Internet-Of-Things Solution Deployment Gains Momentum Among Firms Globally

Improved Customer Experience And Supply Chain Optimization Are Leading Business Benefits Of IoT Solutions

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Executive Summary

Connected world solutions, often referred to as the Internet of Things (IoT), leverage machine-to-machine (M2M) technologies (e.g., sensors, GPS technology, and RFID tags) to link physical assets to analytics and control systems through the Internet.[1] In October 2014, Zebra Technologies commissioned Forrester Consulting to conduct an online study of IT and business decision-makers in 593 global firms representing the retail, manufacturing, consumer products, transportation, healthcare, government, oil/gas, and hospitality industries. Certain key themes were explored in this study and in a similar study conducted in 2012.[2] They focused on identifying organizations' interest in IoT solutions; the timeline for deploying IoT applications; and technical elements of IoT solutions for which firms seek third-party assistance.[3] All survey respondents for these studies were responsible for making or influencing decisions related to their firm's IoT solutions. In addition, the definition of Internet of Things used for both studies is:

Smart interconnected devices that businesses use to get more visibility into the identification, location, and condition of products, assets, transactions, or people to drive more effective and timely business decisions or to improve customer interactions.

Study results show IoT solution deployment is occurring among firms in various geographic regions and vertical markets. IoT solution deployment timelines and initiatives vary by industry sector and geographic region. In addition, many firms seek assistance from third-party vendors to implement various technical elements of these IoT solutions and applications.

KEY FINDINGS

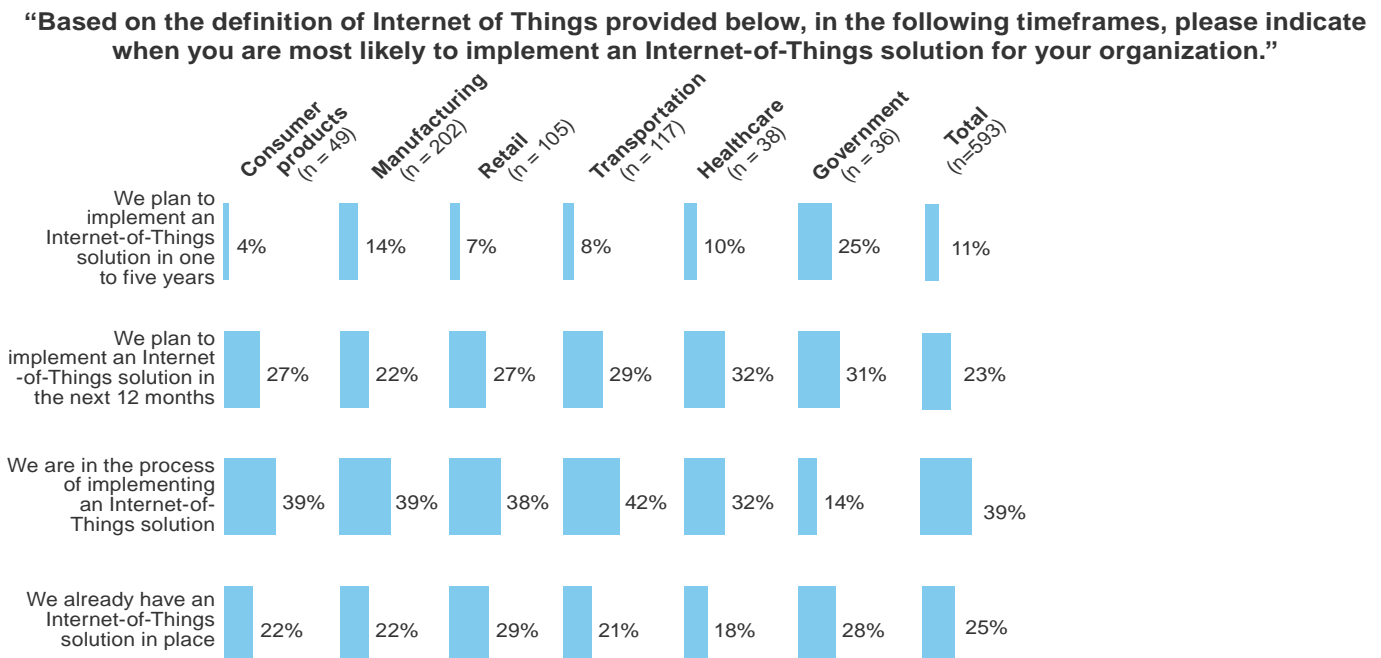Results of this global study yielded the following key findings:

› **Global firms recognize the transformational role of IoT solutions.** Over 80% of surveyed firms agreed that IoT solutions will be the most strategic technology initiative for their organization in a decade. These firms represent many sectors, including retail, manufacturing, consumer products, transportation, healthcare, government, oil/gas, and hospitality. Organizations deploy these IoT solutions to address a variety of strategic, operational, and business challenges.

› **There is strong IoT solution deployment momentum among global firms.** Nearly 65% of surveyed firms have deployed or are in the process of implementing IoT solutions. In 2014, 25% of surveyed global firms already had an IoT solution in place, and nearly 40% of firms are in the process of implementing an IoT solution. Over 70% of Asia Pacific firms have an IoT solution in place or are in the process of implementing an IoT solution. Construction of new cities, buildings, and state-of-the-art infrastructure in many Asia Pacific countries enables this strong IoT solution momentum. In comparison, between 52% and 60% of European and North American firms are in these same stages of IoT solution deployment.

› **Wi-Fi, real-time location tracking, and security sensors are important elements of IoT solutions.** In fact, 83% of firms identified Wi-Fi infrastructure and real-time location tracking technologies as important or very important components of IoT solutions. In addition, sensor technologies to monitor assets and the surrounding environment were identified as important or very important technology elements by at least 80% of global firms. Each technology element has unique characteristics related to security issues, installation costs, and reliability, which must be considered. For example, Wi-Fi, wireless LAN (WLAN), and ZigBee solutions are suited for supply chain applications, while cellular technology solutions are ideal for real-time monitoring assets including shipping containers and railroad cars.

› **Organizations can achieve a wide range of business benefits from IoT solution deployment.** Improved customer experience leads the list of benefits, with 49% of firms identifying this as one of the top five benefits of deploying IoT solutions. Supply chain optimization, visibility, and loss prevention closely follow and were identified as a top five benefit by between 45% and 46% of firms. By enhancing supply chain processes, firms can improve business process efficiencies, reduce working capital, and locate assets.

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Firms Are Deploying Internet-Of-Things Solutions To Transform Operations

Internet-of-Things solutions enabled by M2M technologies like RFID tags, GPS systems, and ZigBee sensors are gaining momentum as multiple forces align to drive adoption. Widely deployed IP networks, declining device costs, and new business opportunities contribute to driving demand for IoT solutions. These solutions use various M2M technologies to monitor and transfer the status of physical assets to improve business processes and cost efficiencies in many industry and government organizations. Forrester's custom study aimed to identify current and future deployment timelines for IoT solutions, the importance of various technical components of IoT solutions, and the need for third-party assistance to deploy IoT components. Our study found that:

› **Global firms recognize the transformational role of IoT solutions.** Over 80% of surveyed firms agree that IoT solutions will be the most strategic technology initiative for their organization in a decade. Momentum for IoT solutions has increased in the past few years. When we compare 2014 survey results with a similar study conducted in 2012, we find a significant increase in IoT deployment. In 2014, 25% of surveyed firms already had an IoT solution in place compared with only 15% of surveyed firms in 2012.

› **There is significant IoT solution deployment momentum among global organizations.** Nearly 65% of surveyed global firms have deployed or are in the process of deploying IoT solutions. An additional 39% of firms are in the process of implementing an IoT solution (see Figure 1). There is significant deployment of IoT solutions across geographic regions. Approximately 70% of Asia Pacific firms already have an IoT solution in place or are in the process of implementing an IoT solution. Development of new cities, buildings, and infrastructure in many Asia Pacific countries enables this strong IoT solution momentum. In comparison, 60% of North American and 52% of European firms are in these same stages of IoT solution deployment.

FIGURE 1

IoT Solution Deployment Momentum Varies By Industry

"Based on the definition of Internet of Things provided below, in the following timeframes, please indicate when you are most likely to implement an Internet-of-Things solution for your organization."

	Consumer products (n = 49)	Manufacturing (n = 202)	Retail (n = 105)	Transportation (n = 117)	Healthcare (n = 38)	Government (n = 36)	Total (n=593)
We plan to implement an Internet-of-Things solution in one to five years	4%	14%	7%	8%	10%	25%	11%
We plan to implement an Internet-of-Things solution in the next 12 months	27%	22%	27%	29%	32%	31%	23%
We are in the process of implementing an Internet-of-Things solution	39%	39%	38%	42%	32%	14%	39%
We already have an Internet-of-Things solution in place	22%	22%	29%	21%	18%	28%	25%

Base: 593 global enterprise Internet-of-Things decision-makers

Source: A commissioned study conducted by Forrester Consulting on behalf of Zebra Technologies, October 2014

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› **IoT solution deployment and plans are evident among industry and government organizations.** Early adopters of IoT solutions are evident, as 18% to 29% of surveyed industry and government organizations already have an IoT solution in place. There is also momentum for continued IoT solution deployment. Between 32% and 39% of industry respondents are in the process of deploying IoT solutions, and another 22% to 32% of these firms plan to deploy IoT solutions in the next year. Government IoT adoption differs, with 28% of these organizations already having an IoT solution in place and about 15% of firms in the process of deploying an IoT solution.

› **Many industries can leverage IoT solutions for asset tracking, security, and surveillance.** Firms address many issues using IoT solutions, including tracking and identifying assets or inventory, providing maintenance or inventory shortage alerts, or highlighting spare parts availability (see Figure 2). These IoT solutions are often combined to enhance an end-to-end process such as fleet tracking, monitoring, and alerting in the transportation industry. Transportation firms can use sensor-enabled IoT solutions to track vehicle location, speed, and fuel usage as well as provide maintenance alerts. Benefits of these transportation-focused asset tracking and monitoring applications include reduced fuel costs, faster maintenance service, reduced insurance rates, and the ability to reroute vehicles in real time. Other common issues addressed through IoT applications include security or surveillance solutions to monitor buildings, office sites, or even workers.

FIGURE 2
Key Issues Addressed By IoT Solutions Vary By Industry

"Which of the following issues, if any, would your organization address by implementing Internet-of-Things solutions?"
(Select all that apply)

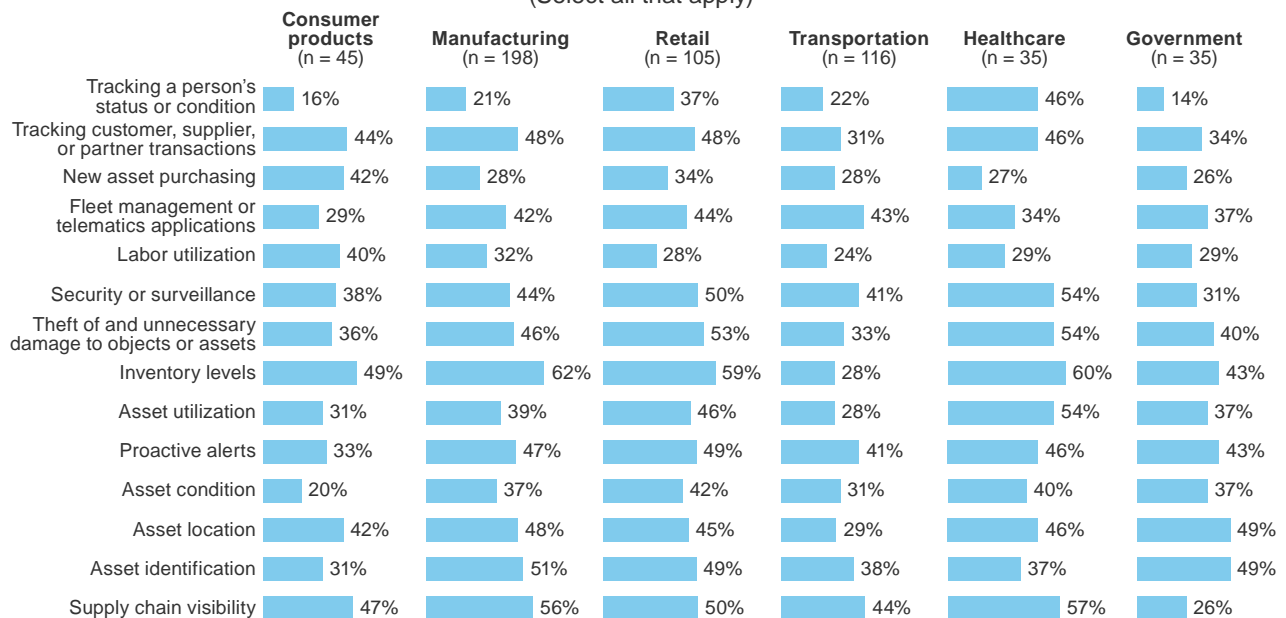|	Consumer products (n = 45)	Manufacturing (n = 198)	Retail (n = 105)	Transportation (n = 116)	Healthcare (n = 35)	Government (n = 35)
Tracking a person's status or condition	16%	21%	37%	22%	46%	14%
Tracking customer, supplier, or partner transactions	44%	48%	48%	31%	46%	34%
New asset purchasing	42%	28%	34%	28%	27%	26%
Fleet management or telematics applications	29%	42%	44%	43%	34%	37%
Labor utilization	40%	32%	28%	24%	29%	29%
Security or surveillance	38%	44%	50%	41%	54%	31%
Theft of and unnecessary damage to objects or assets	36%	46%	53%	33%	54%	40%
Inventory levels	49%	62%	59%	28%	60%	43%
Asset utilization	31%	39%	46%	28%	54%	37%
Proactive alerts	33%	47%	49%	41%	46%	43%
Asset condition	20%	37%	42%	31%	40%	37%
Asset location	42%	48%	45%	29%	46%	49%
Asset identification	31%	51%	49%	38%	37%	49%
Supply chain visibility	47%	56%	50%	44%	57%	26%

Base: 577 global enterprise Internet-of-Things decision-makers

Source: A commissioned study conducted by Forrester Consulting on behalf of Zebra Technologies, October 2014

› W **i-Fi, real-time location tracking, and security sensors are important elements of IoT solutions.** Many different types of technologies are identified as important elements of IoT solutions (see Figure 3). In particular, 83% of firms identified Wi-Fi infrastructure and real-time location tracking technologies as important or very important components to enable IoT solutions. Each type of network technology has associated benefits and challenges. WLAN and ZigBee solutions are suited for supply chain applications, while CDMA and 4G cellular solutions are ideal for real-time fleet

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management and monitoring of mobile assets including shipping containers or railroad cars. Security or condition sensors to monitor assets and the environment were identified as important or very important technology elements by at least 80% of firms. Some of these sensors and computing devices are targeted to the specific needs of a vertical market or application. Why? Often these devices must meet industry- or application-specific requirements focused on temperature, environmental elements, or ruggedized certification.

FIGURE 3

Various Sensors And Network Technologies Are Important To Enabling IoT Solutions

"How important are each of the following technologies in enabling Internet-of-Things solutions in your organization?"

4 ▮ Very important — 5

Technology	4	Very important — 5
Wi-Fi	33%	50%
Real-time location tracking	33%	50%
Security sensors	33%	48%
GPS tracking	38%	42%
Condition sensors	42%	38%
Barcodes	36%	43%
Grid sensors	38%	38%
Passive RFID	41%	34%
Near field communications (NFC)	36%	37%
Telematics	42%	30%
Mobile computing	41%	29%
Bluetooth (e.g., iBeacons)	39%	31%
CDMA/GPRS/4G	40%	30%
Wearables	37%	31%
Mesh networks	43%	25%
ZigBee (802.15)	42%	20%

Base: 577 global enterprise Internet-of-Things decision-makers
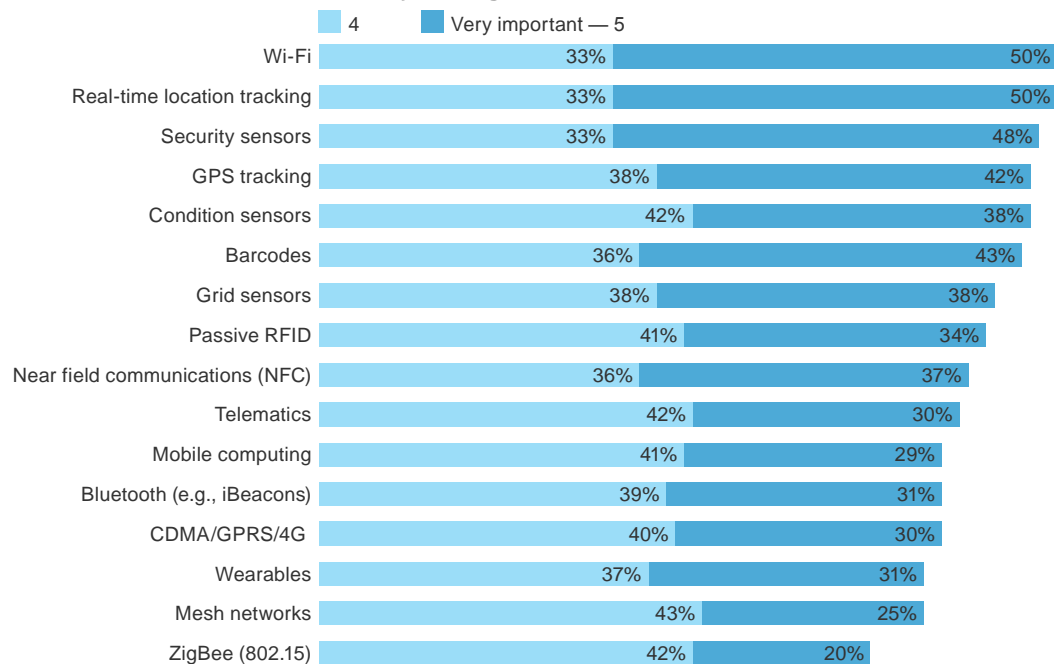
Source: A commissioned study conducted by Forrester Consulting on behalf of Zebra Technologies, October 2014

Firms Are Deploying IoT Applications To Achieve Various Benefits

Many IoT solution functions are focused on identifying, locating, and tracking the status and condition of assets. In fact, between 58% and 77% of surveyed organizations selected locating objects, containers, and personnel as the top fundamental functions of IoT solutions. Survey results show global organizations have implemented or are planning to deploy a wide range of IoT applications that incorporate many different features and functions (see Figure 4). Benefits of IoT include:

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FIGURE 4

Firms Are Deploying Or Planning To Deploy A Wide Variety Of IoT Applications

"What are your firm's plans to adopt the following Internet-of-Things applications ?"
(Select one for each row)

	Planning to implement in the next 12 months	Planning to implement in 1 to 5 years	Implemented, not expanding	Expanding/upgrading implementation
Inventory levels	30%	17%	21%	29%
Asset condition	25%	26%	22%	27%
Fleet management or telematics applications	25%	25%	19%	29%
Security or surveillance	31%	21%	21%	25%
Labor utilization	22%	30%	20%	25%
Asset utilization	26%	25%	24%	21%
Supply chain visibility	32%	22%	18%	26%
Theft of and unnecessary damage to objects or assets	32%	23%	21%	23%
New asset purchasing	25%	28%	21%	22%
Asset location	36%	21%	14%	26%
Asset identification	37%	22%	15%	25%
Proactive alerts	31%	26%	18%	21%
Tracking customer, supplier, or partner transactions	24%	32%	19%	20%
Tracking a person's status or condition	24%	32%	19%	20%

Base: variable global enterprise Internet-of-Things decision-makers

Source: A commissioned study conducted by Forrester Consulting on behalf of Zebra Technologies, October 2014
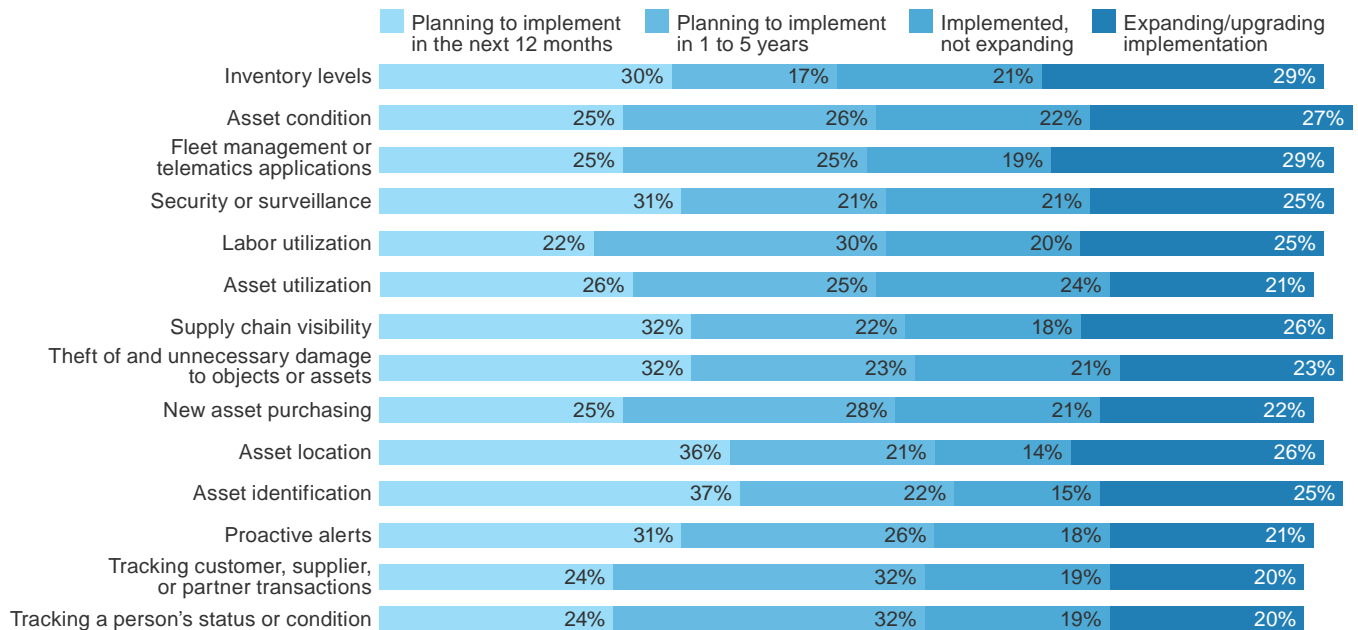
> **Locating, monitoring, and tracking asset condition and utilization are key IoT applications.** Many survey respondents are deploying IoT applications to report the condition, location, and status of assets. These applications enhance asset utilization and reduce plant or factory space requirements. In fact, between 40% and 49% of surveyed firms have implemented or are expanding implementation of IoT applications for asset condition, utilization, location, and identification. For example, in the manufacturing industry, industrial asset monitoring and tracking includes monitoring individual assets to ensure optimal performance and location monitoring. These applications can enhance factory processes such as fabrication, assembly, packaging, supply chain automation, and warehouse monitoring. Manufacturers can also locate equipment, prevent and detect theft, maintain real-time asset inventory, and optimize supply chain processes.

> **Firms are deploying or expanding deployment of IoT applications to enhance operational processes.** Many firms are using IoT applications to transform their daily operations and processes. Some applications, including security and surveillance, are applicable to multiple industry sectors. For example, security and surveillance applications are particularly relevant in manufacturing, retail, and government environments. Survey results show that 46% of firms have implemented, are expanding, or are upgrading implementation of IoT-enabled security or surveillance applications. Momentum for security and surveillance applications is enabled by ubiquitous availability of 3G wireless networks in mature markets, as well as expanding availability of 4G network infrastructure that supports high-bandwidth video often required for security and surveillance solutions.

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› **Organizations can achieve a wide range of business benefits from IoT deployment.** Improved customer experience leads the list of benefits, with 49% of firms identifying this as one of the top five benefits of deploying IoT solutions (see Figure 5). Supply chain optimization, visibility, and loss prevention closely follow and were identified as a top five benefit by between 45% and 46% of firms. By enhancing supply chain processes, firms can improve business process efficiencies, reduce working capital, and locate assets.

FIGURE 5
Improved Customer Experience And Supply Chain Optimization Are Leading IoT Solution Benefits

"Please select the top five categories in which your company can benefit from using the Internet-of-Things."

Improved customer experience	49%
Supply chain optimization and responsiveness	46%
Supply chain visibility	45%
Loss prevention	45%
Cost efficiencies	44%
Improved delivery process	44%
Improved safety	41%
Improved regulatory compliance	38%
Improved forecast accuracy	36%
Risk management	35%
Facilitate collaboration with employees, partners, suppliers, and customers	33%
Data-driven actionable insight	31%
Increased revenues	13%

Base: 581 global enterprise Internet-of-Things decision-makers

Source: A commissioned study conducted by Forrester Consulting on behalf of Zebra Technologies, October 2014

Improved customer experience leads the list of benefits, with 49% of firms identifying this as one of the top five benefits of deploying IoT solutions.

IoT Solution Deployment Requires Firms To Address Various Issues

IoT solutions present new opportunities for firms to transform their strategic, operational, and business activities. However, implementing these solutions is often challenging for firms because:
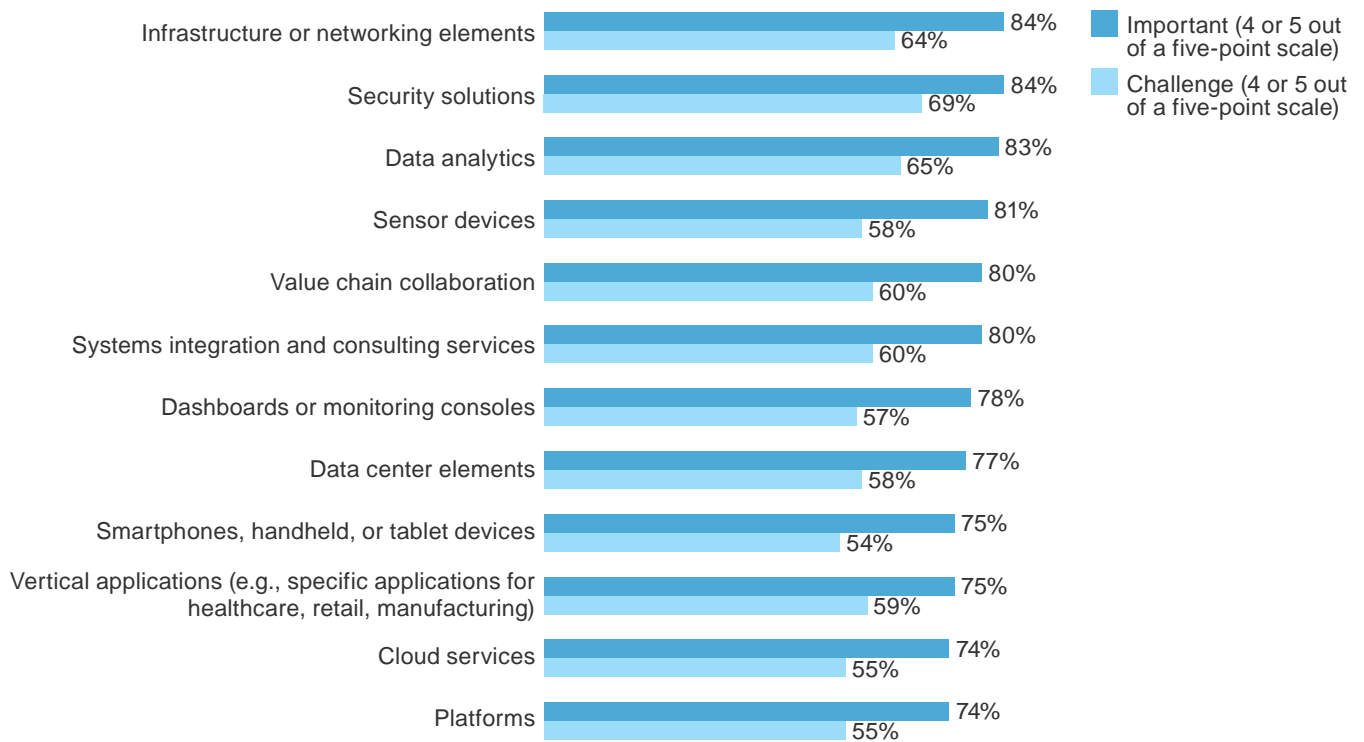
› **IoT solutions require many technical elements.** IoT solutions are often built to support a single type of device and address a specific process or business issue within a particular industry. As with most emerging technologies, there is not a unified interconnection standard to enable seamless integration across IoT devices, applications, and services in all vertical markets. Many different technical elements are important to deploying end-to-end IoT solutions, including network infrastructure, devices, applications, platforms, security solutions, and integration services (see Figure 6). However, between 54% and 69% of surveyed organizations are challenged or very challenged with implementing each of these

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technical elements. Security solutions, data analytics, and infrastructure elements are particularly challenging for between 64% and 69% of firms.

FIGURE 6

Many Firms Are Challenged With Addressing Key Components Of End-To-End IoT Solutions

"Looking at the technical implementation of an Internet-of-Things solution at your organization, how important/challenging is each of the following to implementing Internet-of-Things solutions in your organization?"

Component	Important (4 or 5 out of a five-point scale)	Challenge (4 or 5 out of a five-point scale)
Infrastructure or networking elements	84%	64%
Security solutions	84%	69%
Data analytics	83%	65%
Sensor devices	81%	58%
Value chain collaboration	80%	60%
Systems integration and consulting services	80%	60%
Dashboards or monitoring consoles	78%	57%
Data center elements	77%	58%
Smartphones, handheld, or tablet devices	75%	54%
Vertical applications (e.g., specific applications for healthcare, retail, manufacturing)	75%	59%
Cloud services	74%	55%
Platforms	74%	55%

Base: 577 global enterprise Internet-of-Things decision-makers

Source: A commissioned study conducted by Forrester Consulting on behalf of Zebra Technologies, October 2014
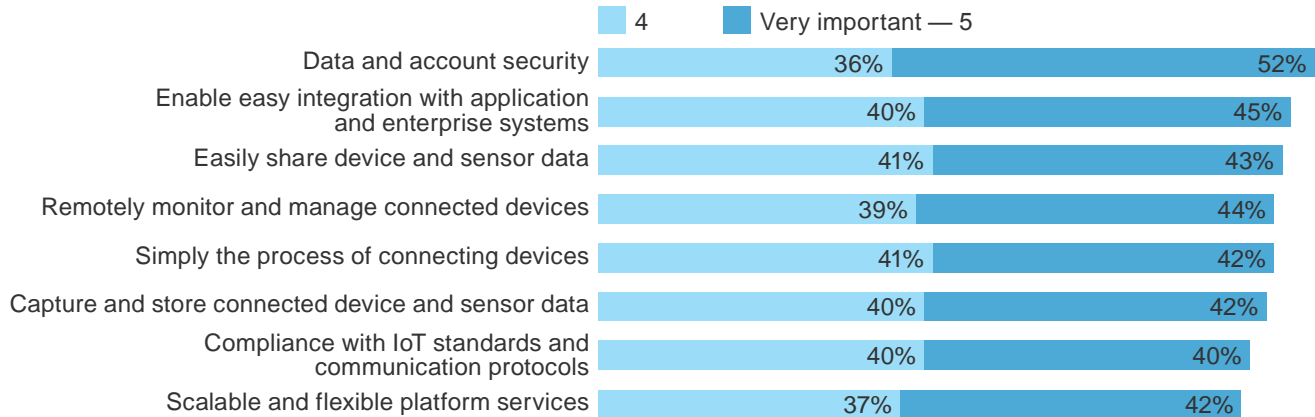

› **IoT platforms drive IoT deployment by helping firms deploy and manage connected devices and applications.** Rapid development, deployment, and monitoring of IoT solutions can be challenging for firms, especially if the solutions span multiple networks and include various types of devices and applications. IoT software platforms help simplify the process of connecting, deploying, and enabling IoT devices, applications, and services. These software platforms include a variety of functions, such as connecting to the fragmented array of wireless and wireline networks, interfacing with APIs to develop IoT applications, and incorporating analytics and monitoring tools (see Figure 7). Our survey results show that survey respondents are interested in many different features. They rated data and account security, easy application integration, and shared device and sensor data as leading IoT platform characteristics.

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FIGURE 7
Many Different Features Are Important Characteristics Of Platform Solutions

"How important are the following characteristics of platforms to enable your firm to deploy Internet-of-Things solutions?"

	4	Very important — 5

Characteristic	4	Very important — 5
Data and account security	36%	52%
Enable easy integration with application and enterprise systems	40%	45%
Easily share device and sensor data	41%	43%
Remotely monitor and manage connected devices	39%	44%
Simply the process of connecting devices	41%	42%
Capture and store connected device and sensor data	40%	42%
Compliance with IoT standards and communication protocols	40%	40%
Scalable and flexible platform services	37%	42%

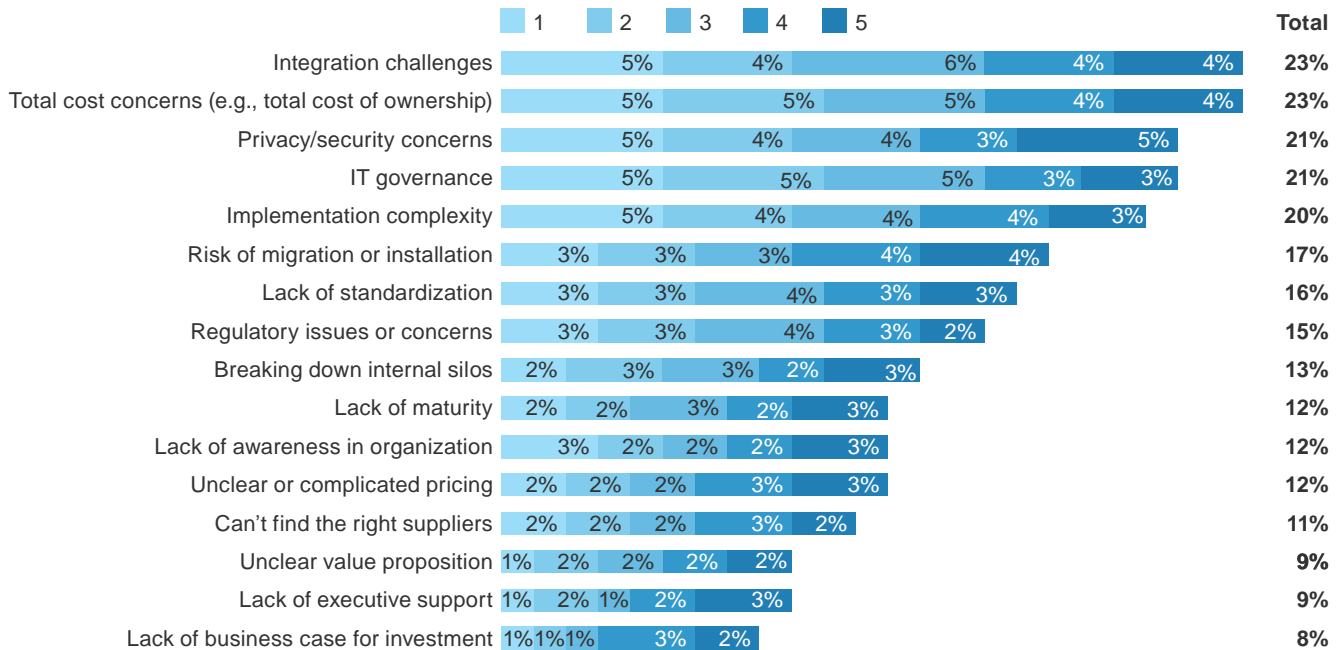Base: variable global enterprise Internet-of-Things decision-makers

Source: A commissioned study conducted by Forrester Consulting on behalf of Zebra Technologies, October 2014

› **Internal stakeholders are often concerned with integration, cost, and security.** The cost and complexity of integrating the fragmented array of devices, networks, and applications in IoT solutions is one of the top five challenges for 23% of firms (see Figure 8). Some decision-makers believe IoT solutions are one-off solutions requiring expensive customization, leading to concerns regarding cost overruns, scope creep, and implementation delays. Privacy and security concerns are one of the top five challenges for internal stakeholders in 21% of firms. Securing hundreds of thousands or even millions of connected devices is significantly different from completing these processes for hundreds or thousands of smartphones and tablets, for which there are far more established tools and processes.

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FIGURE 8

Various Challenges Must Be Addressed To Drive IoT Deployment With Internal Stakeholders

"Thinking of the overall Internet-of-Things solution, please rank the hurdles/challenges to overcome with internal stakeholders for adoption in your organization."

	1	2	3	4	5	Total
Integration challenges	5%	4%	6%	4%	4%	**23%**
Total cost concerns (e.g., total cost of ownership)	5%	5%	5%	4%	4%	**23%**
Privacy/security concerns	5%	4%	4%	3%	5%	**21%**
IT governance	5%	5%	5%	3%	3%	**21%**
Implementation complexity	5%	4%	4%	4%	3%	**20%**
Risk of migration or installation	3%	3%	3%	4%	4%	**17%**
Lack of standardization	3%	3%	4%	3%	3%	**16%**
Regulatory issues or concerns	3%	3%	4%	3%	2%	**15%**
Breaking down internal silos	2%	3%	3%	2%	3%	**13%**
Lack of maturity	2%	2%	3%	2%	3%	**12%**
Lack of awareness in organization	3%	2%	2%	2%	3%	**12%**
Unclear or complicated pricing	2%	2%	2%	3%	3%	**12%**
Can't find the right suppliers	2%	2%	2%	3%	2%	**11%**
Unclear value proposition	1%	2%	2%	2%	2%	**9%**
Lack of executive support	1%	2%	1%	2%	3%	**9%**
Lack of business case for investment	1%	1%	1%	3%	2%	**8%**

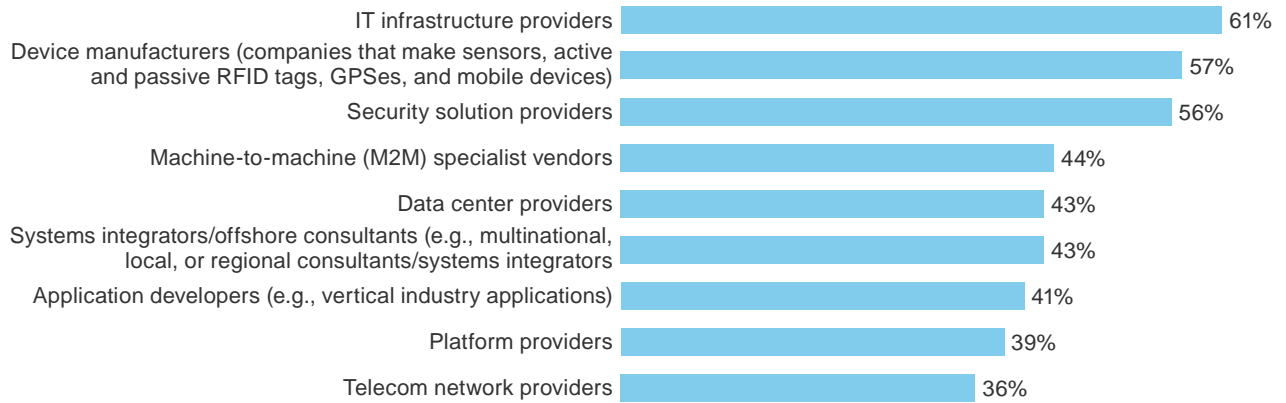Base: variable global enterprise Internet-of-Things decision-makers

Source: A commissioned study conducted by Forrester Consulting on behalf of Zebra Technologies, October 2014\

› **Many firms turn to device manufacturers to assist with IoT solution implementation.** To address these challenges, firms seek assistance from partners, particularly device manufacturers, that have the technical expertise and industry knowledge to help firms achieve benefits from IoT solutions. Survey respondents often seek assistance from vendor and service provider partners to implement IoT solutions. More specifically, 57% of surveyed global organizations identified device manufacturers that make sensors, RFID tags and mobile devices as partners to help them achieve their IoT solution initiatives (see Figure 9). There is emerging interest in seeking IoT solution assistance from platform providers, with 39% of firms turning to platform providers for assistance. Security expertise, reliable solutions, and technical expertise are key partner characteristics.

To address these challenges, firms seek assistance from partners, particularly device manufacturers, that have the technical expertise and industry knowledge to help firms achieve benefits from IoT solutions.

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FIGURE 9
Firms Seek IoT Deployment Assistance From Third-Party Partners

"When thinking about the realization of Internet-of-Things solutions, which of the following partners, if any, would be helpful to your organization?"
(Select all that apply)

Partner	Percentage
IT infrastructure providers	61%
Device manufacturers (companies that make sensors, active and passive RFID tags, GPSes, and mobile devices)	57%
Security solution providers	56%
Machine-to-machine (M2M) specialist vendors	44%
Data center providers	43%
Systems integrators/offshore consultants (e.g., multinational, local, or regional consultants/systems integrators	43%
Application developers (e.g., vertical industry applications)	41%
Platform providers	39%
Telecom network providers	36%

Base: 577 global enterprise Internet-of-Things decision-makers

Source: A commissioned study conducted by Forrester Consulting on behalf of Zebra Technologies, October 2014

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Key Recommendations

Results from our study of global organizations show that Internet-of-Things solutions are being deployed by organizations in many vertical markets and among government organizations. These IoT solutions enable organizations to use smart interconnected devices to get more visibility into the identification, location, and condition of products, assets, transactions, or people to drive more effective and timely business decisions or improve customer interactions. These IoT solutions enhance customer interactions, improve efficiencies, and transform business processes. Successful implementation of IoT solutions requires decision-makers to:

› **Evaluate the opportunities, risks, and benefits of deploying Internet-of-Things applications and solutions.** Business and IT decision-makers should establish a cross-functional team to identify, evaluate, and prioritize the most relevant IoT applications and solutions to their organization. This evaluation process must take into account the unique value proposition, regulatory environment, and competitive landscape facing the organization.

› **Identify key technology components necessary for IoT solution deployment success.** End-to-end solution implementation requires many technical elements, including sensors, devices, network infrastructure, security solutions, applications, and analytics services. It is unlikely that a single vendor can supply all of the elements necessary to deploy a seamless IoT solution. Savvy IoT decision-makers will invest time and resources to determine which elements are required to develop effective solutions and applications. It is also important to assess the organization's ability to implement each technical element and evaluate which areas require third-party vendor assistance.

› **Evaluate IoT solution partners.** IoT innovation teams should develop a list of network infrastructure providers, device manufacturers, platform providers, and other types of vendors that can assist them with IoT solution deployment. Network infrastructure, sensor devices, and tracking and visibility technologies are identified as particularly important components of IoT solutions. The vendor assessment process will enable decision-makers to identify vendors with the necessary characteristics and attributes to assist with their IoT solution implementation goals.

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Appendix A: Methodology

In this study, Forrester conducted an online survey of 593 organizations in 16 countries (Canada, Mexico, the US, France, Germany, Italy, Poland, Spain, the UK, Argentina, Brazil, Australia/New Zealand, China, India, Singapore, and South Korea) to evaluate the evolution of business adoption of the Internet of Things. Survey participants included decision-makers in IT responsible for making or influencing decisions related to their firm's IoT solutions. Questions provided to the participants asked about benefits, financial impact, and challenges of connecting physical to digital. Respondents were offered incentives as a thank you for time spent on the survey. The study began in September 2014 and was completed in October 2014.

Appendix B: Endnotes

[1] Source: "Mapping The Connected World," Forrester Research, Inc., October 31, 2013.

[2] A commissioned study conducted by Forrester Consulting on behalf of Zebra, October 2012.

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