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Leverage the IoT to Enhance Operational Efficiencies

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Internet-Of-Things Heat Map 2018

IOT - THE NEXT BIG THING IN MANUFACTURING AND CONNECTED PRODUCTS

The Internet of Things (IoT) is changing how manufacturing operations are running on a global scale industry wide. Manufacturers need to utilize IoT data to “speak” to machines and plants to keep operations running smoothly. Connecting to the IoT and collecting data for analysis enables manufacturers to predict when maintenance will be needed and avoid unplanned downtime and extra costs. IoT data can also be analyzed on the Edge in real time for quicker resolution of issues before a major impact to operations occurs. Many operators have begun to implement digitalization strategies into their long term plans and an IoT strategy must be at the forefront of the plan to remain competitive, increase revenue and improve customer satisfaction. While many industries stand to gain from leveraging the IoT, primary manufacturing, high-tech production, industrial production, and retail and transportation have already achieved substantial value from IoT.

LEVERAGE AN OPEN PLATFORM AS A SERVICE TO IMPROVE OPERATIONS

The solution for these industries is to leverage an open platform as a service (PaaS) and connect enterprise systems and machines to the IoT. MindSphere is the cloud-based, open IoT operating system from Siemens that connects real things to the digital world, and enables industry applications and digital services to drive business success. The open PaaS of MindSphere provides a rich partner ecosystem to develop and deliver new applications.

MANUFACTURERS REQUIRE RAPID AND FLEXIBLE ACCESS TO ACTIONABLE RESULTS

Because solutions and assets for each industry and production environment will differ, out-of-the-box analytics and reporting may not always meet your or your customer’s needs. Transforming IoT data into meaningful and actionable information for companies is not a one size- fits-all operation. Manufacturers will continue to have unique data sets, operational processes and business drivers that require rapid and flexible access to actionable results. When ready to connect the products that are being manufactured back into operational processes, MindSphere addresses the unique nature of manufacturing operations. By providing customizable options which enable companies to close the loop through product ideation, realization and utilization, MindSphere seamlessly integrates operational data throughout the value chain.

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Internet-Of-Things Heat Map 2018

Prioritize IoT Use Cases Based On Value To Your Company Operations

by Michele Pelino and Frank E. Gillett

April 23, 2018

Why Read This Report

CIOs face a daunting, fragmented array of internet-of-things (IoT) solutions to enhance operational efficiencies and enable personalized customer experiences. IoT use cases like building management, security, and surveillance apply to many firms; other use cases enhance operational processes; and still others address specialized needs in industries such as healthcare or industrial manufacturing. This report helps you determine which use cases might be relevant to your organization and evaluate the impact they have on your company's strategic business priorities.

Key Takeaways

Sorting Out Which IoT Use Cases Make Sense For Your Company Is Challenging

There's a wide variety of IoT use cases, with diverse business value propositions and a plethora of supporting technologies. To figure out how IoT applies to their companies, CIOs should assess their physical assets, some common industry use cases, the maturity of IoT solutions, and the potential business value.

Ensure That Relevant Stakeholders Participate In The IoT Use Case Evaluation Process

Business, technology, and operational stakeholders must participate in identifying your firm's IoT use case requirements, benefits, and deployment timelines to facilitate seamless deployment, scalability, and back-end solution integration.

Prioritize IoT Use Cases Based On Strategic Value And Impact On Customers

An array of functional IoT use cases can transform operational processes and differentiate customer experience. Evaluate the IoT use cases that are particularly relevant to your firm, based on their strategic value and impact on operational efficiencies.

Internet-Of-Things Heat Map 2018

Prioritize IoT Use Cases Based On Value To Your Company Operations

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April 23, 2018

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Choosing Valuable IoT Use Cases For Company Operations Is Hard

Digital leaders have three scenarios at their disposal to incorporate IoT into their business strategy: designing IoT into things, operating IoT-enabled business assets, and consuming third-party IoT insights.¹ This report focuses on the operations scenario for IoT to improve customer experiences with company operations or drive better operational efficiency and flexibility. More than 63% of global telecommunications decision makers employed at enterprises are implementing, expanding, or planning to implement IoT solutions across all major industry categories (see Figure 1).

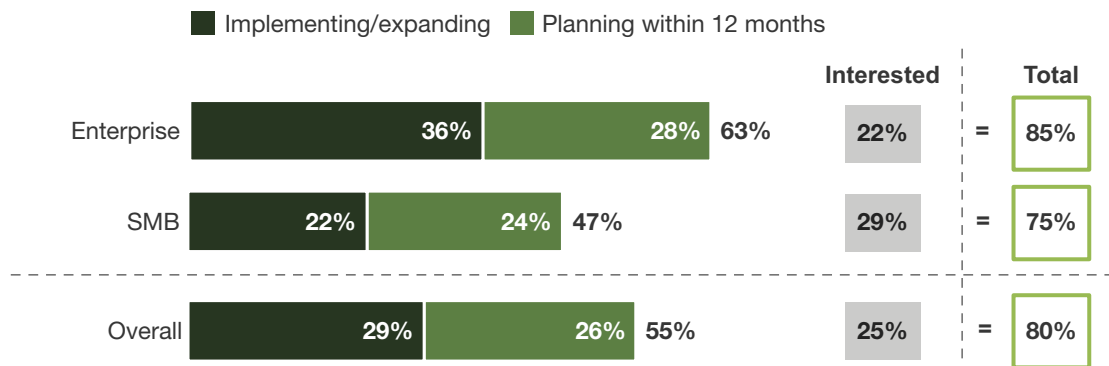
In addition, there are significant differences in IoT deployment and implementation plans based on vertical market (see Figure 2). CIOs and CDOs face the daunting task of evaluating and prioritizing the diverse array of opportunities to implement IoT-enabled processes that help them transform their day-to-day operations. The task of identifying which IoT use cases to prioritize for improving operations is difficult because:

- › **The business value of IoT can range from incremental to transformative.** IoT solutions can help enterprises address a continuum of business benefits, such as enhancing operational processes, using resources more efficiently, or transforming customer relationships. In the utilities sector, Pacific Gas and Electric (PG&E) uses smart grid technology to analyze power usage data, monitor the power grid infrastructure, and proactively identify outages.² Customer benefits include safer, more sustainable, and more reliable energy services. In addition, customers can make more informed energy decisions. Disney transformed the experience of guests in its parks with MagicBand, a wearable device that guests use to navigate their theme park experience and speed access to rides, restaurants, and hotel rooms.³
- › **Execs must assess widely applicable and very specialized IoT use cases to find value.** Firms use IoT technologies to extend digital business into their daily operations and business processes by capturing detailed visibility into the physical world. Industrial manufacturers use sensor-enabled machinery to evaluate machine performance, detect issues, and inform field service personnel when they need to perform proactive maintenance to prevent industrial-line service interruptions. More specialized IoT use cases focus on transforming operations and business processes in specific sectors, such as using cold-chain monitoring of pharmaceuticals or sensor-enabled, remote patient monitoring in healthcare.
- › **IoT solutions vary by technology diversity and ecosystem support requirements.** A diverse array of sensors, networks, protocols, software technologies, and data formats enable IoT use cases. From the networking perspective, there are cellular 3G, 4G, and 5G solutions. In addition, LPWAN solutions complement cellular networks and are relevant for use cases in smart cities, which require lower speeds, smaller data volume, and long battery life. IoT gateways translate communications protocols from legacy devices, such as heating, ventilation, and air conditioning (HVAC) systems, that use BACnet or Modbus communication standards into a recognizable IP format.⁴ An ecosystem of conventional, well-known vendors and new suppliers may assist with specific technical elements of IoT solution deployment.

- › **Company stakeholder spending and benefits don't align for IoT projects.** IoT use cases often bridge many different business, technology organization, and operational stakeholders who are responsible for identifying use case requirements, expected benefits, and budgets to deploy IoT solutions. For example, manufacturing factory managers, plant operations executives, and facilities managers can all benefit from IoT solutions to lower costs, prevent downtime, and improve asset utilization. Tech organization and security executives must also participate in the IoT solution decision-making process early on to prevent problems related to security, network scalability, and back-end solution integration.

FIGURE 1 Almost Two-Thirds Of Decision Makers At Enterprises Use Or Plan To Use IoT Solutions

“What are your firm's plans to adopt IoT/M2M solutions or applications?”

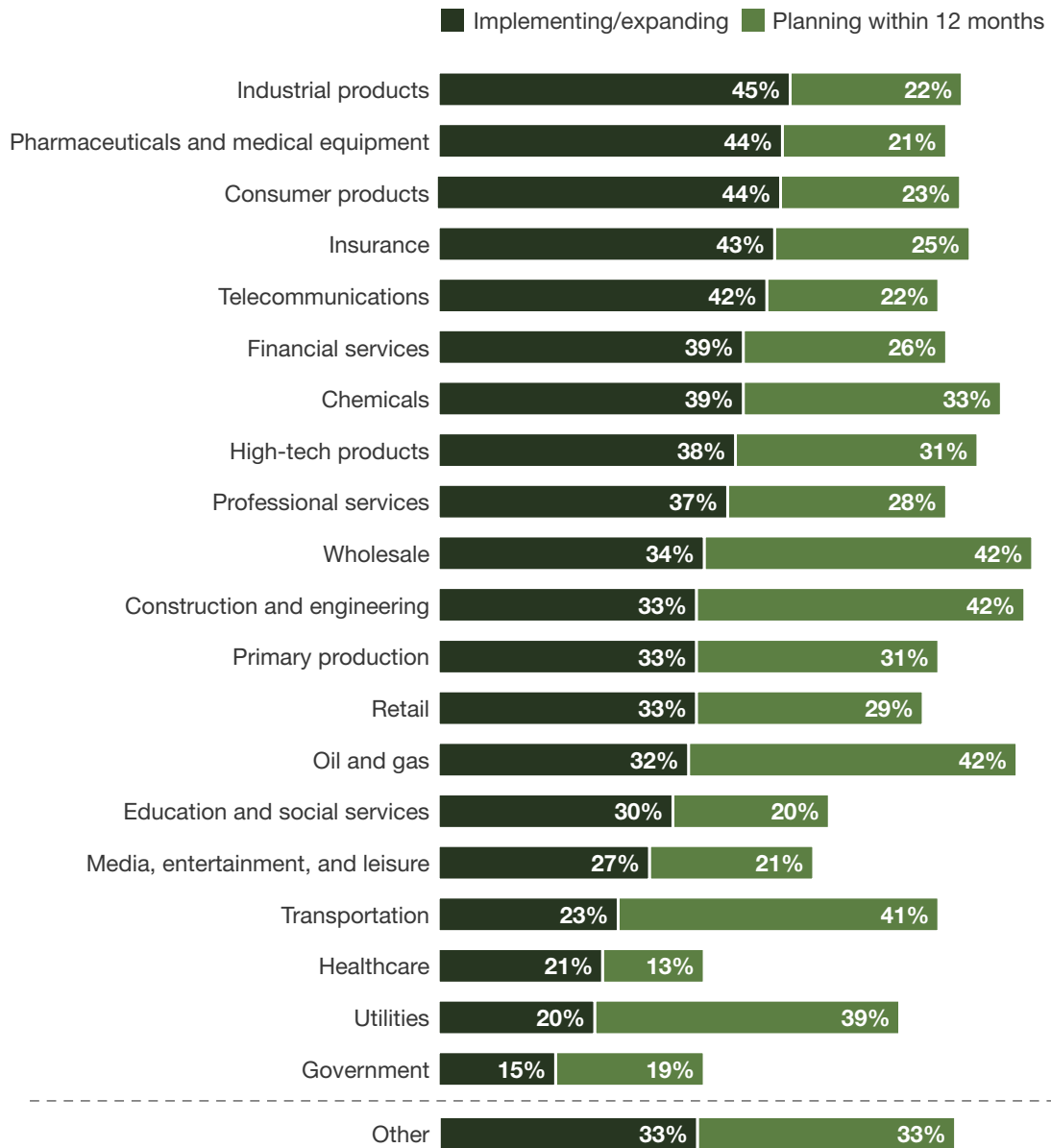


Base: 3,138 (1,586 at enterprises; 1,552 at SMBs) global telecommunications decision makers (employed at firms of 20+ employees)

Source: Forrester Data Global Business Technographics® Networks And Telecommunications Survey, 2017

FIGURE 2 All Major Industry Segments Are Using Or Planning To Use IoT Solutions

“What are your firm’s plans to adopt IoT/M2M solutions or applications?”



Base: 19 to 263 global telecommunications decision makers (employed at enterprises of 1,000+ employees)

Source: Forrester Data Global Business Technographics® Networks And Telecommunications Survey, 2017

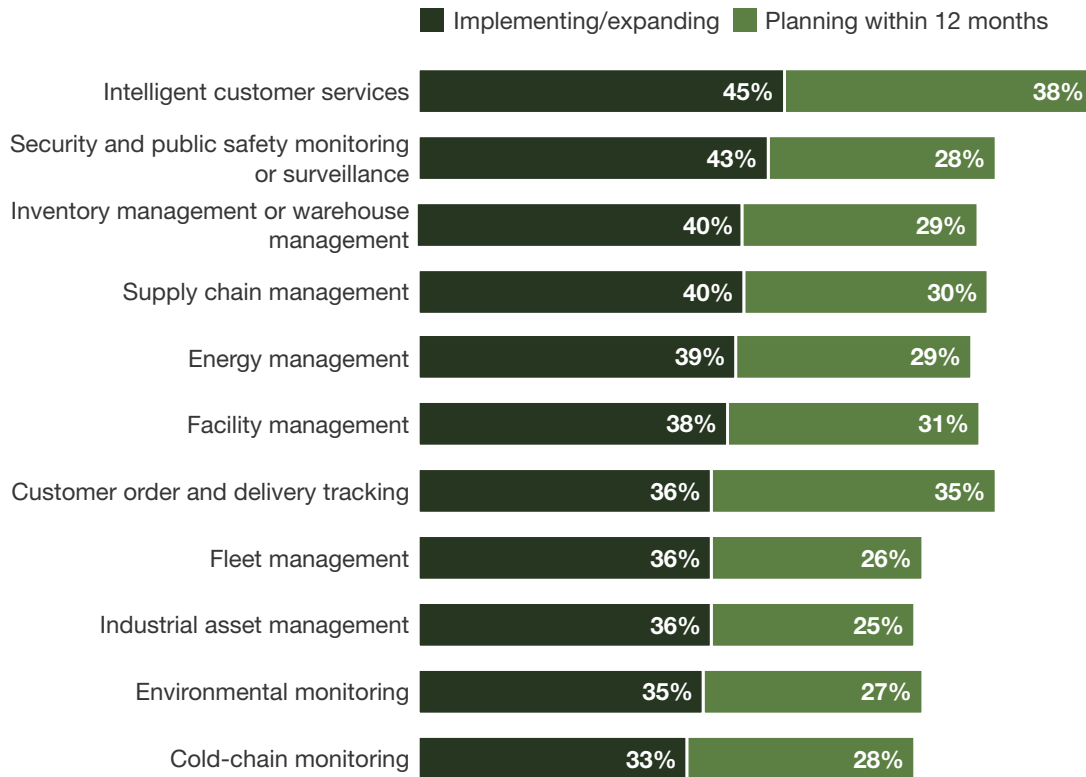
Four Key Dimensions Help Identify IoT-Enabled Operations Use Cases

All companies use assets to conduct their daily business operations. As enterprise operations incorporate the breadth and variety of IoT-enabled assets (e.g., machines, equipment, vehicles, lights, and buildings), firms must evaluate and prioritize the many different types of relevant IoT use cases to transform their operational processes. As a starting point, enterprise stakeholders should consider these elements in their evaluation process:

- › **The physical-asset intensity of their industry.** Many firms use IoT technologies to extend digital business deeply into their daily operations by getting detailed visibility into the physical world. The success of asset-intensive manufacturing, government, utilities, telecom, and transportation organizations depends on how efficiently and extensively they leverage their physical assets. An important driver of IoT solution deployment is the number and value of physical assets (e.g., cars, equipment, machinery, or land) and physical structures (e.g., buildings) within each industry sector. This doesn't include financial assets.
- › **Relevant use cases that firms within their industry are deploying.** Enterprise stakeholders often initially focus on identifying relevant IoT opportunities within their specific industry or vertical market. For example, healthcare providers frequently use IoT solutions to maintain and manage the status and operational performance of medical equipment. However, to truly understand momentum for IoT application and use case deployment, CIOs and their business stakeholder counterparts should also evaluate specific use cases that are relevant to their firm's specific strategic priorities and operational processes (see Figure 3).
- › **The maturity of available IoT solutions.** The enormous range of sensors, technologies, customer scenarios, and business cases supports an extremely fragmented and diverse array of IoT use cases, from programmable logic controllers (PLCs) on manufacturing lines to satellite-connected sensors on long-haul trucks. Evaluate the maturity and adoption for each IoT use case by using various sources of information, including data from Forrester's survey of global enterprise IoT use case adoption and our analysts' judgement, based on many hundreds of inquiry discussions with end user clients, vendors, and service providers across the IoT value chain.⁵
- › **The business value to their company.** Base the decision to deploy each IoT use case on the value and benefits the use case contributes to the strategic and operational priorities of your organization. Some IoT use cases have strategic impacts on customer relationships (e.g., intelligent customer services), while others focus on providing cost-efficient use of resources, such as energy management and security and surveillance. To determine the appropriate mix of IoT use cases and applications to pursue, IoT decision-making stakeholders must evaluate the strategic alignment and fit with corporate strategic priorities and initiatives.

FIGURE 3 Global Enterprise Decision Makers Embrace A Variety Of IoT Use Cases

“Which of the following IoT/M2M applications has your firm implemented/is your firm planning to implement?”



Base: 442 to 565 telecommunications decision makers whose firms are planning to or have adopted M2M/IoT solutions (1,000+ employees)

Note: Not all categories are shown.

Source: Forrester Data Global Business Technographics® Networks And Telecommunications Survey, 2017

The IoT Heat Map Highlights IoT Use Cases By Industry And Function

An almost unlimited array of IoT applications can transform operational processes across many different markets (see Figure 4). To help CIOs evaluate IoT use case deployment opportunities relevant to their firms, we identified IoT use cases that may apply to many, some, or few organizations. Evaluate the applicability of each use case based on your firm’s unique strategic business priorities and operational initiatives.

FIGURE 4 Examples Of IoT Use Cases Across A Wide Array Of Verticals

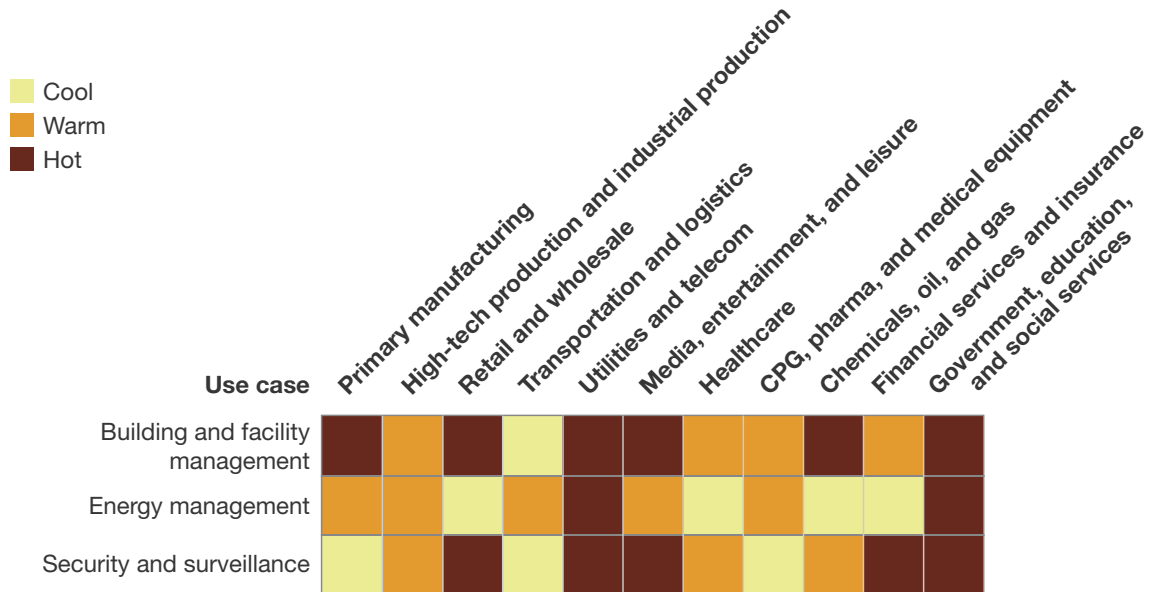
Use case	Definition
Building and facility management	Monitoring the design, construction, and operation of structures and buildings, including lighting and HVAC systems
Energy management	Monitoring, managing, and reporting usage of water, electricity, and other energy resources
Security and surveillance	Security and public safety monitoring and surveillance
Fleet management	Monitoring and managing the condition, location, and usage of vehicle fleets (e.g., airplanes, taxis, buses, and trucks)
Asset management	Monitoring and managing the location, condition, and usage of equipment and machinery
Predictive maintenance	Monitoring and managing equipment operation, wear, and status to optimize maintenance for revenue and cost
Inventory and warehouse management	Tracking inventory levels and managing warehouse operations
Supply chain management	Managing supply chain relationships, including payment processing
Environmental monitoring	Monitoring indoor or outdoor air quality, carbon monoxide levels, and pollution levels
Track and trace	For smaller things such as tools and for high-value customer shipments, tracking location, and condition
Customer order and delivery tracking	Enabling customer visibility into the status of orders and deliveries
Intelligent customer services	Providing customers with personalized experiences and services based on dynamics such as their location, individual preferences, and behaviors (e.g., retail store, hotel, airport, stadium, amusement park)
Remote diagnostics and monitoring of patient status	Providing the ability to monitor patients' vital signs and medical status (e.g., blood pressure, heart rate, or glucose level)
Hospital and clinic asset management	Tracking the location and status of medical devices, assets, and equipment
Self-optimizing production	Monitoring, managing, and automating complex, dynamic operations to improve customer operations and delivery
Cold-chain monitoring	Monitoring and controlling conditions of perishable food, chemicals, and other products when they're in storage or in transit (e.g., temperature and humidity)

HORIZONTAL IOT USE CASES CAN BENEFIT MOST FIRMS

These use cases are broadly applicable and offer incremental value but generally don't provide a strategic advantage (see Figure 5):

- › **Building and facility management.** Many firms operate or manage office buildings, manufacturing plants, or retail sites using smart building solutions.⁶ Intel installed 9,000 sensors throughout its 10-story, 630,000-square-foot office in Bangalore, India to collect temperature, lighting, humidity, electrical usage, and occupancy data.⁷ IoT gateways translate the myriad communication protocols from the sensors and enable multiple building systems to communicate with cloud-based applications. For some, smart building solutions are more strategic and support new topline growth opportunities, including differentiating the building environment for tenants and workers, enhancing worker productivity, creating a healthier and safer work environment, and enhancing visitor experience.
- › **Energy management.** Energy management solutions, often incorporated into building management systems (BMSes), help organizations achieve efficiency goals. Utilities firms deploy these solutions to enable new outage management services and enhanced distribution system monitoring. Lake Land College in Illinois uses Schneider Electric's EcoStruxure BMS to manage HVAC systems in 15 buildings, as well as geothermal heat pumps, photoelectric displays, windmills, and chilled beams for cooling systems.⁸ Lake Land reduced CO2 emissions by 400 tons per year and saves over \$100,000 annually in utility costs. Energy management solutions are more strategic in multibuilding environments, including government and education facilities, commercial offices, retail stores, and banks.
- › **Security and surveillance.** IoT use cases to support physical security include devices such as card readers, door locks, and cameras as well as card personalization software and analytics.⁹ Many organizations lack global standards across their physical locations, which can interfere with the experience of employees visiting different office locations (e.g., requiring them to carry multiple badges). Multiple security systems increase administrative and deployment costs and limit the ability to obtain a consolidated view of physical security across the organization. IoT-enabled physical security and surveillance systems are relevant to government, retail, healthcare, and manufacturing firms as well as companies where employees work in physical office buildings. In some cases, these use cases do have strategic relevance.

FIGURE 5 Broadly Applicable IoT Use Cases Apply To Many Firms



FUNCTIONAL IOT USE CASES CREATE VALUE FOR MANY FIRMS

Use cases for specific operational processes boost efficiency and sometimes provide significant value, though they don't have universal appeal due to the nature of certain businesses. IoT use cases often transform operational processes commonly used across multiple markets or environments. Examples of common processes include inventory and supply chain management, used in industrial and manufacturing, retail, and healthcare sectors (see Figure 6):

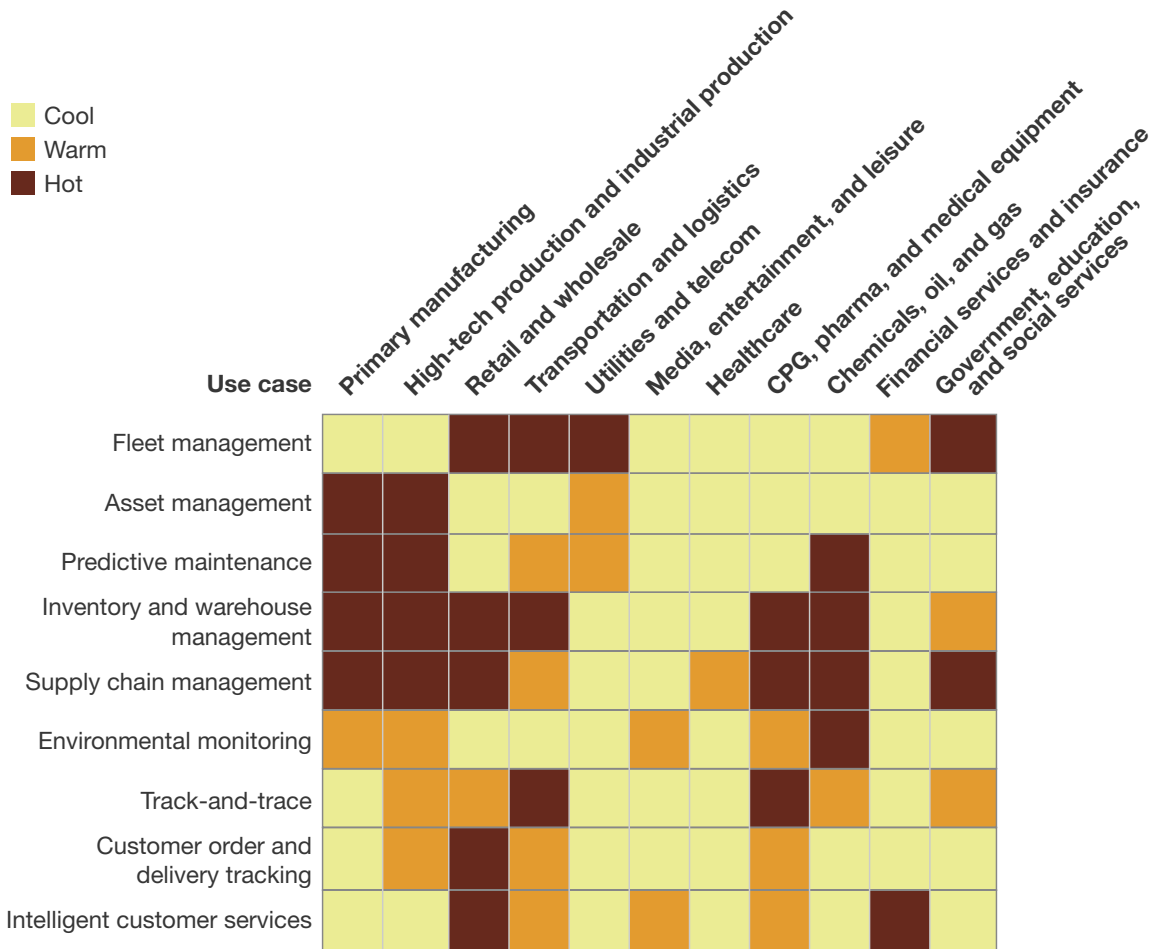
- › **Fleet management.** Fleet managers use telematics solutions to monitor and manage vehicle performance, including engine diagnostics, speed, acceleration, coolant temperature, and brake wear. Navistar, a commercial truck manufacturer, reduced maintenance costs and vehicle downtime by up to 40%.¹⁰ Navistar's OnCommand Connection platform on Cloudera Enterprise centralizes geolocation data and insight from 24 telematics service providers to provide real-time visibility into information on more than 350,000 trucks. Fleet owners can monitor truck health and performance from smartphones or tablets, prioritize needed repairs, and identify the nearest dealer to address maintenance issues. Fleet management solutions are particularly relevant in the transportation, utilities, and telecommunications industries.
- › **Asset performance management and predictive maintenance.** Asset management solutions use IoT to detect status and automate work allocation to increase utilization and speed work.¹¹ In addition, many companies use machinery and equipment to run operational processes that create and deliver value. Each of these assets requires routine monitoring and scheduled maintenance.

IoT solutions for predictive maintenance enable close awareness of actual conditions, allowing firms to accelerate or defer maintenance based on minimizing expenses and improving operational efficiencies. Konecranes, a Finnish manufacturer of cranes and heavy lifting equipment, uses sensors to gauge the condition of its equipment and reports back so an engineer can service it immediately.¹² These solutions are particularly relevant in the manufacturing; production; and chemical, oil and gas sectors.

- › **Inventory, warehouse, and supply chain management.** A growing set of IoT solutions manage supplies and inventory within warehouses and across a company's operations. There's also an expanded version of this use case that integrates across the supply chain, linking partners in the ecosystem to orchestrate multiple stakeholders and better serve customers. Denimwall, owner of multiple G-STAR RAW franchise stores in the US, attached RFID tags to inventory items and installed RFID overhead readers onsite.¹³ This solution makes it easier to locate inventory deliveries, increases accuracy of in-store inventory items, reduces the amount of time that sales associates spend searching for styles or sizes requested by customers, and helps address loss prevention. The retail, wholesale, manufacturing, and production sectors benefit from these inventory management and supply chain management solutions.
- › **Environmental monitoring.** IoT-enabled environmental monitoring solutions analyze elements ranging from air pollutants to noise. The Athens International Airport worked with Ex Machina and Libelium to deploy a solution that monitors and analyzes air quality, noise levels, temperature, humidity, atmospheric pressure, ozone levels, and particulate matter.¹⁴ General packet radio service (GPRS) and LoRa WAN communication modules continuously stream captured data to the cloud and support bulk data uploads and OTA firmware upgrades. This solution enabled the Athens International Airport to achieve carbon-neutral status in 2017. Environmental monitoring helps firms in the manufacturing, oil, chemicals and gas, and pharmaceutical sectors address regulatory and compliance requirements.
- › **Track-and-trace and customer order and delivery tracking.** Track-and-trace solutions enable firms to use embedded or add-on trackers on assets, products, and shipments to determine location and context. Often, these solutions can provide customer order and delivery-tracking capabilities as well. ParceLive is a postcard-sized device inserted into a parcel at the point of distribution that allows users to access location, condition, and security of their shipments in real time.¹⁵ Data transmits every hour unless there's an event (e.g., someone drops or opens the parcel, or it exceeds a temperature limit), in which case an alert goes out. These delivery-tracking solutions have wide applicability in the retail, wholesale transportation, and logistics sectors.
- › **Intelligent customer services.** Firms use IoT-enabled intelligent services to personalize interactions with customers throughout the evaluation, consideration, and purchasing-decision process. For example, retailers offer personalized shopping experiences; identify the physical areas where consumers show the highest propensity to buy; and improve customer engagement by deploying intelligent technologies, including self-service kiosks, intelligent POS systems, digital

signage, and intelligent video analysis. The data collected from intelligent devices empowers retailers to proactively engage their customers and implement operational processes such as dynamic pricing to increase sales and customer satisfaction. IoT-enabled interactive intelligent services are relevant in retail stores, hospitality, public services, and industrial services.

FIGURE 6 Functional IoT Use Cases Apply To Some Firms



SPECIALIZED IOT USE CASES ADDRESS SPECIFIC SITUATIONS AT A NARROW SET OF FIRMS

These narrow or vertical-specific use cases solve specific problems that apply to a few firms. The heterogeneity and diversity of the IoT use case landscape provides enterprise stakeholders in every vertical market with opportunities to differentiate operations, processes, and customer experiences. Here are a few examples of specialized IoT use cases that address requirements of firms in specific sectors (see Figure 7):

- › **Remote diagnostics and monitoring of patient status in healthcare.** Medical device and pharmaceutical companies, including Bayer and Philips Healthcare, are building the IoT into their products to enable virtual compliance and provide differentiated patient care.¹⁶ Leiden University Medical Center in the Netherlands worked with Zebra Technologies to develop a wearable-enabled IoT monitoring system to track patient status and the amount of time it takes for cardiac arrest patients to receive a balloon angioplasty treatment.¹⁷ The solution helps the hospital improve its door-to-balloon (DTB) rate, ensure that patients are treated as quickly as possible, and maximize their chances of survival and recovery.
- › **Hospital and clinic asset management in healthcare.** Many hospitals and healthcare facilities face challenges because nurses and healthcare professionals spend extensive amounts of time searching for movable medical equipment, often causing staff members to hoard equipment once they locate it. Mission Hospital, a two-campus, 550-plus bed facility in Southern California, uses CenTrak's active RFID system to track the location and maintenance status of its moveable medical equipment.¹⁸ Staff can access real-time reports on the location of equipment and ensure that no one loses or steals valuable assets. Deployment of this solution resulted in annual savings of \$150,000 to \$200,000 due to the reduced rate of lost or stolen devices.
- › **Self-optimizing production in manufacturing.** Executives that implement IoT use cases for manufacturing lines seek better visibility and control over operations. This can enable them to change over production runs faster, detect and prevent emerging problems, and automate production of highly customized products. Lockheed Martin Aeronautics licensed Ubisense SmartSpace for its F-35 program at Fort Worth, Texas, to improve manufacturing efficiency.¹⁹ By identifying the precise location of tagged assets and knowing where the assets need to be at specific points in the future, SmartSpace enables manufacturers to proactively stage and schedule assets to help meet critical production milestones.
- › **Cold-chain monitoring in foods and pharmaceuticals.** Pharmaceutical companies must track the temperature and condition of certain types of medications to ensure effectiveness for patients. New regulations in the US have dramatically expanded the list of medications and products that require temperature-controlled packaging and storage requirements.²⁰ The cold-chain distribution process often involves multiple storage and transit locations, including airports and docks, and a variety of transport, including ships, aircraft, and trucks. Cold-chain monitoring solutions often include GPS location capabilities and sensors to monitor temperature, tilt, vibration, shock, and pressure of shipments throughout the supply chain. These cold-chain use cases are also relevant for supermarkets, convenience stores, and transportation firms.

FIGURE 7 Specialized IoT Use Cases Apply To A Few Firms



Recommendations

Scan Operational Assets For Applicable And Valuable IoT Use Cases

Figuring out where and how to use IoT across company operations seems complex, but a few simple guidelines can help digital leaders evaluate their options for best business value. The main insight is to focus on how the broad set of IoT use cases applies to your company rather than just on the narrow set of vertical IoT solutions for your industry. CIOs should help their companies:

- › **Inventory assets to identify which of seven IoT asset types the company has.** There are seven types of IoT-enabled assets — wearables and personal tools; experience spaces; building environments; equipment and machinery; assets for customer use; built infrastructure; and landscapes — but few companies have all seven types.²¹ While almost all companies will have building environments for offices and operations spaces, fewer will also have their employees use personal tools and wearables, a specialized use case.
- › **Prioritize strategic value over incremental benefits.** Many examples of using IoT to improve operations use a business case built on cost savings, such as saving 10% on energy consumption or maintenance costs. But businesses often overlook the potential for IoT to enable better customer experience from operations, such as higher service levels; personalized service; or

entirely new offerings, such as pay-per-use service rather than product purchase. Digital leaders must prioritize IoT uses that enable enduring customer differentiation or new business models over incremental savings that competitors can easily match.

- › **Check for value to critical operations, regulations, and compliance.** IoT solutions can help with monitoring and maintaining critical operations, such as manufacturing lines or electricity production. They can also reduce the burden of monitoring for compliance with regulations, such as checking to make sure that exit signs comply with lighting standards and that fire extinguishers are ready for action. In both cases, IoT helps reduce expensive and unwanted problems.
- › **Look for exceptions to the generalizations about the typical value of IoT use cases.** The IoT use cases with the broadest applicability don't offer breakthrough business value to most companies — but there are exceptions. Take building management as an example. Cutting 5% out of office building energy costs is a big win for facilities management in the first year, but it doesn't do anything to move the business. However, The Edge, Deloitte Netherlands' Amsterdam location, uses IoT solutions in a sustainable building design that produces more energy than it consumes. And because it's such an attractive place to work, Deloitte uses it as a recruiting advantage.

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Supplemental Material

SURVEY METHODOLOGY

The Forrester Data Global Business Technographics® Networks And Telecommunications Survey, 2017, was fielded in December 2016 and January 2017. This online survey included 3,535 respondents in Australia, Brazil, Canada, China, France, Germany, India, New Zealand, the UK, and the US from companies with two or more employees.

Forrester Data Business Technographics ensures that the final survey population contains only those with significant involvement in the planning, funding, and purchasing of business and technology products and services. Research Now fielded this survey on behalf of Forrester. Survey respondent incentives include points redeemable for gift certificates.

Please note that the brand questions included in this survey should not be used to measure market share. The purpose of Forrester Data Business Technographics brand questions is to show usage of a brand by a specific target audience at one point in time.

Endnotes

- ¹ See the Forrester report "[Untangle Your IoT Strategies.](#)"
- ² Source: "Discover the benefits of the Smart Grid," PG&E (https://www.pge.com/en_US/safety/how-the-system-works/electric-systems/smart-grid/smart-grid-benefits.page).
- ³ For more information on the impact of internet-of-things applications in the retail vertical, see the Forrester report "[Infrastructure Will Drive The Retail Store Experiences Of The Future.](#)"
- ⁴ Advantech uses the Arm Mbed IoT device platform to develop IoT gateways and sensors that simplify IoT solution deployment: Source: "Advantech and Arm: Helping cities and factories get connected to the IoT," Mbed Blog, (<https://blog.mbed.com/post/advantech-and-arm-cities-factories-connected-iot>).
- ⁵ Source: Forrester Data Global Business Technographics Networks And Telecommunications Survey, 2017.
- ⁶ See the Forrester report "[Extend IoT Smart Building Solutions To Transform The Workplace.](#)"
- ⁷ See the Forrester report "[Case Study: Use IoT To Transform Your Office Into A Smart Building.](#)"
- ⁸ Source: "Lake Land College – EcoStruxure Energy Expert Increases Electrical as Well as Mechanical Efficiency," Schneider Electric, January 11, 2016 (<https://www.schneider-electric.com/en/download/document/CS-LAKELAND/>).
- ⁹ See the Forrester report "[TechRadar™: Physical Security, Q1 2017.](#)"
- ¹⁰ Source: "Navistar: Reducing Maintenance Costs up to 40 percent for Connected Vehicles," Cloudera, August 30, 2017 (https://www.cloudera.com/content/dam/www/marketing/resources/case-studies/Cloudera_Navistar_Case_Study.pdf.landing.html).
- ¹¹ See the Forrester report "[Embrace Functional IoT Use Cases To Scale Your Digital Business.](#)"
- ¹² See the Forrester report "[I&O Leaders Must Deliver Foundational Technology And Processes For IoT Success.](#)"
- ¹³ Source: "G-STAR RAW franchisee Denimwall sets course for future with real-time data analytics enabled by technology and services from Detego, Impinj and RIoT Insight," Impinj press release, January 8, 2016 (<https://www.impinj.com/about-us/news-room/press-releases/g-star-raw-franchisee-denimwall-sets-course-for-future-with-real-time-data-analytics-enabled-by-technology-and-services-from-detego-impinj-and-riot-insight/>).
- ¹⁴ Source: "Case Study: Airport," Ex Machina (<https://exm.gr/case-study-airport/>).
- ¹⁵ Source: Hanhaa (<https://www.hanhaa.com/parcelive/>).
- ¹⁶ See the Forrester report "[Virtual Care Enables The Digital Health Imperative.](#)"
- ¹⁷ Source: "Leiden University Medical Centre," Zebra (https://www.zebra.com/content/dam/zebra_new_ia/en-us/solutions-verticals/vertical-solutions/healthcare/success-stories/hc-leiden-university-zatar-success-story-gb-en.pdf).
- ¹⁸ Source: "Major Southern California acute-care facility realizes significant savings and new efficiencies with CenTrak RTLS," CenTrak (<http://info.centrak.com/acton/media/17322/download-mission-hospital-case-study>).
- ¹⁹ Source: "Ubisense's IIoT platform improves manufacturing efficiency for Lockheed Martin's F-35 program," Ubisense press release, December 15, 2017 (<https://www.ubisense.net/news/ubisenses-iiot-platform-improves-manufacturing-efficiency-lockheed-martins-f-35-program>).
- ²⁰ Source: "FDA & ICH: Regulations and Standards for Temperature-Controlled Supply Chains," Vaisala (https://www.vaisala.com/sites/default/files/documents/Cold_Chain_FDA_ICH-Application-Note.pdf).
- ²¹ See the Forrester report "[Untangle Your IoT Strategies.](#)"

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