A Forrester Consulting Thought Leadership Paper Commissioned By Zebra Technologies

Building Value from Visibility

2012 Enterprise Internet of Things Adoption Outlook

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FORRESTER®

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Table Of Contents

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Executive Summary

The term "Internet of Things" (IoT) was first used nearly 15 years ago. While there's been no single standard definition of IoT solutions since the possibilities of Internet of Things was first discussed, a variety of technologies are used in implementation (e.g., RFID tags, barcodes, and GPS technologies). These technologies are used to monitor and transfer the status of physical assets to remediate business problems like supply chain inefficiencies in industries such as manufacturing, healthcare, transportation, and retail, as well as to inspire innovation in organizations. For example, information embedded in RFID-tagged containers is collected by readers along the supply chain at the supplier's shipping department, throughout the transportation process, and during storage, collection, and installation along the assembly line. The availability of accurate, current data about supply chain events enables firms to deliver superior customer service while reducing inventory held as a buffer against uncertainty. Other IoT applications include food traceability, patient monitoring, and medical device and medicine tracking. A variety of forces are aligning to drive increased enterprise demand for IoT solutions, including declining device costs, widely deployed wireline and wireless IP networks, and regulatory mandates.

In the first half of 2012, Zebra Technologies commissioned Forrester Consulting to conduct a research study to understand: 1) how well the term "Internet of Things" resonates with global enterprises; 2) what timelines corporations have for implementing IoT applications and solutions; 3) the benefits and challenges associated with IoT solution deployment; 4) and which third-party partners companies seek assistance from as they deploy IoT solutions. The study methodology included an online survey of 646 global enterprise IT decision-makers in specific industries including manufacturing; healthcare; oil, gas, and petroleum; retail and hospitality; transportation and logistics; and government. These decision-makers participated in or were aware of their corporate initiatives related to IoT solutions and applications.

Key results from this online study include:

- **Enterprise decision-makers have a positive perception of IoT solutions.** 64% of survey respondents were familiar with the term "Internet of Things." More than 70% of the respondents who were familiar with the term have a positive perception of it. In addition, 85% of the respondents who were familiar with the term strongly or completely agree with the following definition of "Internet of Things solutions" we provided:

  "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."

- **Barcodes and RFID devices are valuable components of IoT solution implementations.** Firms consider many different devices valuable to implementing IoT solutions. Specifically, 72% of enterprises state that barcodes are valuable to enable IoT solutions; 71% say the same thing about real-time location tracking technologies like active RFID and 58% of firms consider passive RFID devices as valuable IoT solution technologies.

- **Many firms are planning to deploy IoT solutions and applications in the future.** Companies are in the early stages of deploying IoT solutions, as only 15% of surveyed enterprises already have an IoT solution in place. However, future momentum for these solutions appears strong: 53% of surveyed enterprises are planning to implement IoT solutions within the next 24 months.

- **Supply chain visibility and asset-tracking applications are a key focus for many firms.** Supply chain visibility, asset location, and transaction tracking are key applications. Supply chain visibility applications help reduce working capital, improve fixed asset utilization, and improve customer service. Asset-tracking applications are used to reduce the time to locate assets, improve asset utilization, throughput, and customer service.
- **Many enterprises seek IoT solution implementation assistance from device manufacturers.** Firms that design and create enabling technologies such as sensors, RFID tags, and GPS devices are important partners that enterprises turn to for IoT solution implementations. In fact, 66% of surveyed organizations turn to device manufacturers for help with implementing IoT solutions.

Enterprises Have A Positive Perception Of Internet Of Things Solutions

The term "Internet of Things" is not new — it's been in existence for years. But recently, corporations have increased their focus on deploying IoT solutions due to declining device costs, widely deployed IP networks, regulatory mandates, together with an intense focus on operational efficiency to drive productivity. Today's IoT solutions use various technologies to monitor and transfer the status of physical assets to improve business problems like supply chain efficiencies, often in very specific ways, in industries such as manufacturing, energy and utilities, healthcare, and transportation. However, future opportunities to deploy IoT solutions extend to helping companies monitor, operate, and manage physical systems such as electrical grids, transportation systems, factories, and buildings more efficiently, analyze their performance, and modify these systems to be more efficient in a resource-constrained world.

Many vendors and service providers are evolving their products and solutions to address emerging IoT opportunities and capture a share of this emerging market. Various technical components are necessary to implement IoT solutions, including: 1) fixed or wireless network infrastructure to connect devices and sensors to a central server and transmit information about the objects; 2) sensors, RFID endpoint devices, and external hardware to collect data and monitor status; 3) software and middleware applications and services to address the specific needs of vertical markets (e.g., supply chain management in manufacturing and logistics management in the transportation industry) and; 4) systems integration, engineering, and professional services organizations to seamlessly integrate disparate IoT solution components. The data and status information captured from these IoT solutions enables businesses to improve their decision-making processes and improve operational processes through real-time analytics (see Figure 1).

Figure 1
Implementing Internet Of Things Solutions Requires Various Technology Components

Component	Description
Services	Systems integrators and services organizations provide integration and solution implementation services for IoT projects.
Software	Middleware and application infrastructure vendors provide information for analytical engines regarding IoT endpoints and enable vertical market solutions.
Hardware	GPS chips, RFID sensors, actuators, and embedded and external hardware devices capture location and status information.
Network	Network access, satellite, and transport infrastructure vendors provide the network connectivity that underlies IoT solutions.
Analytics solutions	Business intelligence and analytical software solutions such as data mining and predictive analytics, video image analysis, pattern recognition, and artificial intelligence algorithms determine whether to act on or ignore a pattern.

Source: Forrester Research, Inc.

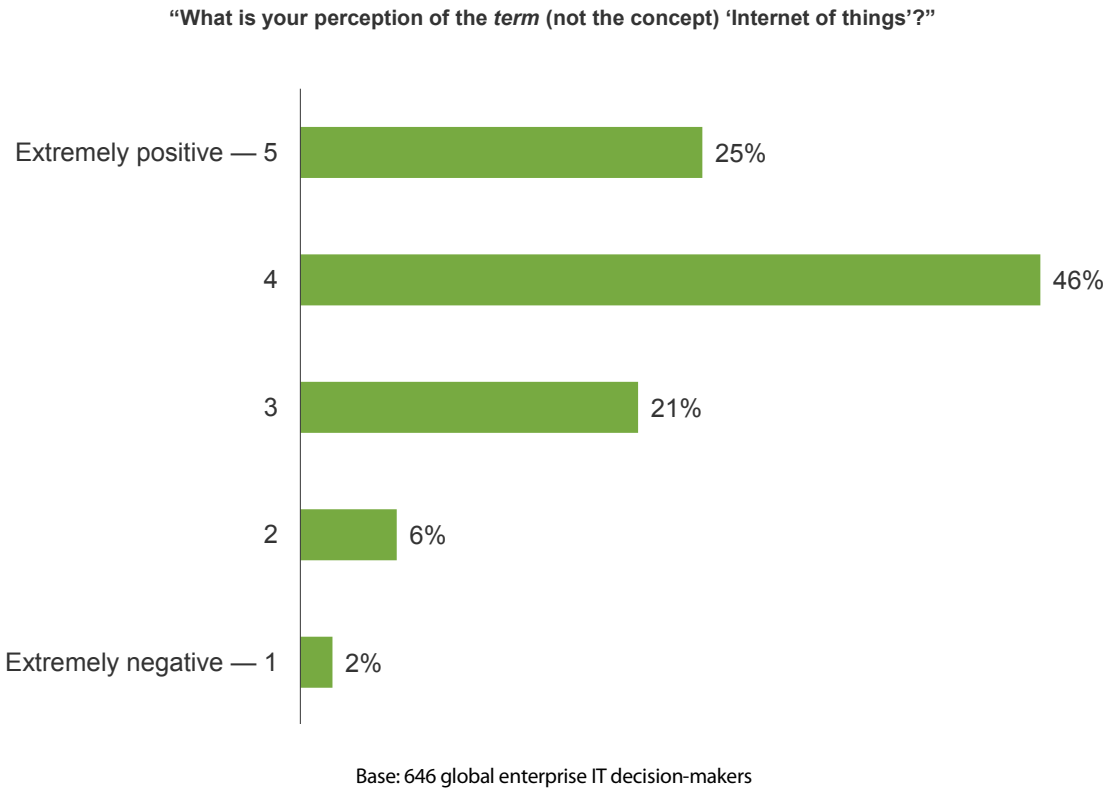
To better understand corporate demand for "Internet of Things" solutions, Zebra Technologies commissioned a global study of 646 enterprises to identify corporate perceptions of this term, implementation timelines for IoT solutions and applications implementation, and the benefits of IoT solutions. This survey showed that many enterprises have a positive perception of IoT solutions.

- **Global enterprises respond positively to IoT terminology and definition.** Overall, 71% of surveyed enterprises have an extremely positive or positive perception of the term "Internet of Things" (see Figure 2). The perception of this term is even stronger in Asia Pacific, with 96% of surveyed enterprises in this region having a positive or extremely positive perception of the term. It is important to recognize that there is no standard definition of "Internet of Things;" however, 85% of survey respondents strongly or completely agree with the following definition of IoT:

"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."

- **RFID tags and barcodes are key technologies to enable IoT solutions.** A wide variety of devices enable IoT solutions; each type of device provides unique value to these IoT solutions in specific vertical industries (see Figure 3). More than 70% of surveyed enterprise decision-makers identified barcodes or active RFID tags as important or very important devices for enabling IoT solutions, while 58% of respondents included passive RFID tags in this category. Other technologies identified as important or very important to bringing value include GPS tracking, Wi-Fi devices, and security sensors.

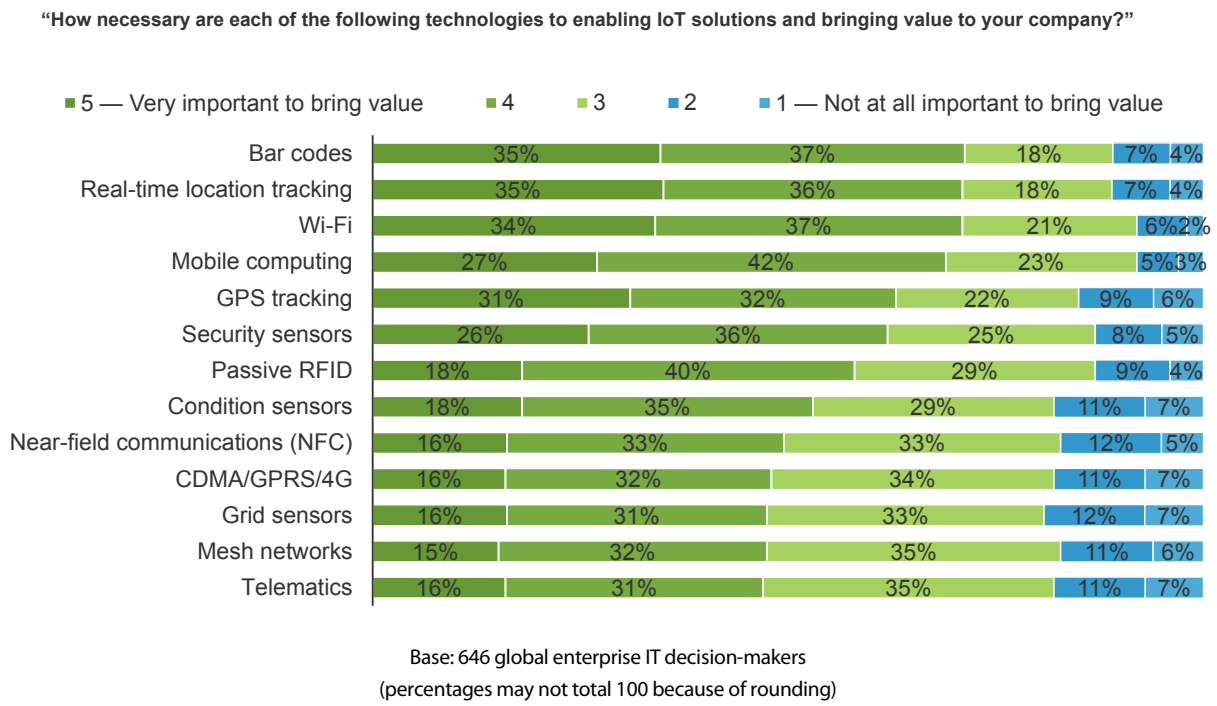
Figure 2
Most Enterprises Have A Positive Perception Of The Definition Of "Internet Of Things"



Base: 646 global enterprise IT decision-makers

Source: A commissioned study conducted by Forrester Consulting on behalf of Zebra Technologies, June 2012

Figure 3
A Wide Variety Of Technologies And Devices Enable Internet Of Things Solutions



Base: 646 global enterprise IT decision-makers
(percentages may not total 100 because of rounding)

Source: A commissioned study conducted by Forrester Consulting on behalf of Zebra Technologies, June 2012

Many Firms Plan To Deploy Internet Of Things Solutions In The Future

Our survey respondents are generally in the early stages of deploying IoT solutions today, but there is clearly a wave of implementation planned within the next 48 months. According to the survey results, 15% of enterprises already have a solution in place, but an overwhelming majority expects to deploy a wide range of IoT solutions in the near future.

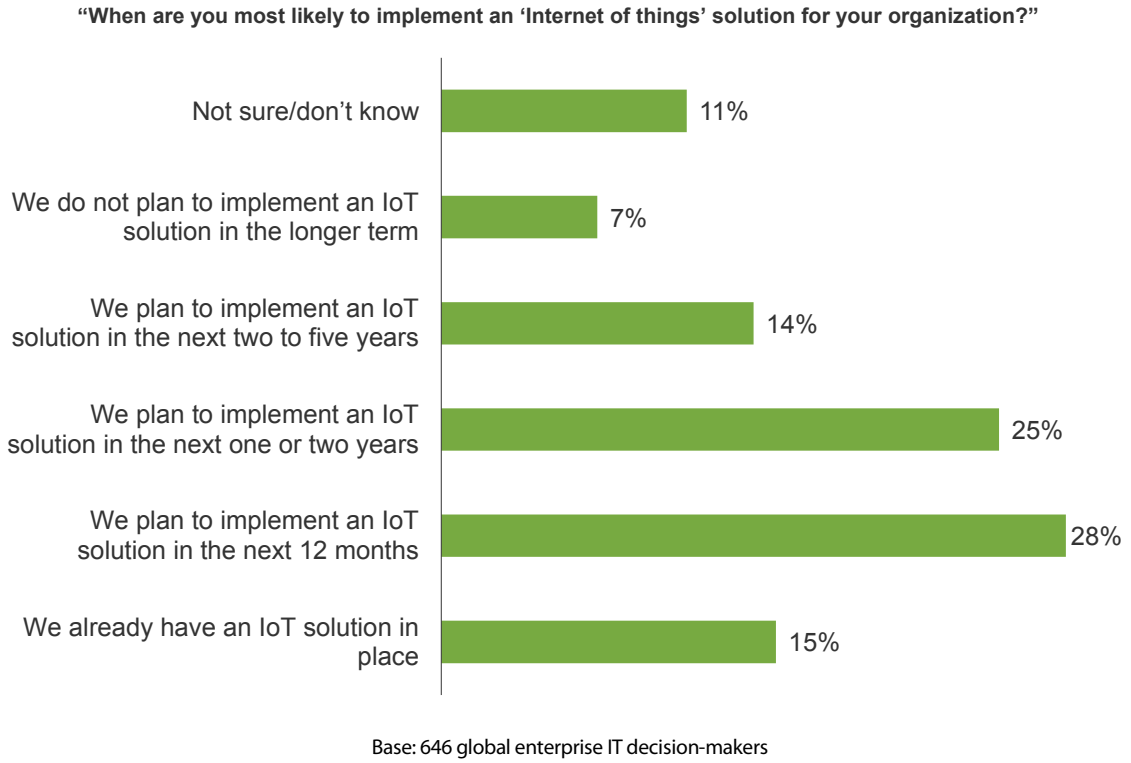
- **The majority of firms plan to deploy IoT solutions in the future.** Enterprises are currently in the early stages of deploying IoT solutions: Just 15% of companies have already implemented such solutions (see Figure 4). The urgent intention to exploit IoT is demonstrated by the fact that more than half (53%) of surveyed firms plan to implement IoT solutions within the next 24 months. An additional 14% of firms plan to implement IoT solutions in the next two to five years. Enterprises in some regions have more aggressive timelines for IoT solution implementation: 69% of surveyed firms in Asia Pacific and 60% of firms in Latin America plan to implement IoT solutions within the next 24 months.

- **IoT solutions address supply chain, transaction tracking and asset location issues.** Enterprises seek to address a variety of issues by implementing IoT solutions (see Figure 5). Between 50% and 56% of surveyed enterprises stated that IoT solutions would help their organization address supply chain visibility, transaction tracking, and

asset location issues. Other issues that 44% to 48% of surveyed enterprises can address with IoT solutions include identifying assets, reducing inventory levels, and minimizing theft of and damage to objects or assets.

- **IoT solutions enable value chain transformation.** For years, firms have deployed tracking technologies to monitor a pool of reusable assets, such as temperature-controlled containers, in order to maintain high levels of customer service and material availability with minimal working capital. But a new generation of solutions monitoring customer and supplier transactions and proactive alerts about demand and inventory levels is enabling more effective deployment of assets and inventory. Smart IoT solutions share asset information, enabling complex multi-partner supply chains to reliably and economically satisfy customer requirements. Traditionally, firms hold inventory and spare logistics capacity as a buffer against supply chain mishaps like goods delayed in customs or containers dispatched to the wrong destination. IoT solutions offer greater visibility onto the shipment pipeline and the opportunity to release excess safety stock or logistics capacity previously available just in case one link in the chain should fail.
- **IoT solutions enable better use of fixed assets.** While sensors have helped with security and loss prevention for years, our current survey responses showed an increased interest in IoT solutions to ensure high utilization of valuable plant and equipment using devices to report the location and condition of equipment and people, ensuring high asset utilization and reducing the need to lease or acquire more plant.

Figure 4
Many Firms Plan To Deploy Internet Of Things Solutions In The Future



Base: 646 global enterprise IT decision-makers

Source: A commissioned study conducted by Forrester Consulting on behalf of Zebra Technologies, June 2012

Figure 5
Internet Of Things Solutions Address A Variety Of Supply Chain Visibility, Asset Tracking And Location Issues

Source: A commissioned study conducted by Forrester Consulting on behalf of Zebra Technologies, June 2012

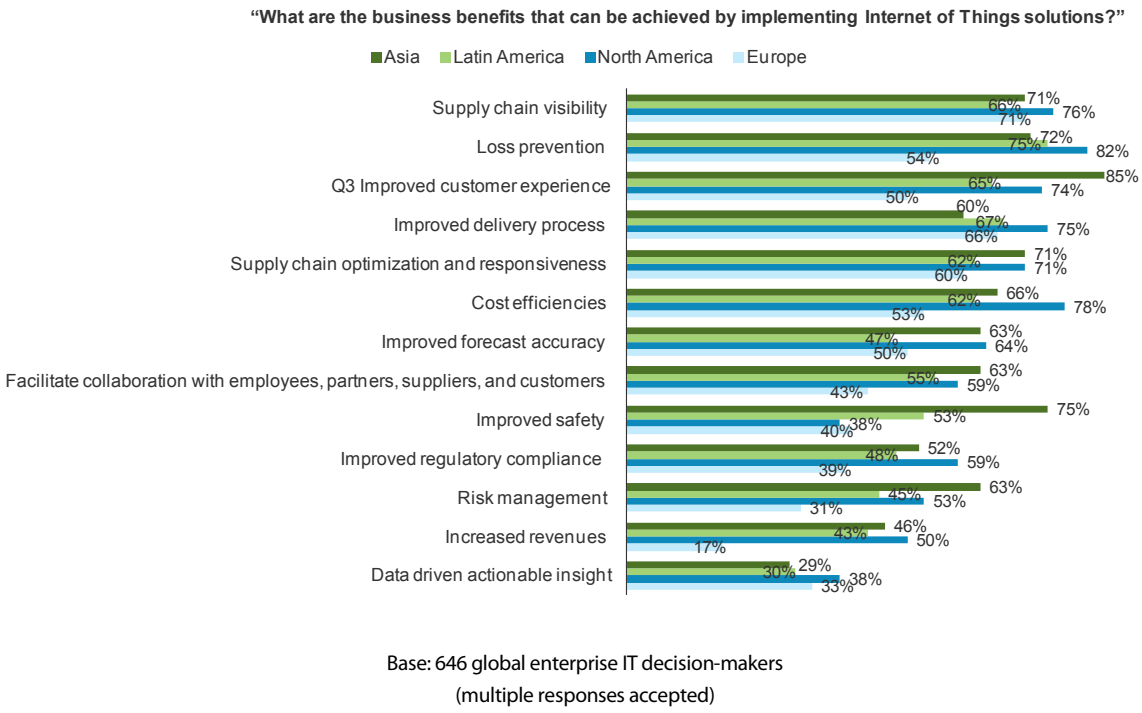
Enterprises Achieve Many Benefits From Internet Of Things Solutions

Firms seek to achieve many different types of benefits by deploying IoT solutions. These benefits can broadly apply to companies in many different vertical industries, such as increasing revenues or improving customer experience. Other benefits are tied to specific industry solutions, such as supply chain visibility (see Figure 6).

- **IoT solutions enable firms to achieve many overall benefits.** Firms expect to achieve a wide variety of benefits from deploying IoT solutions. Overall, at least 70% of enterprises identify supply chain visibility and loss prevention as key benefits achieved from implementing an IoT solution. Providing visibility into supply chain events and processes enables enterprises to make smarter business decisions, improves customer service, reduces operating costs, and releases working capital by reducing investment in safety stock. There are also geographic differences in the benefits of implementing IoT solutions. Top benefits for surveyed North American enterprises include loss prevention, cost efficiencies, and supply chain visibility. In comparison, the top benefits identified by Asia Pacific enterprises include improved customer service, improved safety, and supply chain efficiencies.

- **Supply chain application benefits include increasing visibility into supply chain processes, improving business process efficiencies, reducing working capital, and locating assets.** Our survey data shows that while firms have high expectations of supply chain visibility, they see the benefits more in terms of customer experience and delivery accuracy than in terms simply of cost efficiencies. This reflects the reality of driving complex multipartner global value chains to deliver predictable and high-quality experiences for customers.

Figure 6
The Benefits Achieved From Implementing Internet Of Things Solutions Vary By Geography



Base: 646 global enterprise IT decision-makers
(multiple responses accepted)

Source: A commissioned study conducted by Forrester Consulting on behalf of Zebra Technologies, June 2012

Enterprises Seek Partners To Assist With IoT Solution Implementation

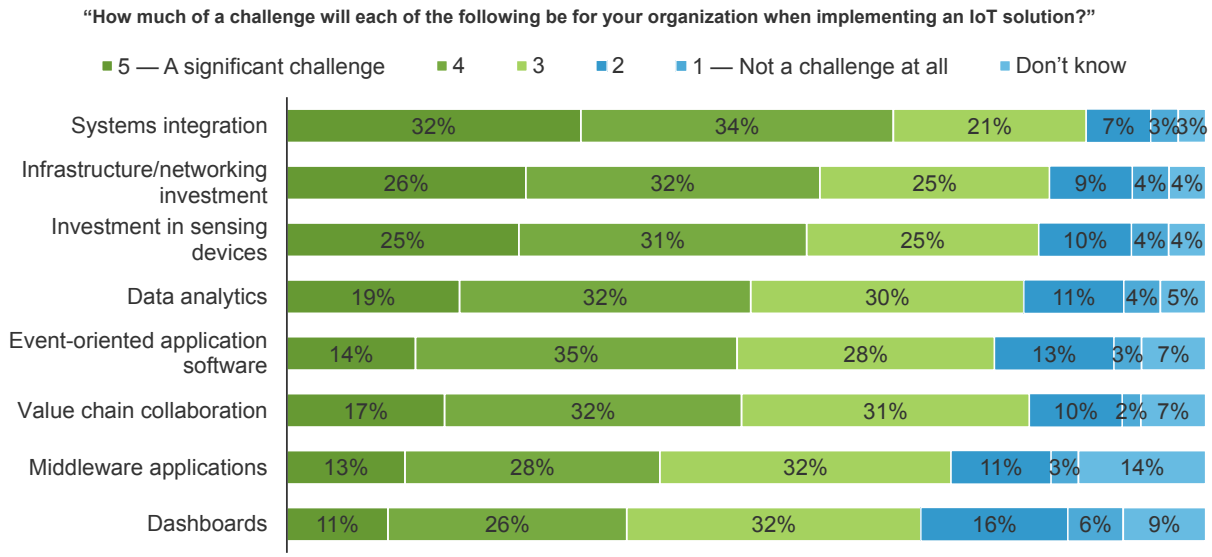
Enterprises face a variety of challenges as they pursue deployment of IoT solutions, including complex implementation, cost, and integration challenges (see Figure 7). To address these challenges, firms seek assistance from partners, particularly device manufacturers, who have the technical expertise and industry knowledge to help firms achieve benefits from these IoT solutions.

- **Enterprises are concerned with IoT solution implementation complexity and total costs.** Between 50% and 52% of surveyed enterprises believe that implementing IoT solutions is complex and expensive. The primary decision-makers driving solution deployment are often the CTO, the CIO, and IT decision-makers who are

responsible for business case justification and solution implementation. Many of these decision-makers are under the impression that IoT solutions are difficult to implement and expensive. In addition, many of these solutions are unique, one-off solutions requiring a high level of customization, which is expensive, difficult to scale, and leads to concerns regarding cost overruns, scope creep, and implementation delays.

- **Many firms turn to device manufacturers to assist with IoT solution implementation.** Survey respondents look for assistance from vendor and service provider partners to implement and achieve benefits from IoT solutions. More specifically, 66% of surveyed enterprises identify device manufacturers as the partners to help them realize the benefits of implementing IoT solutions in specific vertical markets like retail, healthcare, and manufacturing. Important characteristics of IoT solution partners include technical expertise, industry-specific knowledge, and customer service and help desk expertise (see Figure 8). For example, it is difficult to imagine speaking about implementing a solution in healthcare without considering how HIPAA regulations affect solution requirements.

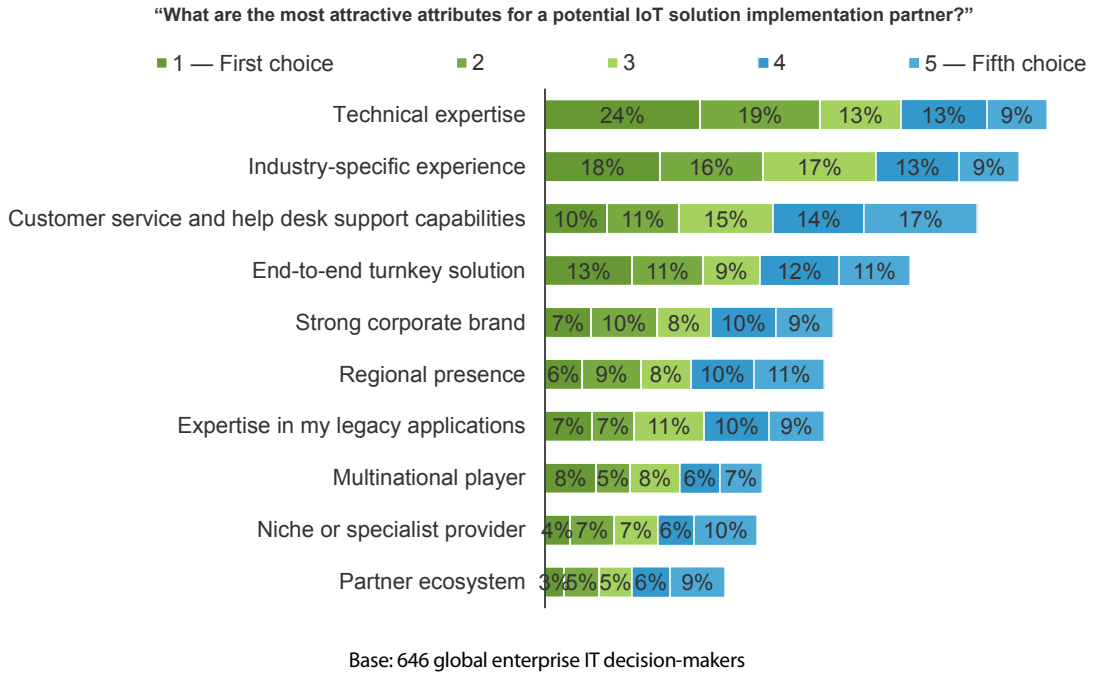
Figure 7
Enterprises Identify Various Challenges To Implementing Internet Of Things Solutions



Base: 646 global enterprise IT decision-makers
(percentages may not total 100 because of rounding)

Source: A commissioned study conducted by Forrester Consulting on behalf of Zebra Technologies, June 2012

Figure 8
Technical Expertise And Industry Knowledge Are Important IoT Partner Attributes



Base: 646 global enterprise IT decision-makers

Source: A commissioned study conducted by Forrester Consulting on behalf of Zebra Technologies, June 2012

KEY RECOMMENDATIONS

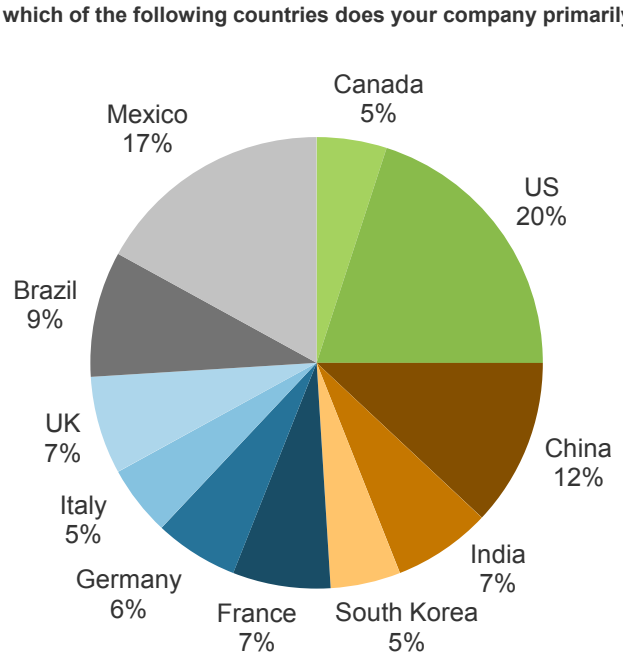
Finance, risk, sales, and supply chain executives share a common interest in capitalizing on the opportunities offered by new value chains. They share a common interest in responding to the threat of digital disruption in their industries. To harness "Internet of Things" capabilities to mitigate threats and capitalize on opportunities, they need to:

- **Prioritize the opportunities and risks.** Leaders should develop a forum for listing and evaluating the risk and opportunity scenarios that are most relevant to their firm's value proposition and competitors.
- **Develop conceptual solutions that mitigate threats and capitalize on opportunities.** For each high-priority scenario, leaders should develop a conceptual solution that describes their vision of a technology-agnostic or idealized capability to meet the requirement.
- **Identify solution components.** It is highly unlikely that a single technology or a single vendor can supply all of the elements that an IoT solution might require, such as sensors or edge devices, integration with legacy applications and processes, analytics, alerts, and business process escalation. Savvy IoT leaders will invest some effort in determining which elements are required to develop effective solutions for the prioritized scenarios.
- **Evaluate solution partners.** Finally, ambitious IoT innovation teams should draw up a list of third-party vendors and systems integrators to help them achieve their IoT solutions. Many surveyed enterprises identify device manufacturers and firms that design and create enabling technologies as key partners they look to for help in realizing the benefits of implementing IoT solutions. This trend opens new doors to companies supplying enabling technologies and solutions that have the opportunity to expand their services to address these emerging IoT requirements.

Appendix A: Methodology

During the first half of 2012, Forrester Consulting conducted primary research through online surveys of IT executives who worked at 646 global enterprises in specific industries including: manufacturing, healthcare, oil/gas/petroleum, retail and hospitality, transportation and logistics, and government. These decision-makers participated in or were aware of their corporate initiatives and plans related to implementing "Internet of Things" solutions and applications. Key questions included in the survey focused on understanding: 1) how well the term "Internet of Things" resonates with global enterprises; 2) what the corporate timelines for implementing IoT applications and solutions are; 3) what benefits and challenges are associated with deploying IoT solutions; 4) which third-party partners companies seek assistance from as they deploy IoT solutions. A profile of the geographic regions, industry vertical markets, and survey respondent decision-makers are included below.

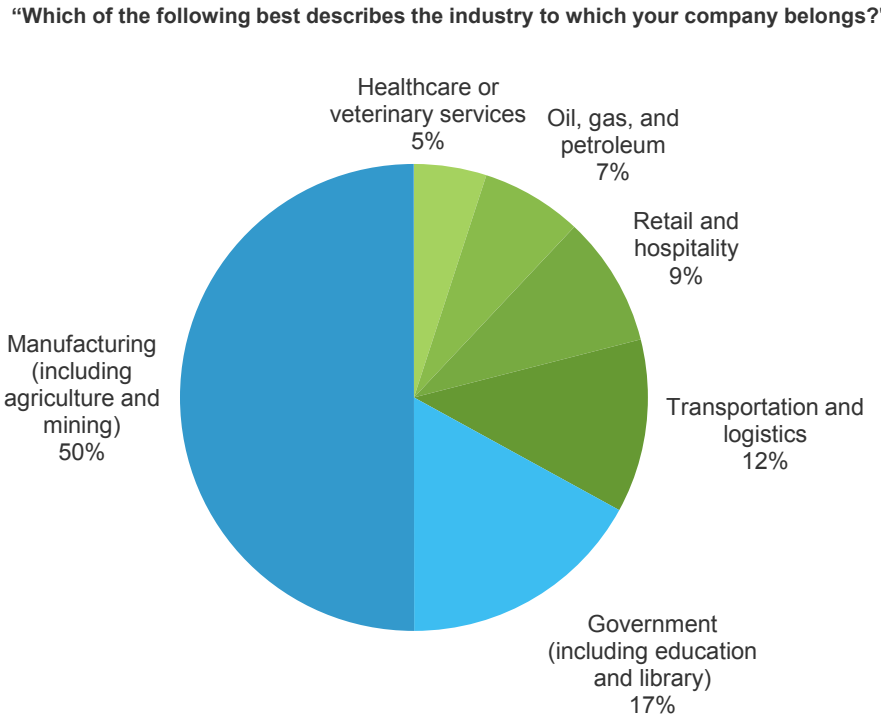
Figure 9
Geographic Distribution Of Survey Respondents



Base: 646 global IT decision-makers

Source: A commissioned study conducted by Forrester Consulting on behalf of Zebra Technologies, June 2012

Figure 10
Vertical Industry Distribution Of Survey Respondents

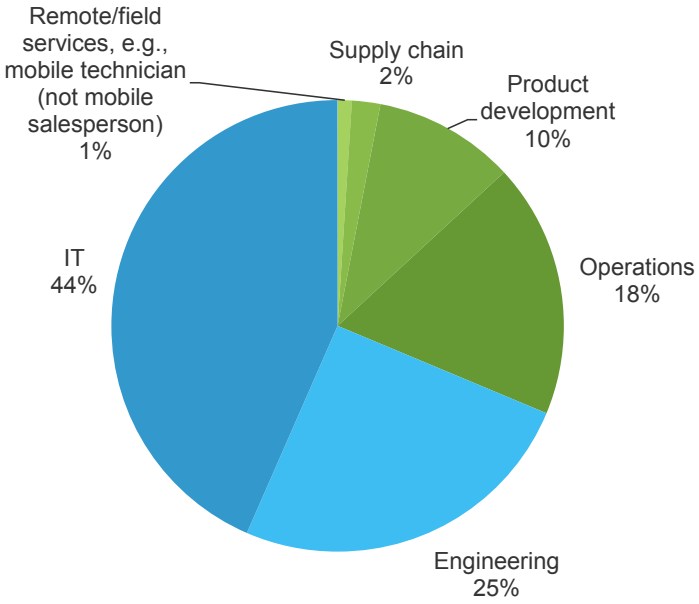


Base: 646 global IT decision-makers

Source: A commissioned study conducted by Forrester Consulting on behalf of Zebra Technologies, June 2012

Figure 11
Departments In Which Respondents Work Within Their Organizations

"Which of the following best describes the position you currently hold or the department in which you currently work?"

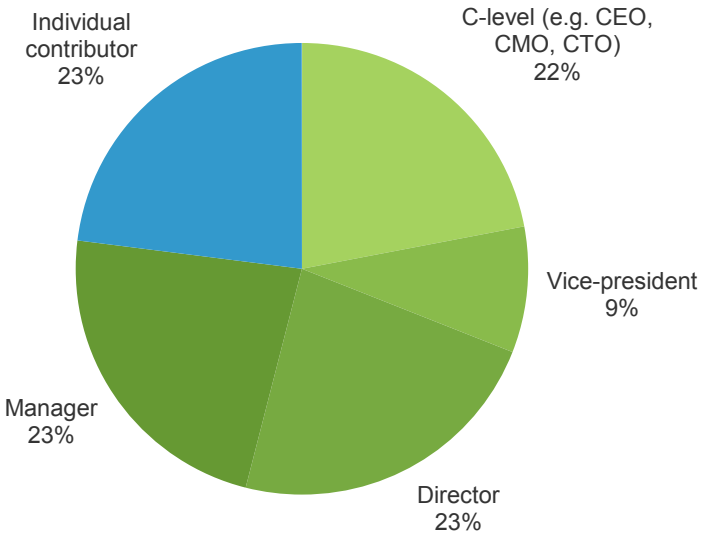


Base: 646 global IT decision-makers

Source: A commissioned study conducted by Forrester Consulting on behalf of Zebra Technologies, June 2012

Figure 12
Survey Respondents' Roles Within Their Organizations

"Which of the following best describes the level of your current position within your organization?"



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