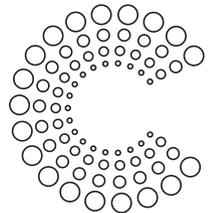


Industrial Products Intelligent Connections

Reinventing enterprises
with Intelligent IoT

Global C-suite Study
19th Edition

IBM Institute for
Business Value



IBM Institute for Business Value (IBV), in cooperation with Oxford Economics, interviewed 3,158 CxOs from 89 countries and 20 industries worldwide. Information was collected through a combination of live phone interviews and face-to-face meetings conducted from July through September 2017. The research in this report focuses on the 271 Industrial Products industry C-suite respondents in the study.

How IBM can help

Clients have the opportunity to harness the game-changing potential of real-time actionable insights and to apply predictive analytics to production and operational processes and equipment. IBM Digital Operations for Internet of Things (IoT) offers integrated services, software and infrastructure solutions. Connect with us to apply artificial intelligence (AI) to IoT. Please visit ibm.com/services/process/iot.

IBM delivers cognitive platforms and services, industry-specific offerings and expert consulting to support Industrial Products companies. We engage clients in identifying cognitive manufacturing entry points that can move beyond cost cutting to transforming production. Capabilities include accelerators and services that allow quick starts to key cognitive manufacturing use cases in visual inspection and quality, maintenance and plant-level IoT. Please visit ibm.com/industries/manufacturing.

Amplifying performance

As virtually everything becomes connected and data proliferates, Industrial Products companies should address three great IoT opportunities:

- Optimizing production operations and plant efficiency
- Improving worker safety and environmental compliance
- Driving the shift to data-enabled services and customer-centricity.

Those leading the way are amplifying their performance – capturing numerous, diverse forms of data from a variety of interconnected devices – and leveraging that data using AI-based applications to reach new levels of operational and financial proficiency. They are developing personalized customer services and experiences that transform their brand and open entirely new opportunities for monetization and competitive conquest. How? They are applying intelligence to the data deluge from their world of connected “things.”

Shifting forces

Digital forces are creating unprecedented levels of change in the Industrial Products industry. New companies are establishing footholds in traditional markets, putting pressure on established industry leaders.

For instance, Skycatch, Inc. manufactures drones for the construction industry that replace traditional land survey equipment to create contour maps and take volumetric measurements. In addition, construction companies can use the drone data software with CAD overlay capability to conduct location validation of a structure during construction, rather than doing a manual survey after a structure's completion.¹

And BuildTraders, a startup in India, is providing an e-commerce platform to help consumers navigate the USD 150 billion Indian construction industry, which is currently highly unstructured. The platform assists consumer home builders in procuring construction materials and selecting suppliers.²

Industry convergence – the merging of industries as suppliers, distributors, customers and competitors cooperate in ecosystems to deliver new products and services – continues to change the basis of how strategic decisions are made. And competitive dynamics and growing customer expectations are driving companies to expand into new areas of offerings.

IoT refers to the growing range of connected devices that send and receive data across the Internet without human interaction.

A *device* is any object with embedded electronics that can transfer data over a network. Examples are wearables and environmental sensors that monitor factory equipment; in-home or office building conditions; or components of mobile assets, such as trucks, trains and aircraft.

Things are *connected* when the devices are attached to the Internet or private network, can exchange data and are uniquely addressable.

Things are *interconnected* when they can interact with each other and with decision agents via the Internet or private network.

Things are *intelligently interconnected* when the data is parsed into analytic or AI-based algorithms for autonomous decision making and to drive more efficient machine-to-human interaction.

Heavy equipment and machinery manufacturer Caterpillar Inc. has embedded connectivity solutions and sensors in its 560,000 vehicles around the world. The company has built a set of software and analytics tools, as well as application programming interfaces, to help it – and its customers – process, analyze and store the data it collects. Caterpillar has partnered with Zuora, Inc., a provider of subscription commerce, billing and finance solutions, to offer clients cloud-based software to manage and analyze their subscription services.³

In response to these and other industry changes, many Industrial Products CxOs plan to modify elements of their existing business models to deliver new value propositions within their market, and/or shift their company’s position in the industry value chain. They recognize a strong need to reinvent their enterprises by digitizing communications and interactions as part of a shift from product innovation to creation of superior customer engagement and experiences.

IoT is a significant component of the reinvention strategy and execution plans for a majority of Industrial Products CxOs (see sidebar on “Degrees of connectedness in IoT”).

Degrees of connectedness in IoT

Sixty percent surveyed in our 2017 study are currently executing plans to incorporate IoT into their operating models. They say the main factors influencing investment in IoT are aimed at increasing efficiency (see Figure 1).

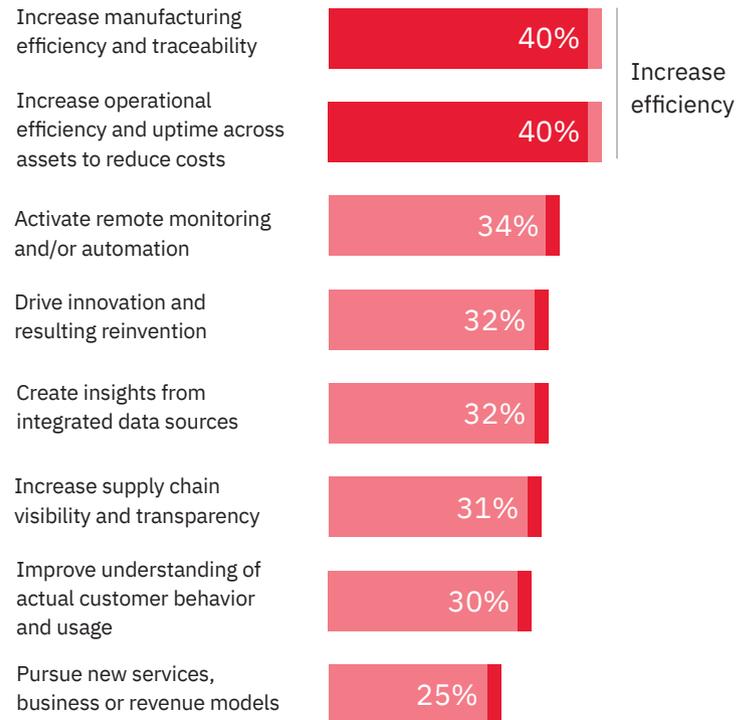
“IoT will enable smart manufacturing which will enhance productivity to new heights.”

Chief Marketing Officer, Industrial Products, USA

Figure 1

Efficiency drives investment

Factors influencing investment in IoT technology by Industrial Products enterprises



IoT opportunities

The Industrial Products industry has been supporting IoT concepts informally for decades. Companies have applied data generated from sensors and actuators in the production process to sequentially drive automated process control. The companies then have used this information to help manage manufacturing operations and have incorporated it into business and logistics planning.

IoT fundamentally changes the game by allowing companies to drive smart manufacturing. With IoT, companies can achieve real-time visibility of what's happening on the plant floor, as well as across the supply chain. They can use IoT to track products, raw materials, people, processes and assets.

IoT can help companies:

Improve operational efficiency through asset maintenance and inventory management. Using RFID and sensors, assets can be monitored continuously to identify possible issues before they occur and advise corrective actions. Real-time information can enable just-in-time manufacturing and help reduce inventories.

Keep employees safe and comply with legislation. Companies can use IoT to verify mandatory safety controls and provide personal protective equipment for workers in hazardous environments. In addition, companies can gather, integrate and analyze sensor data from employees with wearable devices. When combined with AI and external data, such as that related to the environment and weather, IoT can create opportunities for better management of employee health, wellness and safety.

Create new revenue streams. With IoT, organizations can create new data-enabled services. For example, Kaeser Kompressoren SE, a manufacturer of air compressors, has implemented a new business model for predictive maintenance. The company has launched an “Air-as-a-Service” option, in which Kaeser retains ownership and maintenance of its compressors, and sells compressed air by the cubic meter.⁴

Leading elevator and escalator manufacturer and service provider KONE Corp. saw that global connectivity and real-time data provisioning could help improve “people flow” in some of the world’s busiest buildings. KONE chose an IoT solution running on a cloud platform to connect, remotely monitor and optimize management of more than 1.1 million elevators and escalators worldwide. The system predicts maintenance needs and improves equipment availability through reduced downtime, fewer faults and more detailed performance information.

**KONE: Improving “people flow”
in 1.1 million elevators globally⁵**

Meet the Industrial Products Reinventors

We segmented study participants based on their current adoption of IoT to automate their business processes, coupled with their vision for reinventing their enterprises by applying AI to their IoT networks (see Figure 2).

Our analysis reveals significant differences in capabilities, strategies and enterprise agility, with four archetypes emerging. We call them Reinventors, Tacticians, Aspirationalists and Observers.

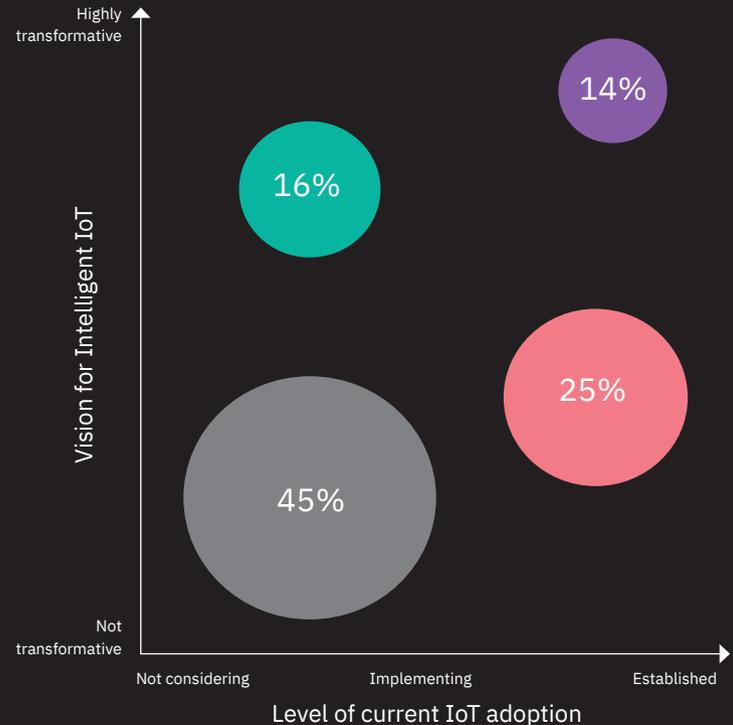
Industrial Products Reinventors (14 percent of surveyed Industrial Products CxOs) have the highest levels of IoT adoption and take a visionary approach to an Intelligent IoT strategy. They leverage a broad range of internal and external data, using it to innovate their products and services, and design new customer experiences.

Figure 2

IoT + AI archetypes

We segmented our Industrial Products respondents by their current use of IoT and vision for Intelligent IoT

Reinventors
Tacticians
Aspirationalists
Observers



Their vision for AI is to bring real-time insights and self-serviceable, “on-the-spot” actions across the enterprise and ecosystem, ultimately driving growth and prosperity. Industrial Products Reinventors stand out as leaders in financial performance and innovation (see Figure 3).

In this report, we examine the perspectives and approaches of the Industrial Products Reinventors, and compare their responses to those of all other respondents in the industry. By examining these leaders, other Industrial Products organizations can understand the need to take action with IoT. They can then begin to:

Create an IoT infrastructure that can scale

Invest in emerging technologies

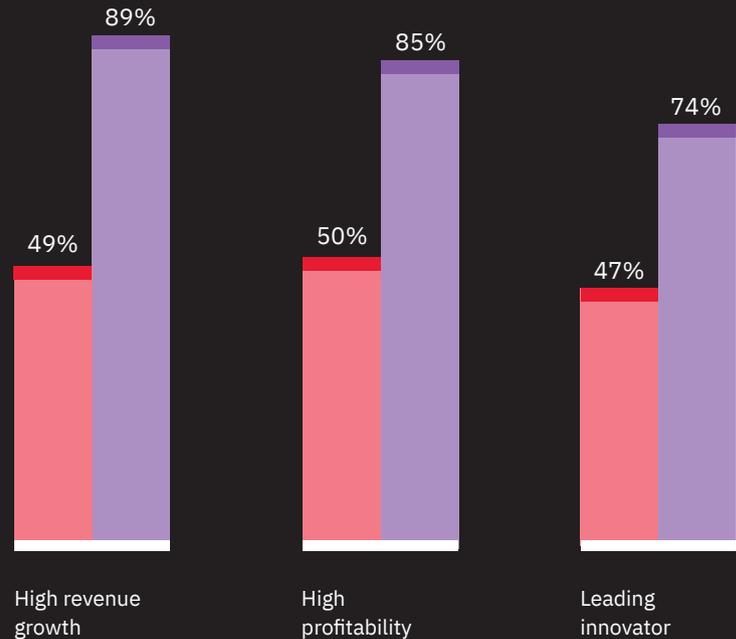
Integrate AI with IoT

Figure 3

Reinventors
All others

Industrial Products Reinventors stand out for leading in financial performance and innovation among industry peers

Financial performance and market perception (past 2–3 years)



“We can gain valuable insights by connecting production and sales data with IoT data to make AI learn more.”

Chief Financial Officer, Industrial Products, Japan

To help employees stay safer in dangerous environments, North Star Bluescope Steel, LLC, a steel producer for global building and construction industries, taps into an IoT solution for wearable safety technology.

The technology gathers and analyzes data collected from sensors embedded in helmets and wristbands. If physical well-being is compromised or safety procedures are not followed, the technology delivers real-time alerts to employees and their managers, enabling them to take preventive actions.

Connected workers are not only inherently safer, but data collected through monitoring can also lead to measures for reducing fatigue, eliminating unnecessary tasks and increasing emphasis on those that are most critical.

North Star Bluescope Steel:
Enhancing workforce safety
with IoT⁶

Create an IoT infrastructure that can scale

Industrial Products Reinventors have created a highly scalable IoT infrastructure. As connectivity increases the capabilities of IoT products and services, network complexity and data grow exponentially. Managing this growth and complexity requires a robust platform that is engineered to scale (see Figure 4).

IoT platforms can support billions of sensors, and can process and route data to endpoints and to other devices. Key components for scale include:

- Cloud infrastructure
- Device connectivity management software
- IoT Platform as a Service
- IoT data storage/data lakes
- Insights as a Service
- Microservices

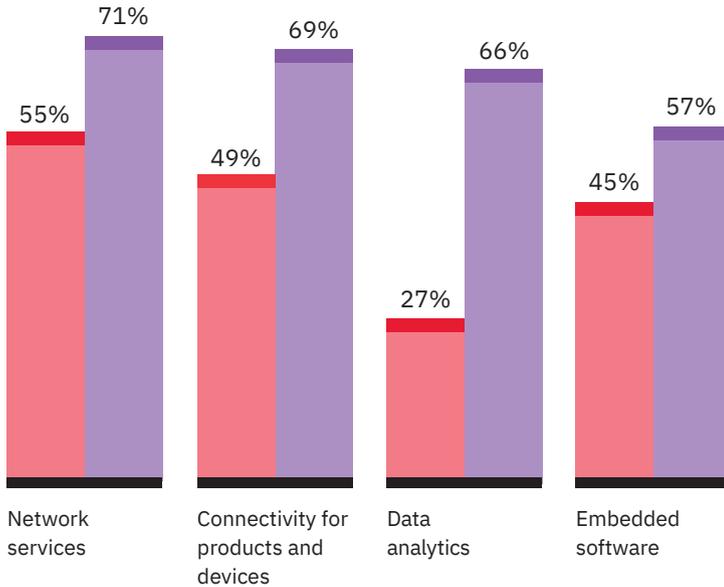
A cloud-based computing environment with these components supports the rapid development and management of applications and analytics required to leverage the value of large volumes of real-time data.

Figure 4

Reinventors
All others

Industrial Products Reinventors are extending their connectivity capabilities by building highly scalable IoT platforms

IoT technologies selected
or implemented



Schaeffler Group, one of the world's leading automotive and industrial suppliers, is pioneering the development of innovative "mechatronic" solutions. These solutions combine mechanical, electronic and software capabilities into individual components and systems that can monitor, report and manage their own performance.

Schaeffler Group's vision is a world where even the seemingly simple ball bearing has built-in intelligence and sensory capabilities. Using AI, Schaeffler plans to interconnect these digitally enabled components and create virtual models of entire industrial systems.

Schaeffler Group: Connecting AI
and IoT for manufacturing⁷

Invest in emerging technologies

Industrial Products Reinventors indicate they are likelier to invest, on average, more extensively in foundational technologies, such as IoT, mobile and cloud, than their peers. They also express a significantly greater commitment to future investment in emerging technologies, such as robots, and AI and machine learning (see Figure 5).

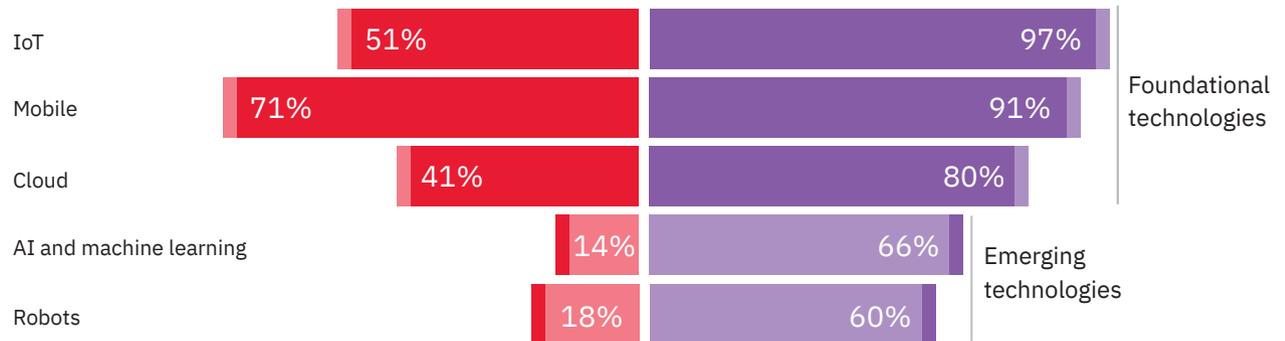
Traditional methods of analyzing structured data aren't designed to efficiently process the vast amounts of real-time data that stream from IoT devices. AI-based analysis and response becomes critical for extracting optimal value from that data. When IoT data is parsed into analytic or AI-based algorithms for autonomous decision making and more efficient machine-to-human interaction, companies can drive interconnected intelligence.

Figure 5

Reinventors
All others

Industrial Products Reinventors are more committed to investing in emerging technologies to enable future capabilities

Very likely to invest in the following technologies to enable strategic goals



The combination of these foundational (such as IoT) and emerging (such as AI and robots) technologies is a set of capabilities that can vastly extend efficiency, speed and value across the enterprise. Additional benefits include the potential to increase throughput and uptime; decrease risk by analyzing machines, predicting outages and handling equipment repairs; and reduce downtime, improve quality and streamline operations by adapting the factory floor in real time.

AI systems can help predict and identify impacts, and then recommend actions to improve production. For machine maintenance, AI can identify anomalies, assess their criticality, determine their root causes and help maintenance technicians correctly perform repairs.

“In the future, instead of offering a product, we plan to follow and analyze the growth cycle of a crop using big data and IoT toward precision-farming.”

Chief Information Officer, Industrial Products, Belgium

Integrate AI with IoT

Industrial Products Reinventors have a vision for integrating AI with IoT across the business. Over two-thirds strongly agree that the full potential of IoT can be realized with the introduction of AI technologies, as compared to less than a quarter of their peers (see Figure 6).

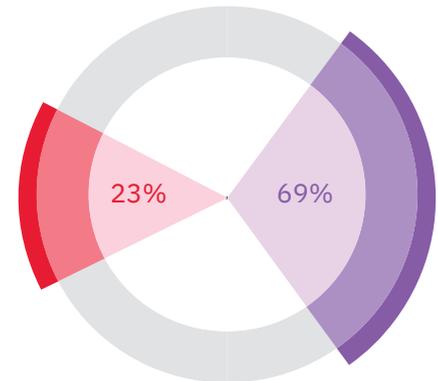
Figure 6

Reinventors
All others

Industrial Products Reinventors have a vision to integrate AI with IoT across the business

With the addition of AI and machine learning, the full potential of IoT can be realized

3X more agree



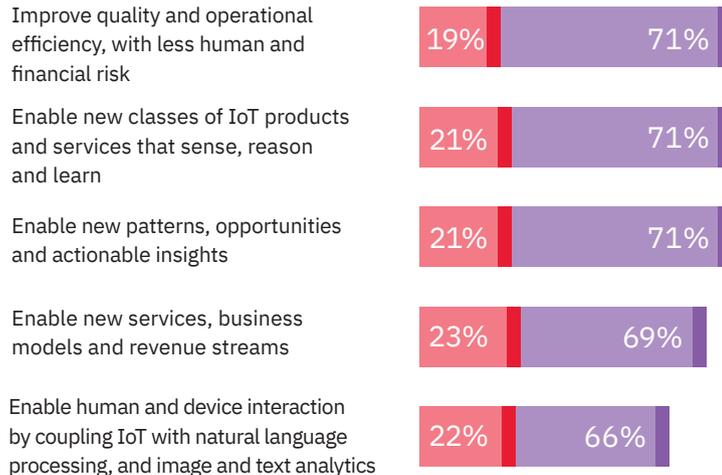
They also understand how combining the two provides potential benefits that can be leveraged for business model reinvention. Ultimately, it can help Industrial Products companies improve operational efficiency, introduce new products and services, and discover new opportunities (see Figure 7).

Figure 7

Reinventors
All others

Intelligent IoT can enable business model reinvention leading to new services and revenue streams

Industrial Products Reinventors understand the benefits of combining IoT and AI



Komatsu Ltd., one of the world's leading manufacturers and suppliers of earth-moving equipment, uses KOMTRAX, its remote monitoring system, to track the activities of almost 430,000 bulldozers, dump-trucks and forklifts owned by its customers. Komatsu's machines ship with GPS chips that provide location information and a unit that gathers engine data. The machines can then transmit the resulting data to a communication satellite, which relays that information to the KOMTRAX data center. Komatsu can apply the captured data to refining R&D activities, targeting customers for replacements or upgrades, improving operations by better predicting the lifetime of parts and the best time for overhauls, and offering customers value-added services.

Komatsu: Adding intelligence to its products⁸

The journey toward Intelligent IoT

A well-constructed program based on specific use cases provides a great starting point for reinventing your Industrial Products enterprise capabilities with Intelligent IoT.

Develop a clear strategy

Identify business problems that AI and IoT technologies can address, then articulate the expected benefits. For equipment manufacturers, IoT can help instrument and interconnect equipment and create new ways to provide higher value services and new revenue opportunities. For machine owners, IoT can help optimize operations across fleets or facilities from multiple OEM manufacturers, and reduce risks and increase ROI.

Establish the data infrastructure and determine the interplay between IoT and other foundational and emerging technologies. For instance, by linking your mobile apps with IoT, you could create virtual shields to protect operators. Your company could then check employees' alertness, hydration levels, proximity to dangerous equipment and environmental conditions (such as temperature or hazardous gases). In another instance, by linking AI with IoT, you could perform predictive machine maintenance. When an IoT sensor detects a machine anomaly, a cognitive advisor could diagnosis it, trigger generation of a worker order and schedule the repair service.

Enhance data analytics skills. With smart manufacturing, employee roles become more analytical and technical. To keep up, build the necessary skills within your organization through training, source talent outside the organization and supplement with skills from your partner network.

Enable execution

Adopt the right platform that has global reach, can enable a large portfolio of services, and is open and extensible. Your platform should include IoT-enabled assets (sensors, instrumentation, controls and materials), operations (production, quality, inventory and maintenance), business systems, and governance and planning systems.

Leverage a broad range of internal and external data (such as audio, video, weather, text and sensor data) across your ecosystem, and use that data to design new customer experiences. For instance, farm equipment manufacturers are combining intelligent machine data with weather data and crop pricing to optimize farm performance.

Create new ecosystems to address supply, manufacturing and distribution. Consider using sensors, meters, actuators, GPS and other devices to provide reporting on shipping containers, trucks, products and parts. This real-time connectivity across an extended value chain can help your company respond in a coordinated fashion to disruptions.

Reinvent your business

Accelerate product innovation by infusing customer experience with IoT intelligence and automation. Using the IoT data collected across a fleet, product engineering can better understand how the installed base is performing and identify factors affecting efficiency. This, in turn, can lead to new ideas for upgrading the installed base with innovative capabilities.

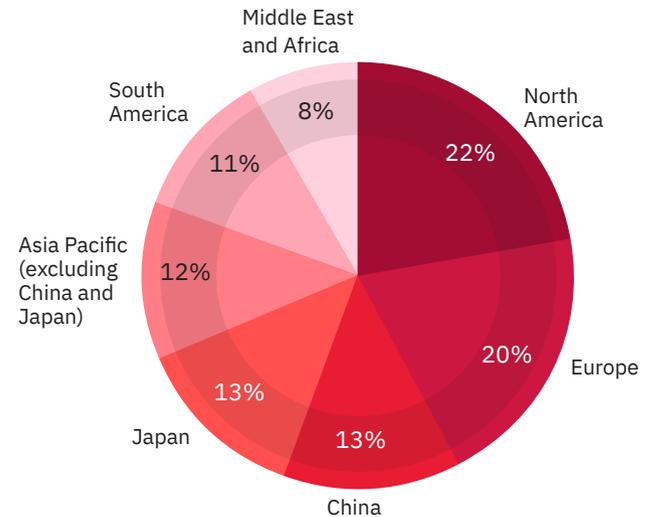
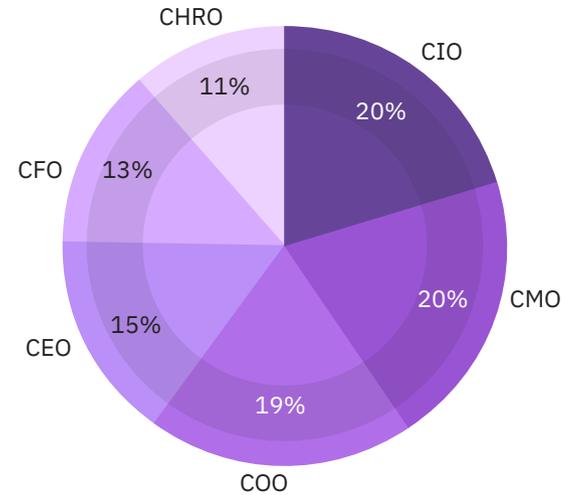
Streamline your operations. Automate and optimize processes to improve quality and operational efficiency with less human and financial risk. In factories, this can make production lines more flexible, thereby enabling more dynamic design and configuration of machines to fulfill specific client considerations, such as the terrain and other environmental conditions where the machines will be deployed.

Develop new services and business models through data monetization. Pay-as-you-go and as-a-service models offer the opportunity to increase asset usage. Examples include a construction equipment manufacturer that rents equipment on a per use basis and a tools manufacturer that provides access to power tools at a fixed monthly rate.

Our research methodology

The IBM IBV, in cooperation with Oxford Economics, interviewed 3,158 CxOs from 89 countries and 20 industries worldwide. Information was collected through a combination of live phone interviews and face-to-face meetings conducted from July through September 2017. This research in this report focused on the 271 Industrial Products industry C-suite respondents. Respondents in our study were a balanced mix of six C-suite roles: Chief Executive Officers, Chief Financial Officers, Chief Human Resource Officers, Chief Information Officers, Chief Marketing Officers and Chief Operating Officers.

We analyzed responses to questions about their current levels of automation and their ability to leverage structured and unstructured data, coupled with their current and future plans to invest in AI for IoT-based applications.



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