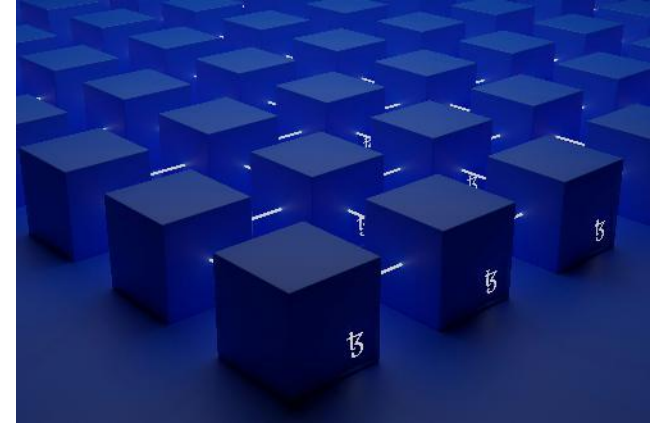


ThoughtLab

# Decoding manufacturing excellence

- strategic priorities for a smart, connected enterprise



# Manufacturers lead the shift to smart connectivity

Manufacturing stands at the forefront of smart IoT connectivity. With their sights on Industry 4.0 and beyond, many manufacturers have already integrated connected devices, sensors, and advanced analytics across their machines, production lines, and supply chains—creating a seamless flow of real-time intelligence from factory floor to global operations.

The rapid advance of IoT and AI technologies is redefining how manufacturers operate, propelling production efficiency, quality, agility, innovation, and asset management to new heights. By embracing these tools, leading manufacturers are turning plants into smart, connected operations that can optimize performance and decision-making across both digital and physical environments. Those that have moved furthest along this path are already seeing tangible gains in productivity, safety, profitability, and customer satisfaction.

## More IoT transformation is needed

However, even for this pioneering sector, the transformation is far from complete. Many manufacturers still lack the full integration and AI-powered solutions needed to unlock their full value. The challenge now is not just to deploy connected technologies, but to make them work seamlessly together across the physical and digital sides of the business.

To track how manufacturing is evolving toward this goal, ThoughtLab and Axis Communications analyzed 100 manufacturers from a global study of 600 organizations across North America, Europe, and the Asia-Pacific region. This report captures where manufacturers stand on the journey to becoming fully smart and connected, and what it will take to get there.

## Survey sample

**Number of respondents:** 100

**Industry profile:** Respondents across six subsectors: automotive, consumer goods, food processing, machinery and equipment, pharmaceuticals and chemicals, and refinement and material production.

**Regional profile:** 51% from EMEA, 31% from APAC, and 18% from North America.

**Revenue size:** Average annual revenue of \$18.7 billion. Roughly 30% with revenues below \$1 billion, 40% between \$1 billion and \$10 billion, and 30% above \$10 billion.

**Executive function:** mix of Chief Operating Officers, Chief Technology Officers, Chief Information Officers, Chief Digital Officers, Chief Data Officers, IoT Directors, and Operations Executives overseeing smart-factory transformation.

# The age of the smart, connected manufacturing

Manufacturers are forging ahead of other industries in driving smart connectivity—and are already seeing the fruits of their labor. But to fully unlock IoT's potential, executives need to overcome a host of obstacles on their journey to excellence.

# The rise of smart, connected manufacturers

Manufacturing leads all industries in the shift toward IoT- and AI-enabled connectivity. Today, 63% of manufacturers are already spreading or fully using IoT devices, a share expected to rise to 76% within two years—ahead of every other sector in the study.

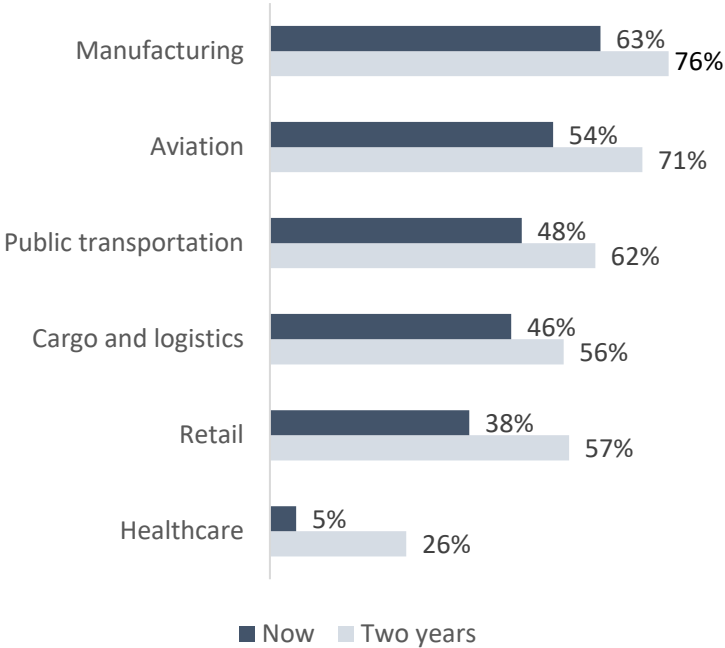
### Manufacturing’s headstart

This leadership partly reflects the industry’s long experience with automation, its dependence on large-scale assets, and early progress in integrating IT and operational technologies. However, it also stems from the industry’s continuous need to prop up profit margins by improving efficiency, productivity, and yield.

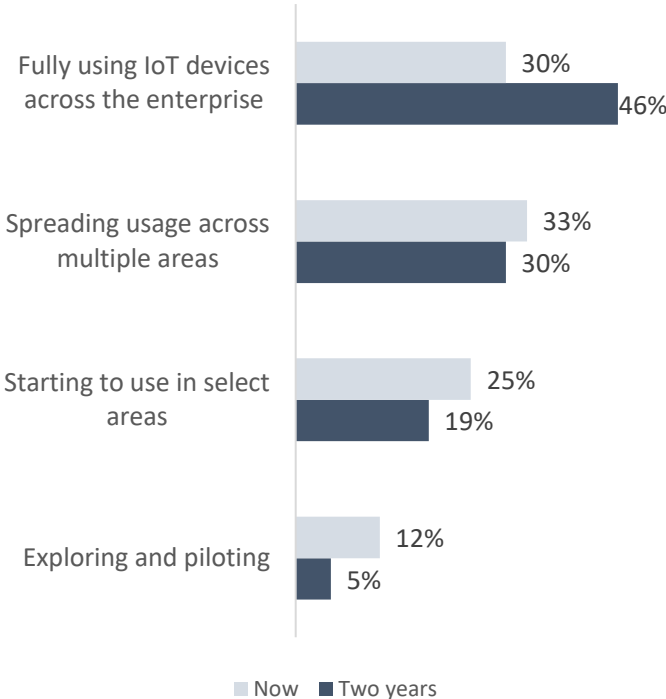
### Driving optimization and competitiveness

IoT provides the visibility and control needed to optimize processes and maintain competitiveness in a global market. The high costs of unplanned downtime make predictive maintenance one of the most compelling IoT applications, rapidly paying back its investment. Moreover, the sector’s embrace of Industry 4.0 has created shared standards, ecosystems, and peer momentum that few other industries can match.

Share of companies with spreading or full use of IoT devices by industry



Stage of IoT use in manufacturing companies



Q6: To what extent does your company now use IoT devices? To what extent does your company plan to use them over the next two years?

# The allure of IoT connectivity

IoT's allure for manufacturers is rooted in its ability to transform all areas of the industry's value chain, from engineering and production to supply chain management and logistics. As IoT connections deepen, the factory starts acting like a coordinated system that learns, anticipates, and increasingly optimizes itself.

## Operational improvements

IoT connectivity optimizes manufacturing operations by tightly linking asset performance, supply chains, and energy use. When machines stream real-time data, manufacturers can boost asset utilization and align production with actual demand, reducing excess inventory, bottlenecks, and energy use. This results in lower operational costs and safer environments for workers.

## Strategic and financial gains

With access to real-time data, manufacturers can go beyond optimization and drive strategic transformation of their businesses. They can plan more strategically, run richer predictive and scenario analyses, and make faster, evidence-based decisions. This intelligence makes it easier to scale innovations across plants and product lines, allowing manufacturers to boost customer satisfaction and profitability.



Quality, predictive maintenance, operations planning and scheduling, and energy management—these are where manufacturing's real ROI emerges.”

**Gabriele Mangiafico**, Business Development Manager - Industrial and manufacturing, EMEA, Axis Communications

## Top operational benefits

Improved asset utilization	76%
Better supply chain and inventory management	76%
Reduced energy and resource consumption	72%
Lower operational costs	71%
Improved worker safety	65%
Enhanced operational performance	60%

## Top strategic and financial benefits

Higher customer satisfaction	75%
Improved strategic planning	72%
Improved predictive and scenario analysis	66%
Improved scalability	60%
Better decision-making	59%
Greater profitability	58%

Q13: What are the main benefits that your company is seeing from the use of IoT solutions?

# Speed bumps on the road to connectivity

Becoming a smart, connected manufacturer can be an arduous journey for unprepared executives. Even as adoption accelerates, many firms continue to face significant barriers when rolling out deploying IoT programs.

The most common challenge cited by manufacturers is data security and privacy, followed by regulatory compliance. Regulatory pressure amplifies this concern, forcing manufacturers to impose stricter governance.

## Technology hurdles

Without the right IT foundation, manufacturers can find it difficult to make IoT progress. Fragmented legacy systems not only hinder integration and efficiency, but they can also lead to inconsistent data quality, as well as silos that obstruct real-time insights. Connectivity gaps can further restrict scalability, impede data management, and derail real-time decision making.

## Organizational roadblocks

Often, the company's organization stands in the way of an effective IoT journey. For example, lack of cross-departmental collaboration can prevent a cohesive enterprise IoT approach and even drive high costs, as siloed teams fail to pool efforts and budgets. Difficulty to scale compounds the problem, turning promising IoT pilots into isolated efforts that do not gain ground across the enterprise.

To overcome these barriers, manufacturers in our study take many steps, from providing staff with collaboration platforms and standardized IT architectures to prioritizing high-impact use cases that can be scaled across the organization.

## Trust, security, and reliability challenges

Data security and privacy concerns	56%
Regulatory, ethical, and compliance issues	44%
Worries about reliability and maintenance	41%

## Technology and data challenges

Integration complexity with legacy systems	46%
Data management challenges	38%
Connectivity limitations	25%

## Organizational challenges

Lack of cross-departmental collaboration	37%
High costs	29%
Difficulty to scale	28%

Q16: What are the biggest challenges that your organization has faced in deploying IoT devices?

# Becoming a IoT leader in manufacturing

Our research identified IoT leaders in the manufacturing industry that have successfully seized the opportunities of IoT connectivity. Their approach provides a roadmap for others striving to become smart connected businesses.

# Identifying the leaders

As part of our survey, we asked executives to rank their firms' use of IoT devices against five levels of maturity:

**Level 1:** IoT devices are managed individually or within isolated networks.

**Level 2:** IoT data is monitored through dashboards showing basic visualizations and status updates, with limited system integration.

**Level 3:** A centralized IoT platform manages devices and consolidates data and is integrated with existing core IT systems.

**Level 4:** A centralized IoT platform integrates both IT systems and operational technology data streams, enabling insights across digital and physical operations.

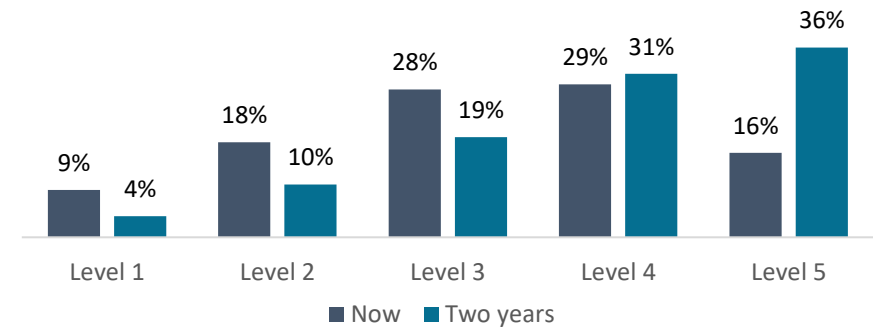
**Level 5:** An advanced, centralized IoT platform that maximizes value by using AI to deliver predictive insights and automation across IT and OT systems.

## Fast progress

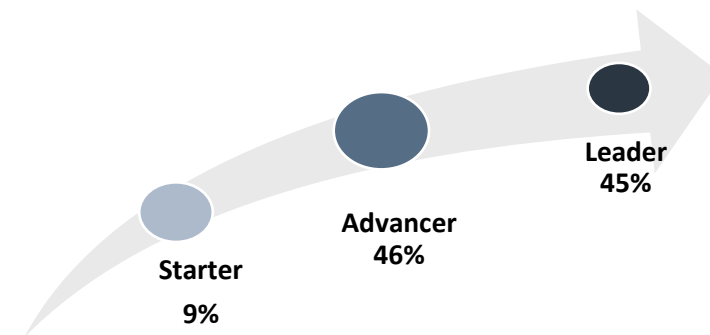
Progress in IoT maturity is advancing faster than in manufacturing than any other sector. At present, 27% of manufacturers remain in the early stages of maturity (Levels 1 and 2), while 45% have already reached the most advanced stages (Levels 4 and 5). Manufacturers at Level 1 are considered starters, those at Levels 2 and 3 are classified as advancers, and those at Levels 4 and 5 are defined as leaders.

Separately, we also measured the IoT maturity of industries and subsectors by assigning each respondent a score from 0 to 100, based on five levels of usage. Levels 1 through 5 corresponded to scores of 20, 40, 60, 80, and 100. This resulted in a total industry or subsector score that was divided by the number of companies included. The index was 65.0 for the manufacturing industry as a whole, 71.4 for industrial manufacturing (which encompasses automotive, machinery, and other capital-intensive subsectors) and 60.0 for consumer manufacturing (which covers food processing, pharmaceuticals, and consumer goods).

## The path to becoming a smart connected manufacturer



## IoT journey in the manufacturing industry



Q9: Which best describes your company's level of maturity in managing IoT devices now? What level of maturity does your company plan to achieve in two years?

# Who are the manufacturing IoT leaders?

Manufacturing stands out as the most advanced industry in IoT adoption, with 45% of firms identifying as leaders.

Industrial manufacturers, are particularly ahead: 59% of them classify as leaders, compared with 34% among consumer manufacturers. This reflects the capital-intensive nature of industrial operations, where optimizing assets and uptime directly affects profitability.

As Gabriele Mangiafico, business development manager, industrial and manufacturing, EMEA at Axis Communications, explains, “Industrial manufacturing deals with high-value assets and low tolerance for error, creating a stronger need for predictive maintenance, process optimization, and data-driven decision-making.”

## Scale and region

Large manufacturers retain a clear advantage: the vast majority of firms with revenues above \$10 billion are IoT leaders, versus none below \$1 billion. Scale supports investment in integration, cybersecurity, and skilled talent. Regionally, North American manufacturers remain in front, supported by early adoption and deeper technology budgets, while EMEA and APAC are catching up quickly but remain more uneven in readiness and investment.

The gap between industrial and consumer segments underscores a broader truth -- IoT leadership grows from operational need, sustained strategy, and the ability to turn connectivity into measurable performance gains.

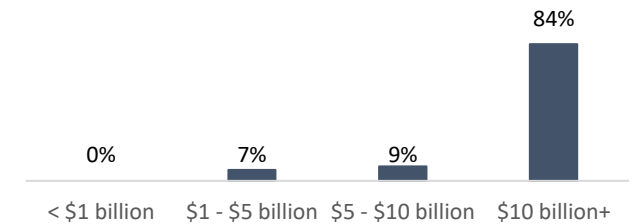
## IoT journey, industrial manufacturers

Level 1	7%
Level 2	11%
Level 3	23%
Level 4	36%
Level 5	23%

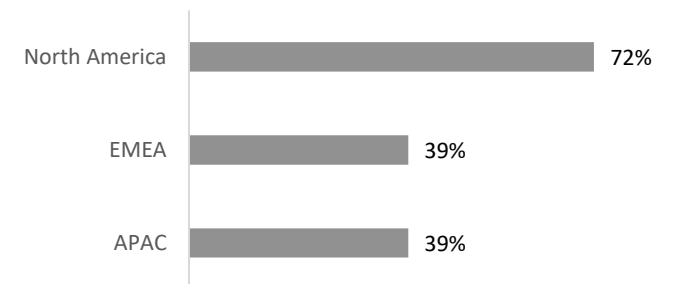
## IoT journey, consumer manufacturers

Level 1	11%
Level 2	23%
Level 3	32%
Level 4	23%
Level 5	11%

## Share of leaders in each revenue group



## Percentage of leaders by region



# Becoming a manufacturing IoT leader takes time

Becoming a connected manufacturing leader is a long-term journey that demands persistence, investment, and organizational change. On average, manufacturing leaders have been refining their IoT capabilities for more than six years.

The evidence shows that maturity pays off. Manufacturers that have reached full integration between information and operational technologies achieve sharper visibility, fewer disruptions, and faster decision-making. Once IoT data flows freely between production equipment and enterprise systems, factories can anticipate maintenance needs, optimize throughput, and react instantly to quality issues.

## Starters invest more upfront

To catch up, starters dedicate a higher share of their IT/OT budgets to IoT. They are putting resources into the digital backbone that leaders already have in place: connected assets, unified data platforms, and skilled people to run them.

In practice, building this level of connectivity takes some years, as manufacturers evolve from siloed data capture to integrated, analytics-driven operations. Companies that sustain the effort see significant higher efficiency and productivity once their IoT systems reach full maturity.



Developing a data-centric culture takes years, and it is only after the company has really done it that it is ready to make the most of an expanding tech stack to support its IoT journey.”

**Gabriele Mangiafico**, Business Development Manager - Industrial and manufacturing, EMEA, Axis Communications

## Average time manufacturers have used IoT devices

Leaders	Advancers	Starters
6.17 yrs	3.82 yrs	1.33 yrs

## Share of IT/OT budget spent on IoT devices

	Leaders	Advancers	Starters
Now	9.4%	10.8%	11.3%
Two years	11%	11.9%	12.7%

Q11: How long has your company been using IoT devices for driving operational efficiency and supporting business intelligence? (Average number of years) Q10: Please estimate the percentage of your company's IT/OT budget now spent on IoT devices.

# What sets IoT leaders in manufacturing apart

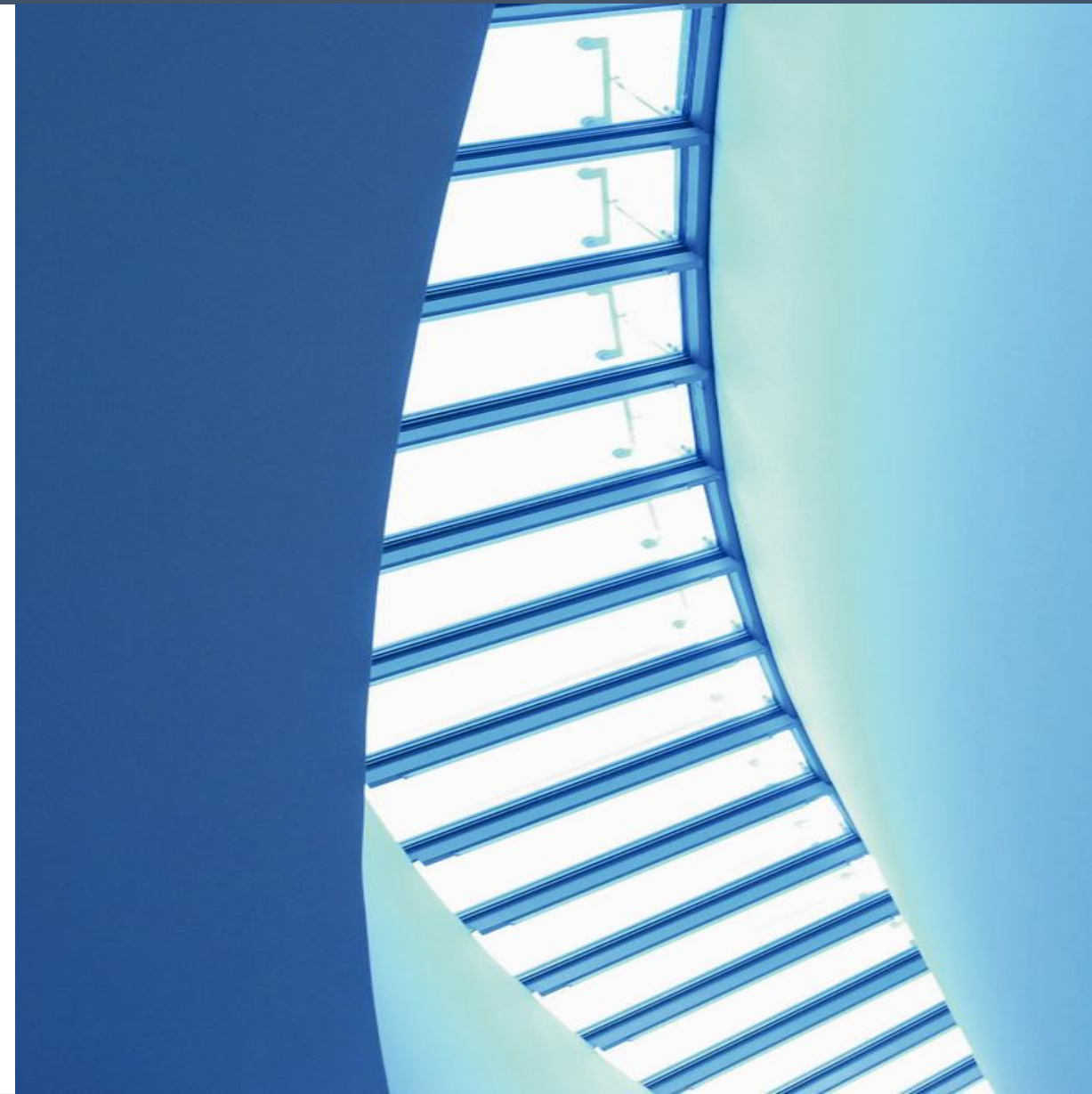
Manufacturing leaders transform connectivity into a powerful driver of efficiency and growth by embracing continuous innovation, implementing a range of IoT technologies and use cases and overcoming speed bumps on the road to IoT leadership.

# Leaders show the way

Our research identified a select cadre of manufacturing leaders that are well ahead of their peers in smart connectivity. These enterprises excel at harnessing AI and real-time data from across physical and digital assets to drive business performance and decision-making.

Our study shows that leaders do five things differently than others:

1. **Deploy an array of IoT devices** on a centralized IoT platform that integrates IT and OT data streams.
2. **Build multiple use cases**, including advanced solutions such as scenario analysis and predictive maintenance—to supercharge results.
3. **Excel at overcoming IoT hurdles**, such as those around data security and privacy, compliance, skills gaps, and high costs.
4. **Make IoT innovation a continuous process**, constantly embracing new IoT devices and use cases and driving workforce transformation.
5. **Turn connectivity into a force multiplier**, delivering much higher ROI and many more strategic, operational, and financial benefits.



Q13: What are the main benefits that your company is seeing from the use of IoT solutions?

# 1. Leaders deploy and integrate an array of IoT devices

Manufacturing leaders are distinguished by the breadth and integration of their IoT environments. Rather than deploying devices in isolation, they connect them through centralized platforms that merge data from cameras, sensors, and machines into a single operational view across production systems in real time.

Leaders follow a consistent pattern: they start with core monitoring tools such as network cameras and access control, then expand into robotics, environmental sensing, and audio-visual analytics. The result is a connected ecosystem that unites visibility, safety, and efficiency. By managing this array through interoperable platforms, they reduce data silos and lay the groundwork for AI-driven decision-making.

## Scaling connectivity

The same logic helps them scale connectivity from a handful of pilot plants to global operations. For other manufacturers, the takeaway is clear: progress depends on not only the number of connected devices deployed, but also on how well they work together.

Every leader in our study uses a centralized IoT platform that integrates IT systems and data streams from operational technology.

## Types of IoT devices deployed by maturity

	Leaders	Advancers	Starters
Network access control	100%	93%	56%
Network cameras	100%	93%	44%
Network environmental sensors	93%	80%	22%
Network motion detectors	93%	63%	0%
Robots	80%	65%	0%
Network audio	76%	33%	22%
Network thermal imaging	60%	43%	0%
Network radar	49%	15%	0%
Digital signage (screens/TV)	18%	9%	22%

Q8: What types of IoT devices does your company currently deploy? Which types of IoT devices do you expect it to deploy over the next two years?

# From Industry 4.0 to Industry 5.0



## Gabriele Mangiafico

Business Development  
Manager - Industrial and  
Manufacturing, EMEA,  
Axis Communications

As part of the continuous improvement process, smart connected manufacturing leaders are now looking beyond Industry 4.0 to industry 5.0, according to Gabriele Mangiafico, EMEA business development manager at Axis Communications.

“Connectivity and IoT remain the foundation,” explains Mangiafico. “They link machines, systems, and people through real-time data to enable predictive, agile, and efficient operations. But the pandemic and other disruptions have shown that manufacturing also needs to become more resilient, more sustainable, and human-centric.”

Industry 5.0 focuses on collaboration between humans and advanced technologies, including AI, robotics, IoT, and big data analytics. On top of the automation and efficiency that characterize Industry 4.0, Industry 5.0 seeks to add human, environmental, and social aspects back into manufacturing and production processes. The approach emphasizes worker well-being and ensures production adheres to planetary welfare.

### **Continuous feedback loops**

To foster collaboration between people and intelligent systems, IoT and AI create continuous feedback loops where data supports and enhances human decision-making rather than replacing it. This shift allows factories to become not only smarter, but also safer and more adaptive—able to respond in real time to operational changes, supply chain shocks, or quality issues. At the same time, by optimizing energy use and reducing waste, connected operations contribute directly to environmental goals and long-term sustainability.

### **Cultural change**

Mangiafico points out that this transformation demands both technological integration and cultural change. Connectivity alone is not enough: organizations must also break down data silos, ensure interoperability between IT and OT systems, and cultivate a workforce comfortable with analytics and automation. Upskilling is key, enabling employees to use technology to solve problems creatively and manage increasingly complex digital ecosystems. Industry 5.0 therefore represents a rebalancing of the work handled by people and machines: skilled humans working alongside resilient, intelligent systems. It envisions manufacturing environments where AI and IoT automate repetitive tasks, while human insight drives innovation and value creation.

By merging technology with human capability, manufacturers can build smarter, more adaptive, and more responsible operations; in short, factories that are not only efficient and connected but also sustainable, secure, and deeply human at their core.

## 2. Leaders build multiple use cases to supercharge results

IoT manufacturing leaders squeeze more value out of every sensor, network, and platform by using them for multiple purposes.

For instance, they leverage the same IoT infrastructure for quality control, energy management, asset tracking, and predictive maintenance. And they design use cases to interlock—data gathered for real-time response on the line also feeds forecasting and scenario analysis in the boardroom. The result is a powerful multiplier effect on performance, payback, and ROI, as every additional use case builds on sunk costs and shared infrastructure.

### Advanced applications

Our research shows that IoT manufacturing leaders often start with operational priorities like quality control, customer satisfaction, energy management, and asset management. This approach allows them not to just deliver quick wins in reduced waste, costs, and energy usage, but to create the data backbone for more advanced value-generating IoT solutions.

Once core operations are implemented, leaders layer on use cases that improve how they run the business. They improve strategic planning, decision-making, and forecasting and scenario analysis by leveraging the continuous stream of IoT data from initial initiatives.

This allows leaders to simulate demand shifts, optimize capacity, and align production with commercial priorities.

These advanced applications allow them to test decisions virtually before acting on the shop floor, reducing downtime and material waste. This creates a self-reinforcing flywheel in which every use case strengthens the next.

### Top IoT use cases by maturity

	Leaders	Advancers	Starters
Quality control	98%	89%	33%
Enhanced customer experience	96%	80%	33%
Energy management	93%	78%	0%
Asset tracking and management	93%	72%	0%
Strategic planning	91%	43%	11%
Decision-making	89%	70%	44%
Forecasting and scenario analysis	89%	37%	11%
Data gathering	84%	87%	67%
Predictive maintenance	82%	61%	22%
Real-time response	82%	59%	22%

Q7: In which ways does your company use IoT devices today?

BMW

## Elevating quality control

BMW is not only a leading company in the automotive industry, but it is also a role model for smart connected innovation. At the forefront of its approach is its iFACTORY program, which combines IoT and AI solutions. BMW is now rolling out this program across all plants around the world.

BMW's iFACTORY is built on BMW's proprietary AIQX (Artificial Intelligence Quality Next) IT platform, which leverages IoT sensors and AI to streamline quality control processes. By using cameras to capture intricate details of each car produced—and applying computer vision and deep learning technology—the AIQX platform enables highly automated quality control to take place in fractions of a second.

### Image and video analysis

The AIQX platform leverages a vast network of IoT sensors and cameras to automatically detect design flaws and various errors by reviewing millions of collected data points, primarily images and videos. The real-time video images are swiftly transmitted to the cloud-based AIQX platform for immediate analysis using advanced AI models.

Production line staff can access the data and analysis immediately on their smart devices, allowing them to swiftly identify and address any defects before the vehicle progresses further in production. This results in substantial time and cost savings.

*This example is drawn from a [full case study](#) on the website of Axis Communications.*



Nestlé

## From protection to performance

Nestlé, one of the world's largest food manufacturers, has deployed Axis network technologies to improve both safety and operational performance across 22 production sites in France. More than 600 cameras, complemented by advanced radar systems, provide precise motion detection and perimeter protection, ensuring that potential intrusions are identified even in low-visibility conditions. The solution minimizes false alarms and enables faster on-site responses, helping Nestlé maintain uninterrupted operations in high-value industrial facilities.

### Optimizing production

Beyond security, the company is using connected video technologies to optimize production. In its coffee-jar filling lines, compact modular cameras supervise multiple robots, capturing detailed footage that supports machine diagnostics and process improvement. Recorded video is analyzed to identify the causes of incidents, fine-tune equipment performance, and support continuous optimization efforts.

For Nestlé, IoT-enabled video has evolved from a safety tool into a productivity platform—one that melds quality, reliability, and efficiency. Working closely with Axis and its partner AES DANA, Nestlé continues to expand these capabilities, proving that smart vision technology can strengthen both security and industrial performance at scale.

*This example is drawn from a [full case study](#) on the website of Axis Communications.*



# 3. Leaders turn early complexity into long-term resilience

Becoming a smart, connected manufacturer requires more than installing sensors; it demands the systematic dismantling of operational and structural barriers.

Manufacturers starting their IoT journeys face an average of 6.6 challenges, far above the 5.3 average for all other industries. This reflects the sector’s complexity from asset-heavy facilities, legacy equipment, and strict compliance requirements. Advancers also report slightly higher difficulty, showing how steep the mid-transformation stage can be.

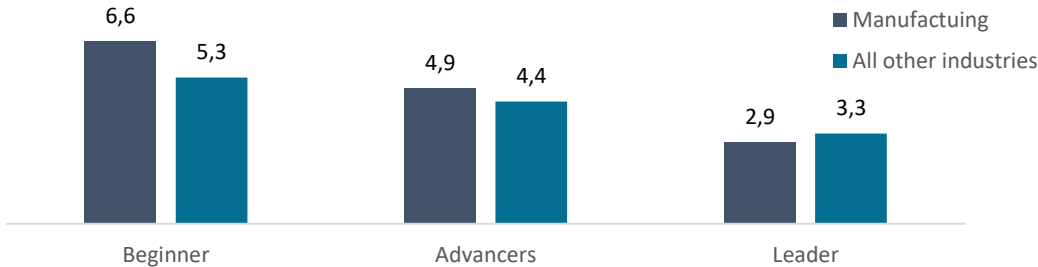
Once manufacturers cross into leadership, however, the pattern reverses. They face fewer challenges than leaders in other industries, proving that early investments in standardization and interoperability pay off. Leaders embed privacy and security by design, close skills gaps, and manage costs.

### Leader pain points

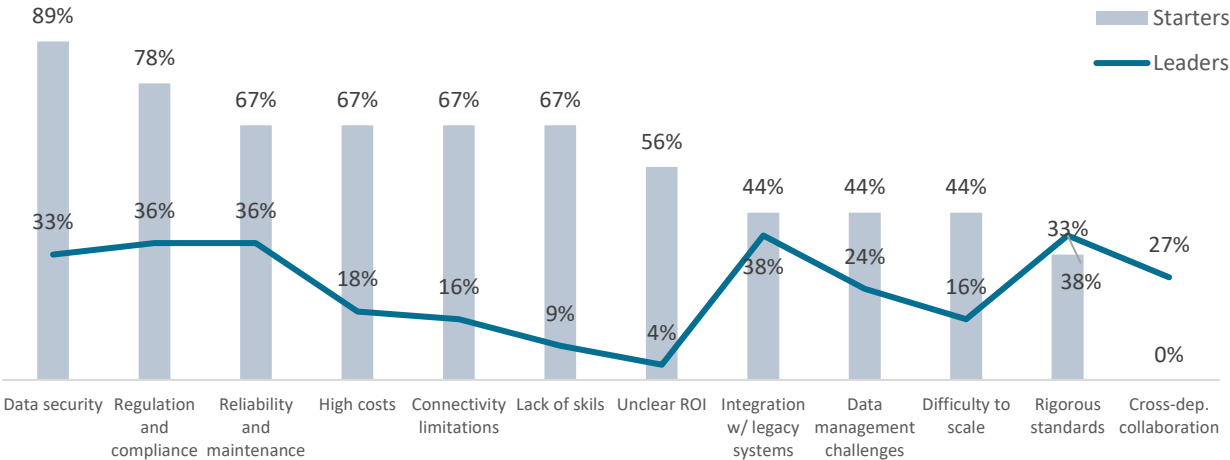
Yet as technical barriers fall, new organizational ones emerge. Leaders struggle more with rigorous standards and cross-departmental collaboration as they push IoT connectivity to the highest level. Compliance grows harder as IoT scales across global sites, while integration of IT, OT, and business functions demands greater alignment across silos.

The lesson: as manufacturers mature, technology simplifies operations, but only if the organization keeps up with change.

Average number of challenges by maturity



Leaders overcome many hurdles that starters face



Q16: What are the biggest challenges that your organization has faced in deploying IoT devices?

# How leaders surmount hurdles

## Data security and privacy

“Implemented a 'security by design' approach where operational teams are trained to consider security implications in all IoT-enabled processes.”

**Sr. executive, Japanese machinery manufacturer**

“We have been able to overcome the challenges with the help of data encryption and continuous audits.”  
**CIO, Indian automotive manufacturer**

## High costs

“We used a cost management partnership program for our suppliers to submit ideas for cost reduction.”  
**IoT Director, Australian automotive manufacturer**

“We are lowering expenses by using centralized data collecting and analysis tools that have given us a deeper understanding.”  
**Sr. executive, German consumers goods company**

## Data management

“We are establishing clear data governance regulations that specify data ownership, access restrictions, and compliance obligations.”

**Sr. executive, US consumer goods company**

“We implemented robust data governance framework to ensure data reliability and consistency.”  
**Sr. executive, French automotive company**

## Connectivity limitations

“Connectivity challenges were managed by using edge analytics to reduce data overload.”

**IoT director, US pharmaceutical company**

“We found creative ways to connect our older equipment using adapters and middleware.”  
**COO, UK consumer goods company**

## Regulatory compliance

“Our IoT systems include built-in compliance checks that flag potential issues before they become problems, keeping us ahead of new regulations.”  
**CTO, German consumer goods company**

“We collaborate with accredited certification providers or compliance consultants.”  
**CDO, Canadian automotive company**

## Reliability and maintenance

“Reliability and maintenance concerns were addressed through predictive maintenance algorithms and service agreements with vendors.”  
**CIO, Japanese materials producer**

“Worked on predictive analysis models to reduce unexpected equipment failures.”  
**IoT Director, UK materials producer**

## Lack of skills

“We have launched internal training programs to upskill our employees.”  
**IoT Director, Japanese pharmaceutical company**

“We partnered with external expertise to guide us through the initial phase because our team lacked skilled staff.”  
**CDO, Indian pharmaceutical company**

## Unclear ROI

“We set clear metrics before installing any sensors, tracking exactly how much downtime we reduced and energy we saved.”  
**CIO, US machinery and equipment company**

“Implementing IoT reduced our profits in initial stages, but complete integration in vehicles has given us much better ROI.”  
**Sr. executive, UK automotive company**

Q17: How has your organizations overcome these challenges?

# Creating real-time factories



**Cyrus Shaoul**

CEO, Leela AI

“Today’s best practice in manufacturing is achieving real-time, highly accurate visibility into operations so that companies can react swiftly to environmental changes,” according to Cyrus Shaoul, CEO and co-founder of Leela AI.

Thanks to advances in AI and IoT technologies, manufacturers are moving towards more autonomy in operations, explains Shaoul.

“For example, if a machine slows down unexpectedly, an IoT-connected system can detect this anomaly and initiate corrective actions or alerts without delay, minimizing downtime and bottlenecks.”

While traditional sensors have provided foundational data, many manufacturing activities have been very difficult to digitize, especially tasks involving complex, manual steps. “The best practice is using new kinds of sensors like video cameras, IP cameras, to fill in those holes, thereby capturing the nuances of manual work that otherwise remain invisible to digital systems,” argues Shaoul.

### **Leveraging visual AI**

In Shaoul’s view, AI—particularly computer vision—is critical for monitoring production activities in real time. “Visual AI allows us to accurately interpret high-speed video streams and determine exactly what is happening on the factory floor,” he says. “AI enables us to look at every pixel in a video stream. That’s an enormous amount of data when you consider there are millions of data points per frame, and we are analyzing 30 frames a second. Our AI algorithms examine what’s happening in the video feeds and determine whether someone is starting on a task, completing it, or if an activity is not adding any value. Without AI you would need to hire hundreds of people to do that.”

### **Building a strong data foundation**

Such advanced analysis is only possible if you have a modern data management system in place, according to Shaoul. “You need a foundational data platform, where data is collected correctly, stored in a uniform way, and managed with full metadata and taxonomy. And you need an enterprise data team focused on making sure that everything is running properly. Without a data foundation and the people to manage it, even the most advanced IoT and AI systems cannot operate reliably or deliver maximum value.” His advice: “Reevaluate your information architecture, remove silos, and ensure that data quality is high enough to drive full scalability and ecosystem integration.”

# 4. Leaders make IoT innovation a continuous process

For manufacturers, IoT innovation is a continuous process of integration, learning, and scaling. Already, 36% of leaders have reached Level 5 maturity, and 54% expect to do so within two years —well ahead of peers in other sectors.

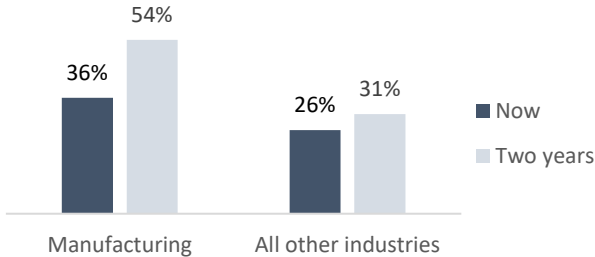
This evolution extends beyond the factory floor: predictive maintenance, remote diagnostics, and supply-chain visibility are becoming near-universal. Each new connection links assets, systems, and people through shared data, creating compounding value.

In manufacturing, the IoT journey never ends; every layer of connectivity fuels the next, turning smart factories into adaptive, intelligent, and continuously improving enterprises.

**67%** of manufacturing leaders now fully use IoT devices across their enterprises.

This number will grow to **91%** in two years.

Share of Level 5 among leaders\*



\*Defined as organizations with advanced centralized IoT platforms that leverage AI to deliver predictive insights and automation across IT and OT systems, maximizing the value of IoT systems.

IoT device types with largest increases for manufacturing leaders

	Today	2 years	% increase
Digital signage (screens/TV)	18%	62%	244%
Network thermal imaging	60%	96%	60%
Network radar	49%	76%	55%
Network audio	76%	98%	29%
Robots	80%	100%	25%

IoT use cases with the largest increases for manufacturing leaders

	Today	2 years	% increase
Remote management and diagnostics	69%	96%	39%
Safety and compliance	69%	91%	32%
Predictive maintenance	82%	100%	22%
Real-time response (act on data instantly)	82%	98%	20%
Supply chain management and visibility	82%	98%	20%

Q6. To what extent does your company now use IoT devices? To what extent does your company plan to use them over the next two years? Q7. In which ways does your company use IoT devices today? In which ways will your company use IoT devices over the next two years? Q8. What types of IoT devices does your company currently deploy? Which types of IoT devices does your company plan to deploy over the next two years? Q9. Which best describes your company's level of maturity in managing IoT devices now? What level of maturity does your company plan to achieve in two years

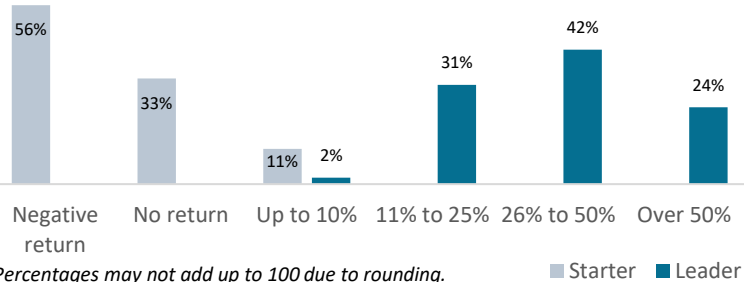
# 5. Leaders turn connectivity into a force multiplier

Manufacturing leaders have turned connectivity into a force multiplier. As they scale IoT across plants and supply chains, the benefits expand exponentially—far beyond efficiency. Manufacturing leaders report an average ROI of 37.7 %, compared with a meagre 0.6% for starters. They capture 3.5 times more benefits, from lower operational costs and superior scenario analysis to reduced downtime safety and greater asset utilization.

### A strategic engine

The turning point is integration: when data from cameras, sensors, and machines flows seamlessly into decision systems, every insight compounds in value. Leaders transform IoT from a monitoring tool into a strategic engine that drives continuous performance gains. In manufacturing, connectivity amplifies advantage. Each layer of intelligence not only strengthens operations but powers faster growth, resilience, and competitiveness.

### Leaders fire up results\*



### Leadership force multiplier

% reporting specific benefits, and multipliers realized by leaders

	Starter	Leader	Multiplier
Lower operational costs*	1%	91%	91
Improved predictive and scenario analysis*	1%	84%	84
Greater top line growth*	1%	67%	67
Reduced downtime*	1%	58%	58
Greater resilience*	1%	44%	44
Improved asset utilization	11%	93%	8.5
Improved worker safety	11%	91%	8.3

\*Adjusted from 0% to 1% to enable the multiplier calculation.

Q13: : What are the main benefits that your company is seeing from the use of IoT solutions? Q15. What is the current ROI on your investments in IoT devices?

# Connectivity is the backbone of modern manufacturing



**Veli-Pekka Salo**

Head of AI, Analytics  
and Automation  
Solutions, Wapice

Connectivity is far more than a helpful productivity tool; it's "the backbone of modern manufacturing," says Veli-Pekka Salo, Head of AI, Analytics and Automation solutions at Wapice. This is because the combined capabilities of IoT and AI are reshaping factories into intelligent, adaptive ecosystems where machines, processes, and people operate in a continuous dialogue.

According to Salo, Industry 5.0 builds on the connectivity foundations of earlier industrial waves but adds three defining pillars: resilience, sustainability, and human-centricity. By equipping every asset, from production machines to mobile robots, with sensor-rich intelligence, manufacturers can respond instantly to disruptions, support workers with better tools, and optimize resources in real time. "IoT enables dynamic feedback loops that make operations more predictive, more sustainable, and ultimately more human-focused," he explains.

## **Anticipatory action**

This transformation is most visible in advanced use cases such as predictive maintenance, real-time quality control, and digital-twin-driven simulation. Salo highlights how connected systems can detect anomalies before breakdowns occur, trigger automated responses, and help teams fine-tune processes long before issues escalate. "Real-time insights let factories shift from reacting to anticipating," he says.

A second hallmark of leadership is interoperability. Modern factories rely on a diverse mix of machines, sensors, and software platforms, and the ability to unify these environments is critical. "The true value of IoT lies in how well data flows across the ecosystem," Salo notes. Open architectures, common standards, and secure integration between IT and OT systems are essential to unlocking automation and AI at scale.

## **Providing services**

Another powerful outcome of IoT transformation is a shift toward "servitization"—where manufacturers become value-added service providers. Salo points to equipment makers who now offer remote diagnostics, machine-health insights, and even pay-per-use business models. "Connectivity lets manufacturers deliver services that were impossible before," he says. "It turns products into continuous value streams."

For Salo, the end goal is a manufacturing model where humans and intelligent systems work side by side, in flexible, self-optimizing, and deeply resilient factories. "Technology should empower people, not replace them," he emphasizes. "That's the real promise of smart manufacturing."

# How leaders plan to unlock additional value

## Improved asset utilization

“We're tracking how our equipment is actually being used, helping us get better performance from our machines.”  
**Sr. executive, German machine and equipment company**

“We will use smart IoT systems to predict issues in key machines before they happen, helping us avoid unexpected breakdowns.”  
**CIO, Indian automotive company**

## Greater quality control

“Smart tools will help spot defects instantly and alert our teams right away, improving product quality and speeding up production.”  
**CDO, Polish materials producer**

“In the next two years, real-time data will help automatically fine-tune production steps to keep food quality consistent.”  
**IoT director, Japanese food company**

## Improved worker safety

“IoT wearables and sensors will keep workers safe by monitoring conditions and spotting risks early while also ensuring safety rules are followed.”  
**CIO, Japanese materials producer**

“IoT-enabled accelerometers and fire-detection sensors will improve worker safety by monitoring environmental conditions and equipment status.”  
**CDO, Polish food processing company**

## Lower energy and resource usage

“Digital energy monitoring systems will lower resource usage and cut emissions.”  
**Sr. executive, UK refinement and material production company**

“Smart sensors throughout our facilities will help us identify where we're wasting energy and materials, and cut costs while helping the environment.”  
**CIO, US machinery and equipment company**

## Better supply chain and inventory management

“We will use IoT to monitor the progress of raw materials and components as they pass through the supply chain.”  
**IoT Director, Australian automotive company**

“IoT devices can optimize and centralize pharmaceutical inventory across our centers.”  
**IoT Director, Japanese pharmaceutical /chemical company**

## Higher customer satisfaction

“We tailor customer experiences using connected devices and focus on creative solutions that are cost-efficient.”  
**COO, US consumer goods company**

“Our aim is to improve our customer experience by enhancing integrated IoT.”  
**Sr. executive, UK automotive company**

## Improved strategic planning

“Live data from our production lines and supply chain will help us make smarter choices about what to make and when.”  
**CTO, German consumer goods company**

“We will identify trends to prepare to modify our operations in order to increase efficiency.”  
**Sr. executive, US consumer goods company**

## Improved predictive and scenario analysis

“We will be able to do better scenario planning and improve resilience in volatile environments.”  
**Sr. executive, French materials producer**

“We're using IoT data to test different production scenarios, helping us choose the most efficient approaches.”  
**CIO, Japanese consumer goods company**

Q17: How has your organizations overcome these challenges?

**IoT scorecards:**

**Industrial manufacturing and  
consumer manufacturing**



# Industrial manufacturing

# IoT maturity score 71.4

Industrial manufacturing—encompassing automotive, machinery, and other capital-intensive subsectors—leads the IoT connectivity journey in manufacturing. These firms operate complex processes with low tolerance for error, making IoT adoption essential to their success.

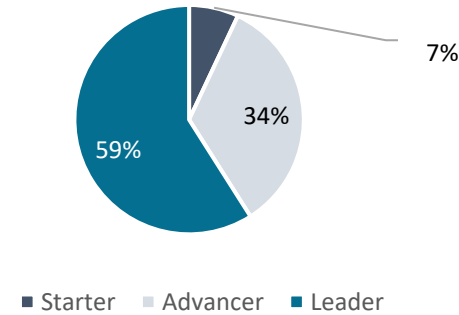
Leaders in industrial manufacturing are advancing quickly toward real-time, AI-enabled factories. Through IoT sensors, including access control, cameras, and environmental sensors, they continuously monitor production, anticipate equipment failures, and adapt to changing conditions with speed and precision.

### Reaping the benefits

Because of their highly repetitive, sensor-rich operations, industrial manufacturers have continuous access to data that can be used to detect defects, enhance customer experience, and improve decision making. In such a capital-intensive, complex industry, even small efficiency gains can translate into large financial rewards.

Industrial manufacturers unlock many benefits from IoT, particularly improved asset utilization, customer satisfaction, and worker safety. Meanwhile, as predictive maintenance and asset optimization become core capabilities, servitization models—such as machine-as-a-service—are helping many industrial manufacturers turn maintenance from a cost into a new revenue source.

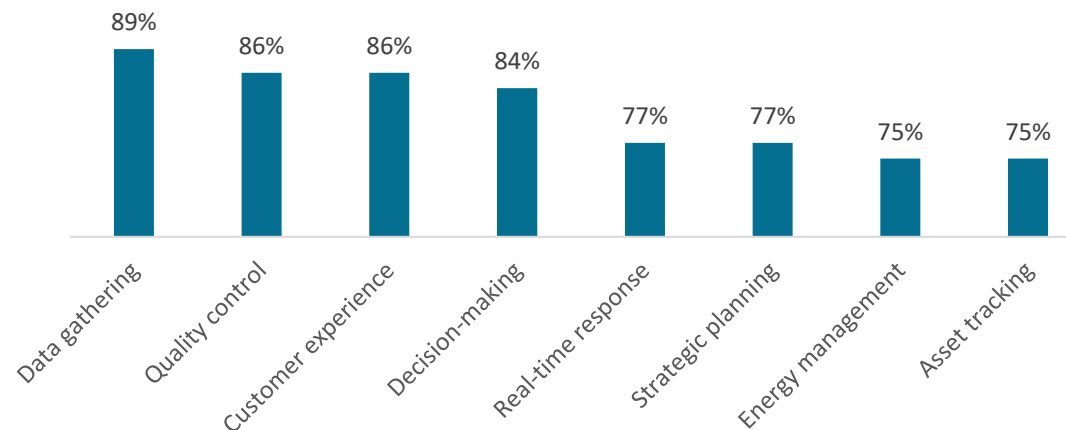
Breakout by IoT maturity



IoT devices used today

Access control	95%
Cameras	93%
Environmental sensors	82%
Motion detectors	77%
Robots	70%
Network audio	61%

Top IoT uses for industrial manufacturing



27.2% average ROI

5.2 years average period of use

10.1% of IT/OT budget spent on IoT devices

### Top three benefits

1. Improved asset utilization
2. Higher customer satisfaction
3. Improved worker safety



Consumer manufacturing—including food processing, pharmaceuticals, and consumer goods in our survey—is advancing quickly in its connectivity journey, though it still lags industrial manufacturing. IoT adoption is driven by quality control, data gathering, and customer experience, rather than automation alone.

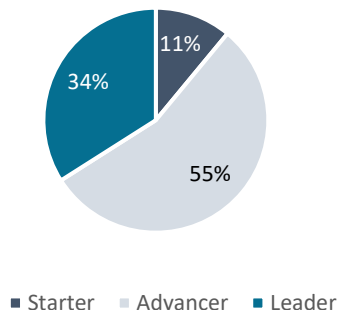
Leading firms use network cameras, sensors, and analytics to monitor production, ensure consistency, and reduce waste, while flexible, connected lines enable mass customization and faster responses to changing consumer demand.

### Catching up

Consumer manufacturers are often smaller than their peers in industrial segments. This poses a challenge, since smaller firms face barriers such as limited data expertise and strict regulatory oversight, which slow integration and scale.

Yet as they strengthen data infrastructure, adopt open platforms, and upskill workers, consumer manufacturers are rapidly progressing. With better data and interoperability, consumer industry manufacturers will achieve greater resilience, efficiency, and sustainability across its value chains.

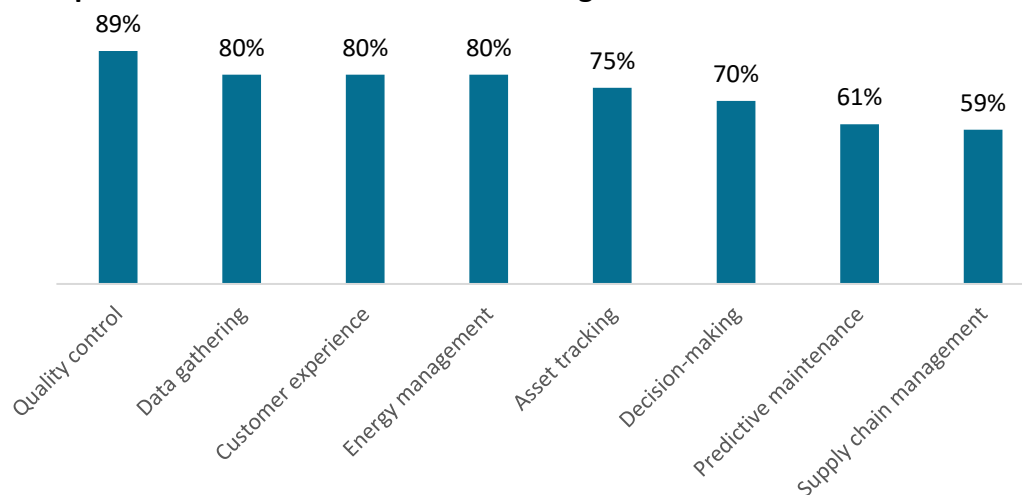
### Breakout by IoT maturity



### IoT devices used today

Access control	91%
Cameras	91%
Environmental sensors	80%
Motion detectors	66%
Robots	63%
Thermal imaging	52%

### Top IoT uses for consumer manufacturing



20.9% average ROI

4.2 years average period of use

10.3% of IT/OT budget spent on IoT devices

### Top three benefits

1. Better supply chain management
2. Reduced energy and resource consumption
3. Improved asset utilization

# Strategic priorities for success

With the right priorities manufacturers can move from fragmented operations to connected, predictive, and human-centric production—and turn IoT into a true driver of performance and resilience.

# The six priorities of manufacturing excellence

## 1. Build real-time operational visibility everywhere

Use IoT sensors, video intelligence, and connected machines to reveal what happens across the factory floor. Closing visibility gaps enables teams to detect anomalies instantly, optimize workflows, and respond to changes as they occur. Real-time insights help manufacturers reduce downtime, strengthen reliability, and support faster, more confident decision-making.

## 2. Strengthen your data and systems foundation

Modern manufacturing requires a unified data foundation that gathers information reliably, structures it consistently, and integrates it across silos. Invest in strong data structures and governance so IoT and AI applications can scale. Salo recommends a process where knowledge builds step by step: “Collect data and progress through descriptive, diagnostic, predictive, and prescriptive analytics. Finally, use generative and agentic AI to make insights conversational and actionable, transforming how people interact with and apply data.”

## 3 Boost interoperability across systems and teams

Manufacturing thrives on seamless communication among robots, sensors, machines, and enterprise systems. Leaders adopt open standards, shared protocols, and integration-first architectures to ensure data flows freely and securely. Treat interoperability as a strategic asset enabling flexibility, reducing fragmentation, and unlocking new automation and optimization opportunities across the entire production ecosystem.

## 4. Move from reacting to trends to predicting them

Shift maintenance, quality, and production planning from reactive approaches to predictive, AI-supported operations. Use visual intelligence, time-series models, and digital twins to anticipate failures, optimize workflows, and test scenarios. This proactive approach boosts resilience and enables more agile responses to supply chain or demand fluctuations.

## 5. Empower people with human-centric technology

Industry 5.0 emphasizes augmenting people, not replacing them. Equip workers with AI-supported tools, real-time insights, and collaborative automation to improve safety, reduce repetitive tasks, and enhance decision quality. When technology elevates human capability, manufacturers gain higher productivity, stronger engagement, and a more adaptable, future-ready workforce.

## 6. Scale innovation with ecosystem partners

Manufacturing leadership depends on strong collaboration with sensor providers, AI specialists, integrators, and software platforms. “We could not do what we do without great partnerships,” says Shaoul. By setting up the right ecosystem, Shaoul says that manufacturers can accelerate implementation, expand expertise, and ensure ongoing innovation.

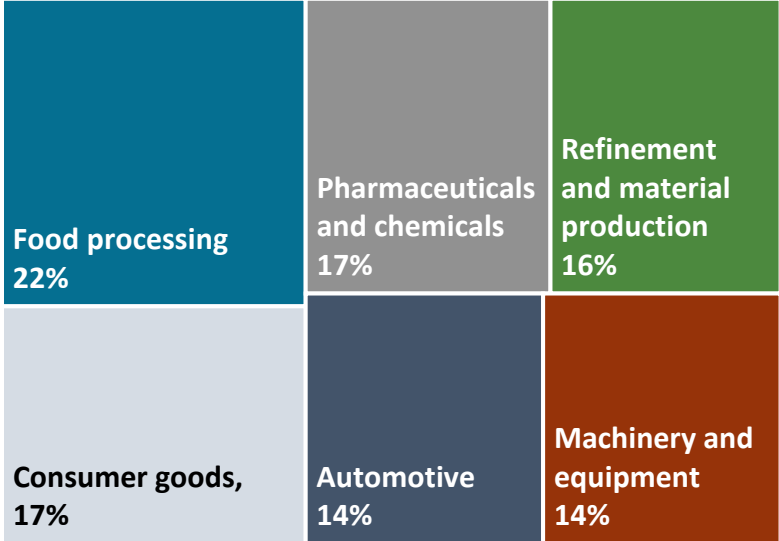


# Appendix: Survey sample

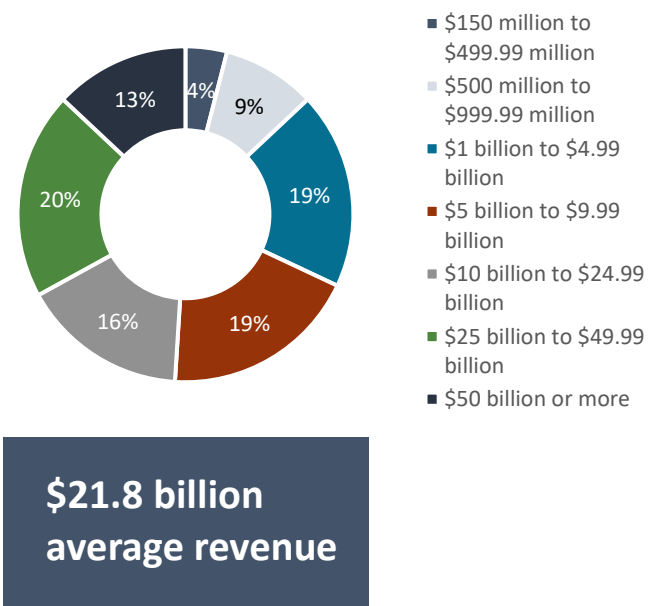
# Survey demographics

To better understand where manufacturing companies are in their connectivity journeys, ThoughtLab and Axis Communications conducted a study of 100 manufacturing respondents across North America, Europe, and the Asia-Pacific region in Q3 of 2025. This was part of a larger, cross-industry survey with 600 organizations.

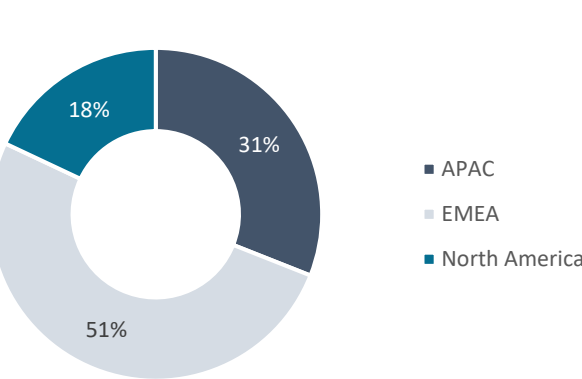
### Respondents by sector



### Respondents by revenue



### Respondents by region



# ThoughtLab

ThoughtLab is an innovative thought leadership and economic research firm providing fresh ideas and evidence-based analysis to help business and government leaders cope with transformative change. We specialize in analyzing the impact of technological, economic, and demographic shifts on industries, cities, and companies.

To learn more about ThoughtLab, visit: [www.thoughtlabgroup.com](http://www.thoughtlabgroup.com)

For further information about this study, please contact:

Lou Celi, Chief Executive Officer  
[louceli@thoughtlabgroup.com](mailto:louceli@thoughtlabgroup.com)

Daniel Miles, Chief Economist  
[danielmiles@thoughtlabgroup.com](mailto:danielmiles@thoughtlabgroup.com)