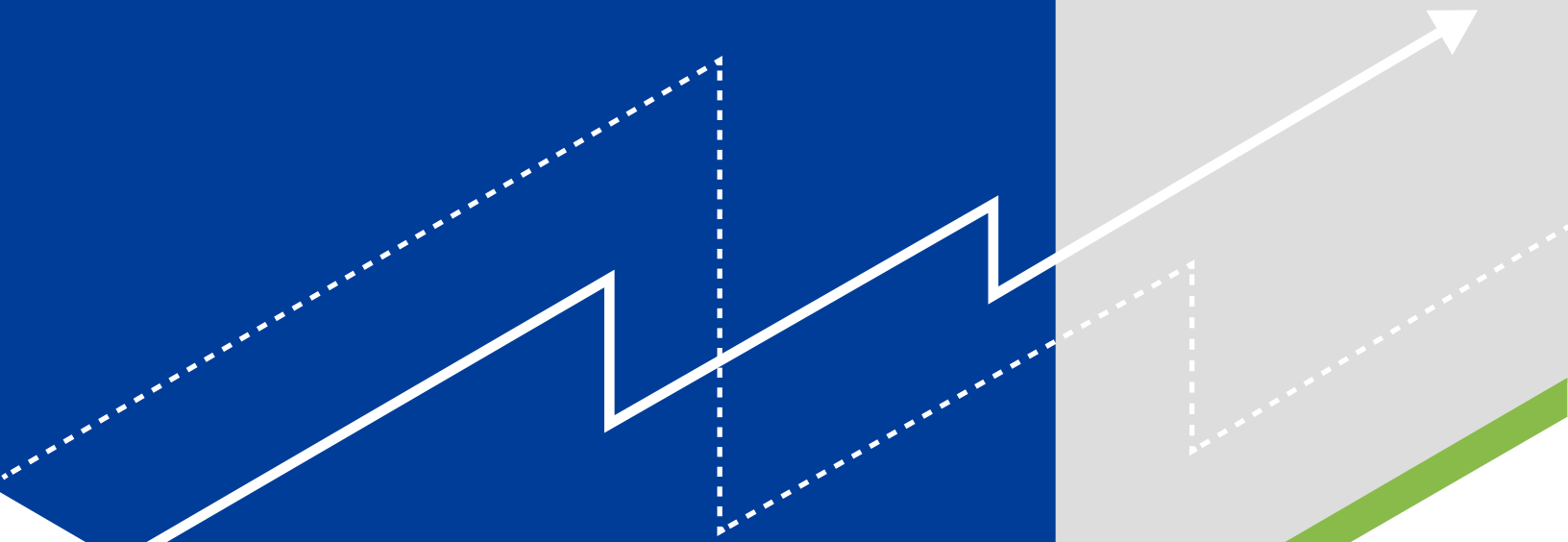
A Forrester Consulting
Thought Leadership Paper
Commissioned By Siemens

May 2019

Digital Twins And Data Insight Enhance Benefits For Firms At All IoT Maturity Levels

Closing The Loop Between Product, Production, And Performance



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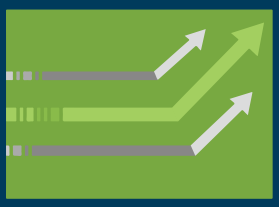

Executive Summary

Internet of things-enabled products and solutions have been propelling businesses forward for the past decade. These smart connected devices, and the data that they produce, allow businesses to differentiate their products, improve customer experiences, enhance operations, and develop new business models. Internet-of-things (IoT) solutions momentum often creates challenges for businesses as they work to overcome diverse stakeholder requirements, network connectivity issues, and data management complexity. Many organizations engage partners to help evolve their initial IoT investments into true business-changing implementations that will deliver new revenue growth through as-a-service offerings.

In January 2019, Siemens commissioned Forrester Consulting to evaluate IoT use case deployment and digital twin initiatives in the manufacturing, electronics/semiconductors, energy/utilities, resource industries, retail/wholesale, transportation, pharma/medical devices, and aerospace/defense spaces. Forrester conducted an online survey with 418 respondents and six interviews with professionals to explore these topics.

Throughout this report, we have segmented organizations based on their IoT maturity. Characteristics of these IoT maturity segments are:

- **Mature organizations:** Mature organizations are approaching data collection, product development, IoT integration, and data analysis holistically. Additionally, mature firms are investing in digital twins to enable products and production processes and to monitor performance. Twenty-one percent (21%) of the sample are mature organizations.
- **Immature organizations:** Immature organizations are firms that are more nascent in their IoT investments relative to use of data insights and have limited use of digital twin functionality to enable products and production processes. Twenty-one percent (21%) are immature organizations.
- **Transitioning organizations:** The remaining fifty-eight percent (58%) of organizations are transitioning. These firms are evolving their use IoT solutions, analytics, and digital twin capabilities beyond the early stage but are not yet considered to be mature.

KEY FINDINGS

- **IoT investments are increasing.** Businesses are continuing to increase their investments in connected devices, recognizing the potential business-changing impact that IoT can have on their organizations.
- **Despite this enthusiasm, many businesses face challenges in maximizing their IoT implementations.** Key challenges include stakeholder complexity, network connectivity, and data management.
- **Partners are seen as the key to bridging the gap between enthusiasm and execution.** Businesses are looking to partner with companies to maximize their IoT investments.

IoT Investments Are Growing As Capabilities Expand

IoT investment continues to gain momentum as businesses across a range of vertical markets begin to recognize the power of deploying smart, connected devices to transform their products, operational processes, and business offerings.

- **Companies are investing in IoT to fundamentally evolve their businesses.** Over three-quarters of surveyed firms believe IoT will generate significantly better customer experiences and enhance operational efficiency. In fact, 62% of respondents are confident that IoT will create new revenue streams for their firms.
- **Stakeholders recognize that data is the foundation of a successful IoT strategy.** Utilizing IoT data is the key to maximizing investments in IoT use cases and solutions. Many businesses are focused on building a strong data architecture to support their IoT initiatives. Over two-thirds of respondents identify improving their security architecture to secure IoT data as a top IoT priority, followed by designing an IoT architecture to secure their IoT data.
- **Companies are exploring connecting digital twins; however, few use them effectively yet with IoT.** A digital twin is a cross-domain digital model that accurately represents a product, a production process, or the performance of a product or production system in operation. Digital twin functionality is an emerging category of IoT investment for some firms. Nearly 40% of surveyed organizations have implemented digital twins to enable IoT connected products, while only 13% of firms are currently using digital twins to improve performance monitoring. Some respondents recognize that digital twins are necessary to achieve IoT solution maximization. In fact, 36% of respondents are piloting or planning to implement digital twins to improve performance monitoring within the next year.
- **Respondents identify digital twins as key enablers of continuous innovation.** In fact, both mature and immature businesses recognize that digital twins can continuously improve their product offerings and improve product quality (see Figure 1). This finding points to the fact that digital twins are not merely a nice-to-have function but instead are a fundamental game-changer for businesses that are evolving their IoT deployment strategies.

36% of respondents are piloting or planning to implement digital twins to improve performance monitoring within the next year.

Figure 1

"What are your objectives with digital twins?"

Base: 418 decision makers responsible for IoT processes and/or product development
Source: A commissioned study conducted by Forrester Consulting on behalf of Siemens, February 2019

32% of businesses are looking to digital twins to help with continuous innovation.

Businesses Are Challenged By Stakeholder Diversity, Network Connectivity, And Data Management

Despite the enthusiasm for IoT investments, many businesses face challenges in deploying their IoT solutions to maximum effect. Challenges tend to be focused on three discrete areas:

> "The problem is few companies can really articulate what their corporate IoT strategy is. . . . There's still work to be done at a corporate level to coordinate all the different efforts."
>
> *VP of supply chain at Fortune 50 retailer company*

I. STAKEHOLDER DIVERSITY

› **IoT project responsibility spans a wide array of stakeholder roles.** Deploying IoT solutions spans many steps, from identifying the business need and getting budget approval to implementing the end-to-end IoT solution. An average of five different stakeholder roles participate in various aspects of the IoT solution implementation process, including CIOs, CEOs, and individual line-of-business leaders (see Figure 2). This diverse array of stakeholders can create complexity as each stakeholder has his or her own objectives for the IoT solution investment and deployment.

Figure 2

"Who at your organization has primary responsibility for each of the following aspects of IoT initiatives?"

	Identifying the paint point or business need	Defining the scope of the initiative and building the business case	Funding/ budget ownership	Technology selection	Technology implementation	Communication/ messaging to customers	Program evaluation and metrics	Utilizing the data to inform business decisions
CEO	22%	16%	35%	2%	1%	1%	3%	10%
CIO, CDO, CTO, or other C-level head of IT	39%	39%	28%	18%	10%	8%	17%	27%
IT VP or director	19%	23%	22%	31%	15%	10%	18%	15%
IT manager	7%	10%	7%	26%	28%	22%	28%	19%
Individual lines-of-business leaders	8%	7%	5%	16%	27%	33%	22%	16%
Head of operations	4%	2%	1%	5%	13%	22%	9%	10%
Engineers	0%	1%	1%	2%	4%	3%	2%	1%

Base: 418 decision makers responsible for IoT processes and/or product development
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› **IT and OT teams often struggle with internal alignment.** Overall, 46% of respondents report that OT — operational technology — teams are siloed from IT — infrastructure technology — teams at their organizations. However, mature organizations are far less siloed compared to immature organizations. Only 36% of mature organizations state that their OT and IT teams are siloed. As one CEO noted, these mature organizations recognize that successful implementation is a tango between IT teams and OT teams: "IT is our customer — the operations group is the main driver, and our service group."

II. CONNECTIVITY AND APPLICATIONS

› **Network connectivity is a key challenge when implementing IoT solutions.** Top challenges for respondents include collecting data, developing applications to leverage IoT devices, and connecting the fragmented array of IoT-enabled devices to wireless, wireline, and industrial networks. Examples of network connectivity options can include cellular, Bluetooth LE, LTE Cat 0, and Wi-Fi. Other connectivity options capture data from complex industrial assets using industrial protocols such as legacy SCADA to more modern OPC UA communication protocols.

› **IoT implementation challenges differ significantly between mature and immature organizations.** Nearly a third of immature organizations struggle with finding an appropriate partner to assist with their IoT initiatives and are concerned with IoT device connectivity on a fundamental level. Mature organizations struggle with higher-level challenges, such as security vulnerabilities, rather than tactical challenges, such as building a robust back-end technology ecosystem, which is a top challenge for immature organizations. Firms at all maturity levels struggle with network connectivity and data utilization issues.

III. DATA MANAGEMENT

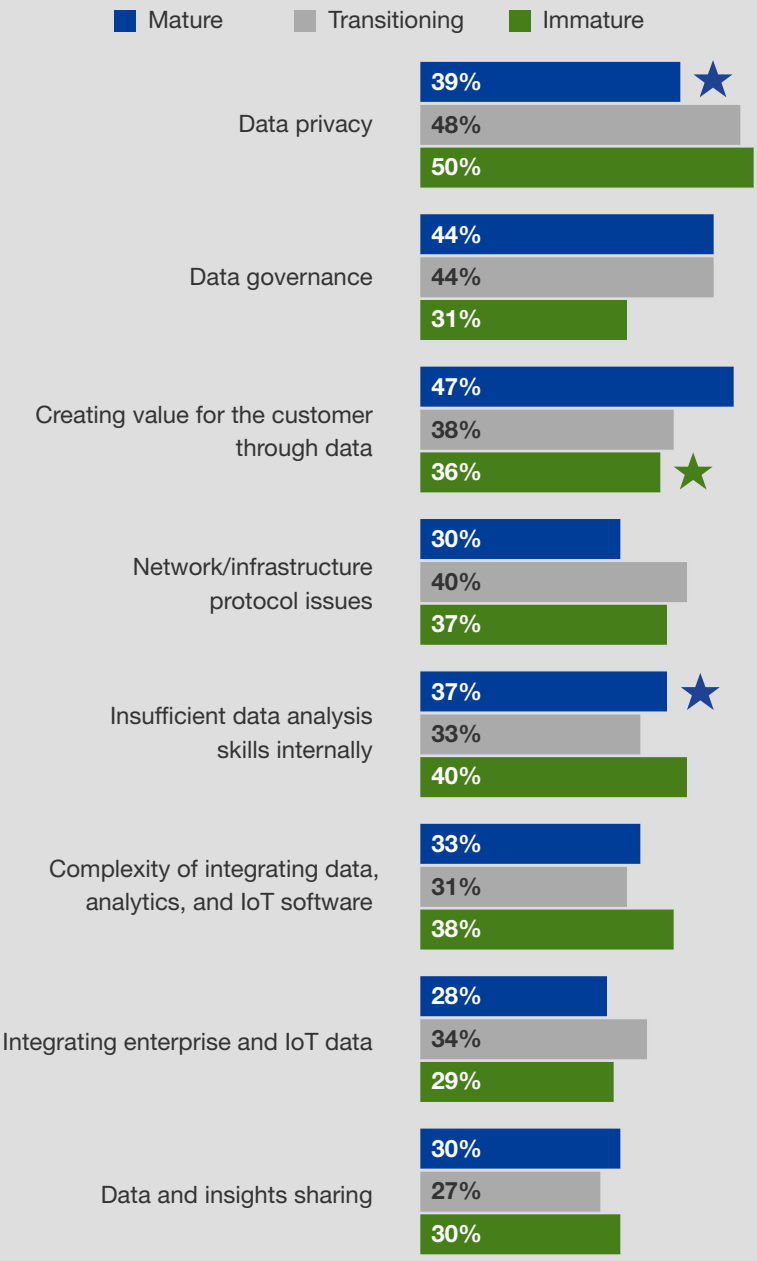
› **Data privacy and data governance are challenges for organizations across all maturity levels.** IoT devices generate sensitive information about company operations, products, and customers. Many business stakeholders recognize the importance of strong data privacy and data governance for successful IoT implementation. However, surveyed businesses across the board struggle with ensuring they are storing, transferring, and accessing data properly.

› **Data utilization challenges differ based on IoT maturity level.** Immature organizations often have insufficient internal data analysis skills, which is a key roadblock to maximizing the value of IoT devices (see Figure 3). Conversely, mature organizations are far more likely to face challenges creating value for customers through data. In fact, creating value through data is the top-rated challenge for mature organizations, pointing to the fact that while they may have mastered the nuts and bolts of IoT data management, they still struggle with the strategic implementation of this data.

> "Data quality is an issue because when you're talking about devices that collect data, you want the data to be precise. You have to determine how to capture data that is granular, precise, and useful, where the measurements aren't just high, medium, low."
>
> *Director of M&A and business development at a technology manufacturer*

Figure 3

"Specifically as it pertains to IoT data management/analytics, which of the following challenges is your organization facing?"



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Top 3 challenges for mature organizations are:

1) Creating value
2) Data governance
3) Data privacy

Top 3 challenges of immature organizations are:

1) Data privacy
2) Insufficient skills
3) Integrating software

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The Benefits Of IoT Are Clear

The benefits of IoT implementation are evident, regardless of organizational maturity. Digital twins can be the bridge to close the gap between strategic benefits and tactical ones, but many organizations need partners to help deploy these capabilities.

- **Business benefits abound when organizations deploy IoT solutions.** The top benefits of IoT solutions among mature organizations include improved customer experience (76%), revenue growth (57%), and accelerated shift to digital business (48%). These mature organizations use IoT solutions to unlock strategic growth and fundamentally transform their business models into as-a-service offerings. In comparison, less mature organizations recognize business benefits from IoT deployments that are more tactical than strategic. Fifty-two percent of immature organizations cite improved employee productivity and experiences based on IoT deployments, and 44% report improved security and privacy capabilities.
- **Successful digital twin implementation unlocks further benefits for businesses.** Over a third of mature organizations have noted that they have improved their product designers' experience, increased efficiency of production, and increased revenue from existing business streams by implementing digital twin capabilities. On top of these benefits, mature organizations have noted that the predictable performance that digital twins enable has raised their customers' satisfaction rates.
- **However, all businesses recognize that two partner types are the key to evolving their IoT solution to maximize its benefit.** One — application developers — and two — original equipment manufacturers (OEMs) that incorporate edge technologies in their devices — are the two types of partners that businesses of all maturity levels are turning to help with their IoT solutions. Application developers are seen as the key to help businesses with their data management challenges, while OEMs can help with network connectivity issues.

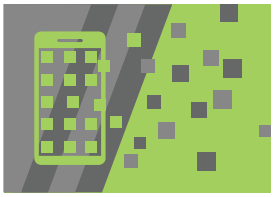
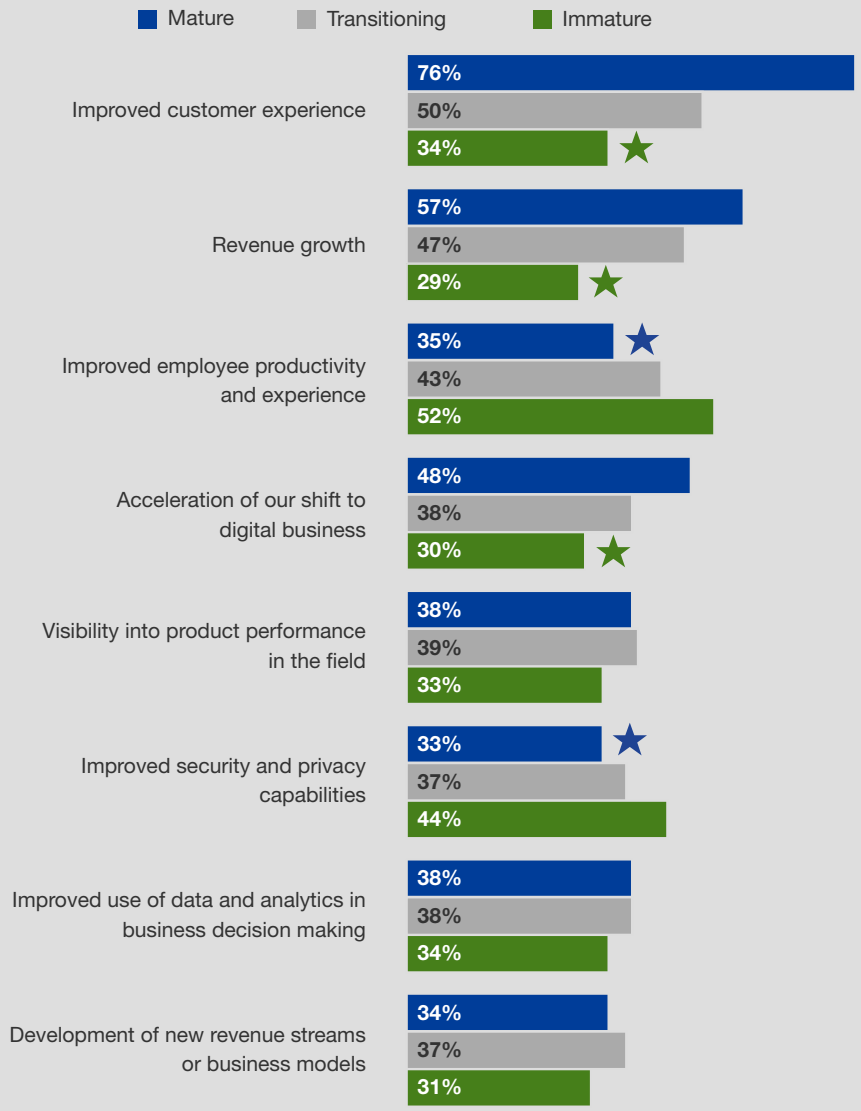


Figure 4

"Which of the following business benefits have you have realized or would expect to realize by deploying IoT solutions?"



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Key Recommendations

Enterprises across a range of industries are deploying IoT-enabled devices to enhance operations, improve customer experiences, and enable new types of business models. However, successful IoT solution deployment requires businesses to leverage new digital twin functionality and data analytics capabilities to achieve comprehensive IoT solution benefits. Forrester's in-depth survey of global IoT stakeholders across a range of industries yielded several important recommendations:

Enable coordination between IT and OT to identify relevant IoT use case requirements. As IoT solutions that run on and connect with business technology and software platforms replace legacy siloed technology, line-of-business executives representing many different roles (e.g., plant operations, manufacturing, product engineering) must increasingly work with IT teams to implement IoT solutions. Business, operations, and IT colleagues must work together to surface critical scalability, security, and architecture requirements.

Identify IoT use cases to address your firm's current and future digital transformation goals. Global enterprise stakeholders must identify relevant IoT initiatives to address their firms' short-term and long-term priorities. IoT use cases are often used to power new business models, deliver personalized customer experiences, and enhance operational processes. As the breadth and range of your IoT use case deployments expand, so too will the amount and variety of captured data. It is important to evaluate the implications of evolving IoT data characteristics and use cases on your data analytic requirements.

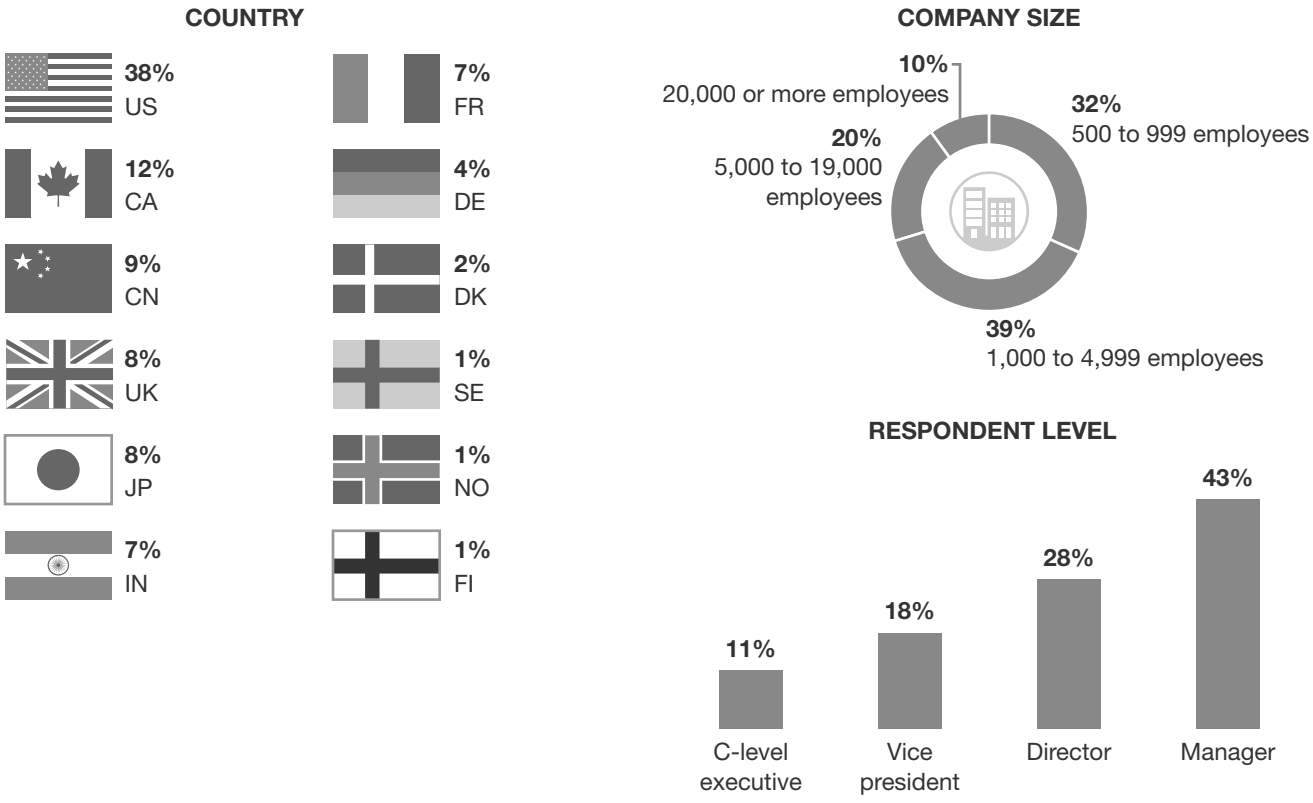
Consider your requirements for digital twins and IoT data analytics. Evaluate opportunities to use digital twin functionality to improve product development, increase production efficiency and accuracy, and increase revenues from existing business streams. In addition, after capturing IoT performance data using digital twins, organizations often have insufficient internal data analysis skills to transform IoT data into actionable insight, which are necessary to maximize the value of IoT solution deployment.

Proactively seek assistance from partners to accelerate your IoT initiatives. Partners play a critical role in successful IoT solution deployment. Many stakeholders recognize gaps in their operational skills and data analytic expertise necessary to seamlessly deploy IoT solutions and capture insight necessary to achieve comprehensive benefits from IoT solutions. Third-party partners are often used to fill these skills gaps. Enterprise stakeholders seek partners with the following characteristics: advanced IoT analytics skills, IT expertise, and data analytics knowledge. In addition, third-party partners must demonstrate successful IoT deployment case studies within specific industry segments, vertical markets, and use cases.

Appendix A: Methodology

In this study, Forrester interviewed six stakeholders with responsibility over IoT processes and/or product development at their organizations and surveyed 418 enterprise decision makers across 12 countries with responsibility over IoT processes and/or product development in their organizations to explore IoT use cases. Respondents were offered a small incentive as a thank you for time spent on the survey. The study began in January 2019 and was completed in February 2019.

Appendix B: Demographics/Data



Base: 418 decision makers responsible for IoT processes and/or product development
Note: Percentages may not total 100 because of rounding.
Source: A commissioned study conducted by Forrester Consulting on behalf of Siemens, February 2019

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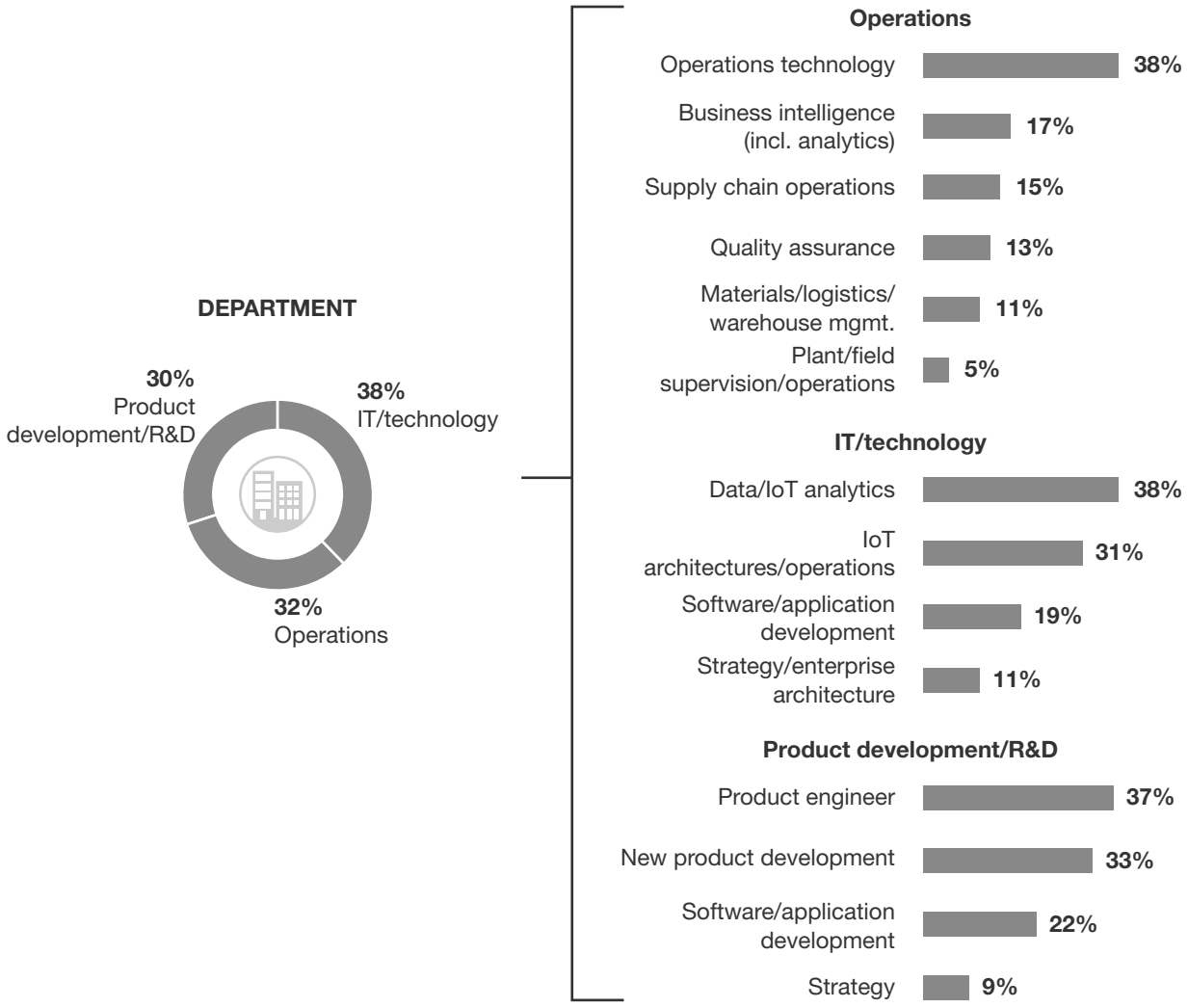

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