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</tr>
</tbody>
</table>
BACKGROUND

The Internet of Things (IoT) is transforming the way people live and work. Beyond just the smart devices you use every day, IoT is revolutionizing the way companies do business – allowing them to become faster, smarter, safer, and more efficient.

Microsoft has been at the forefront of IoT, innovating and investing as IoT continues to gain traction worldwide. The IoT Signals report was created to give the industry a holistic view of the IoT ecosystem – providing insight into adoption rates as well as benefits and challenges.

The goal of the IoT Signals report is to better serve our partners and customers, as well as help business leaders develop their own IoT strategies.

This report focuses on two pieces of research conducted in February 2019, including a deep dive into the manufacturing industry.
Microsoft commissioned Hypothesis Group, an insights, design, and strategy agency, to execute the IoT Signals research.

In February 2019, a 20-minute online survey was conducted with over 3,000 decision makers at enterprise companies across the US, UK, Germany, France, China, and Japan who were currently involved in IoT. The research included business decision makers (BDMs), IT decision makers (ITDMs), and developers from a range of industries such as manufacturing, retail/wholesale, government, transportation, healthcare, and more. The survey also included a 5-minute deep dive with 521 manufacturing decision-makers.
01  IoT IS DRIVING BOTH OPPORTUNITY AND OVERALL SUCCESS
Among the IoT decision-makers we spoke to, 85% have adopted IoT. The most commonly mentioned reasons to adopt IoT include efficiency of operations and employee productivity. Once organizations adopt IoT, the top benefits align with the reasons they adopted – companies experience increased efficiency, yield, and quality. Due to these benefits, 88% of IoT decision-makers believe IoT is critical to their company’s continued success.

02  SECURITY THREATS ARE NOT HINDERING ADOPTION
Nearly all companies are concerned about security threats as they adopt IoT. However only 19% perceive security as a top challenge, falling below other challenges including complexity, budget, knowledge, and finding the right solution. Even for adopters who consider security a top concern, 93% are satisfied with IoT and most intend to keep using IoT in the future as they believe IoT will continue to be critical to the success of their company.

03  A LACK OF SKILLED WORKERS CAN HOLD BACK THE POTENTIAL OF IoT
Despite its rapid adoption, 47% of current adopters feel that their companies don’t have adequate workers and 44% don’t have enough resources to see their projects through to realization. Companies with enough skilled workers are able to propel more IoT projects into the ‘use’ stage and reach it in less time, due in part to less failures during proof of concept.
WHO WE TALKED TO – OVERALL

BDMs, Developers, and ITDMs
who work at enterprise-size companies (1000+ employees)

- 63% FAMILIAR WITH IoT
  Self-stated, pass a knowledge test

- 92% HAVE INFLUENCE/DECISION-MAKING POWER ON IoT STRATEGIES

- 85% IN IoT ADOPTION

- 15% NOT IN IoT ADOPTION
IoT: THE BIG PICTURE

In the commercial arena, the Internet of Things continues to grow in popularity. Business decision makers, IT decision makers, and developers at enterprise-size commercial organizations are incorporating IoT into their businesses at high rates, and the overwhelming majority is satisfied with the business results. As an outcome, companies are increasingly eager to adopt IoT.

The enthusiasm for IoT adoption is global, and it also crosses industries. Among the enterprise IoT decision makers we surveyed, 85% say they have at least one IoT project in either the learning, proof of concept, purchase, or use phase, with many reporting they have one or more projects currently in ‘use’. (See Exhibit 1)

Adoption rates are similar across surveyed countries (US, UK, Germany, France, China, and Japan) and core industries (manufacturing, retail/wholesale, transportation, government, and healthcare). (See Exhibit 2)

### Exhibit 1
% IoT Decision-Makers in Adoption

- 85% using IoT
- 5% not using but have in past
- 10% not using, hasn’t in past

### Exhibit 2
% IoT Decision-Makers in Adoption

#### By Market
- US: 87%
- UK: 73%
- Germany: 88%
- France: 87%
- China: 88%
- Japan: 83%

#### By Industry
- Manufacturing: 87%
- Retail or wholesale: 90%
- Transportation: 86%
- Government: 83%
- Healthcare: 82%
IoT growth shows no signs of slowing: adoption is projected to increase by 9 points over the next two years, meaning 94% of businesses will be using IoT by the end of 2021. (See Exhibit 3)

Companies who incorporate IoT into their businesses are happy with the results: 88% of adopters say IoT is critical to the success of their company (See Exhibit 4). Nearly all decision makers are satisfied with IoT, most likely because they believe it has a strong return on investment (ROI).

As IoT influencers and decision makers look to the future, even more expect to adopt IoT and find new ways to use the technology. We heard from those in IoT adoption that, two years from now, they believe they will see a 30% ROI, inclusive of cost savings and efficiencies. The continued success of IoT will also rely on other innovations: decision makers believe that in the next two years, AI, edge computing, and 5G will be critical technological drivers for IoT success.
WHY ADOPT IoT?

On average, companies cite three to four major reasons that led them to adopt IoT. Efficiency and productivity are key motivators; the top two reasons that companies implement IoT are operations optimization (56%) and improvement of employee productivity (47%). The next most common use cases are safety and security, which 44% of companies view as top reasons to utilize IoT. 30% to 40% of enterprise companies also adopt IoT to manage supply chain, assure quality, track assets, and enable sales. On the whole, BDMs and developers view IoT as a way to streamline processes and work more efficiently. (See Exhibit 5)

EXHIBIT 5
REASONS FOR IoT ADOPTION

<table>
<thead>
<tr>
<th>Reason</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operations optimization</td>
<td>56%</td>
</tr>
<tr>
<td>Employee productivity</td>
<td>47%</td>
</tr>
<tr>
<td>Safety and security</td>
<td>44%</td>
</tr>
<tr>
<td>Supply chain management</td>
<td>40%</td>
</tr>
<tr>
<td>Quality assurance</td>
<td>40%</td>
</tr>
<tr>
<td>Asset tracking</td>
<td>33%</td>
</tr>
<tr>
<td>Sales enablement</td>
<td>31%</td>
</tr>
<tr>
<td>Energy management</td>
<td>26%</td>
</tr>
<tr>
<td>Condition-based maintenance</td>
<td>25%</td>
</tr>
<tr>
<td>Health and wellness</td>
<td>16%</td>
</tr>
</tbody>
</table>
While IoT has beneficial applications across industries, each industry prioritizes different use cases, according to its specific needs. In manufacturing, the top use cases for IoT are: automation (48%), quality and compliance (45%), production planning (43%), supply chain logistics (43%), and plant safety and security (33%). *(See Exhibit 6)*

For retail/wholesale companies, IoT is highly relevant for supply chain (64%) and inventory optimization (59%), while for transportation and government organizations equipment management and safety/surveillance are particularly important (~40%-55%). Within healthcare, IoT helps companies track patients, staff, and inventory (66%), as well as assists with remote device monitoring and service (57%). *(See Exhibit 7)*

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**EXHIBIT 6**

**MANUFACTURING TOP 5 USE CASES**

<table>
<thead>
<tr>
<th>Use Case</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial automation</td>
<td>48%</td>
</tr>
<tr>
<td>Quality and compliance</td>
<td>45%</td>
</tr>
<tr>
<td>Production planning and scheduling</td>
<td>43%</td>
</tr>
<tr>
<td>Supply chain and logistics</td>
<td>43%</td>
</tr>
<tr>
<td>Plant safety and security</td>
<td>33%</td>
</tr>
</tbody>
</table>

**EXHIBIT 7**

**ADDITIONAL TOP USE CASES BY INDUSTRY**

<table>
<thead>
<tr>
<th>RETAIL/WHOLESALE</th>
<th>TRANSPORTATION</th>
<th>GOVERNMENT</th>
<th>HEALTHCARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply chain optimization</td>
<td>Fleet management</td>
<td>Public Safety</td>
<td>Tracking patient, staff, and inventory</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Inventory optimization</td>
<td>Security, surveillance, and safety</td>
<td>Infrastructure and facilities management</td>
<td>Remote device monitoring and service</td>
</tr>
<tr>
<td>Surveillance and security</td>
<td>Manufacturing operations efficiency</td>
<td>Regulations and compliance management</td>
<td>Remote health monitoring and assistance</td>
</tr>
<tr>
<td>Loss prevention</td>
<td>Vehicle telematics and infotainment</td>
<td>Fleet and asset management</td>
<td>Safety, security, and compliance</td>
</tr>
<tr>
<td>Energy optimization</td>
<td>Predictive maintenance</td>
<td>Incident response</td>
<td>Facilities management</td>
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</tbody>
</table>
Once organizations adopt IoT, the top benefits align with the reasons they adopted – companies experience increased efficiency (91%), yield (91%), and quality (85%). Enterprise companies are quickly starting to see how IoT can deliver a return on investment by increasing productivity and production capacity, reducing business expenses, and lowering the chances of human error. IoT can also improve customer satisfaction and increase opportunities for companies to make better and more informed decisions. (See Exhibit 8)
WHAT ARE THE CHALLENGES OF IoT ADOPTION?

Despite its success, IoT is not without challenges. Both for companies striving to get IoT projects off the ground and for companies looking to use IoT more, the roadblocks are often the same: complexity and technical challenges, security concerns, and lack of talent and training.

Companies who want to utilize IoT more find that complexity and technical challenges are their biggest barriers: 38% of companies say these are the reasons they aren’t using IoT more. Lack of budget and staff resources (29%), lack of knowledge (29%), and difficulty finding the right solution (28%) are the next most common roadblocks. Security is also a challenge (19%). (See Exhibit 9)

EXHIBIT 9

TOP IoT CHALLENGES

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complexity/technical challenges</td>
<td>38%</td>
</tr>
<tr>
<td>Lack of budget/staff resources</td>
<td>29%</td>
</tr>
<tr>
<td>Lack of knowledge</td>
<td>29%</td>
</tr>
<tr>
<td>Haven’t found the right IoT solutions</td>
<td>28%</td>
</tr>
<tr>
<td>Security</td>
<td>19%</td>
</tr>
</tbody>
</table>
Lack of talent and training present challenges for almost half of IoT adopters. In this relatively new field, it’s hard to find workers with the right skills and experience. 47% of companies that have adopted IoT report that they don’t have enough skilled workers (See Exhibit 10), and 44% don’t have enough available resources to train employees. (See Exhibit 11)

EXHIBIT 10
TECHNICAL TALENT ASSESSMENT

- **47%** Not enough available skilled workers
- **43%** Enough available skilled workers
- **10%** No need for talent

EXHIBIT 11
INDUSTRY TRAINING ASSESSMENT

- **44%** Not enough available resources to train workers
- **46%** Enough available resources to train workers
- **10%** No need for training resources
Security concerns around IoT adoption are universal: 97% of companies are concerned about security when implementing IoT (though this is not hindering adoption). Collectively, the top security priority is software/firmware management (e.g. encryption protocols – 34%, hardware/software testing – 32%, and updating software and firmware - 31%). (See Exhibit 12)

IoT device management is another hot-button security issue. 38% of organizations are concerned about tracking and managing each IoT device as well as creating security endpoints for devices (i.e. the hardware device to which IoT information is communicated). Additionally, securing and authenticating accounts plays a factor – 43% of companies cite ensuring network-level security with strong user authentications for network-level data as their main concern. (See also Exhibit 12)

EXHIBIT 12

TYPES OF IoT SECURITY CONSIDERATIONS

- Ensuring network-level security (strong user authentications for network-level data) - 43%
- Tracking and managing each IoT device - 38%
- Security endpoints for each IoT device - 38%
- Updating encryption protocols - 34%
- Conducting comprehensive training programs for employees involved in IoT environment - 33%
- Performing hardware/software tests and device evaluation - 32%
- Making sure all existing software is updated - 32%
- Updating firmware and other software on devices - 31%
- Securely provisioning devices - 30%
- Changing default passwords/credentials - 24%
- Shifting from device-level to identity-level control - 23%
Our findings show that IoT adopters believe around one-third of IoT projects fail in proof of concept (POC), often because implementation is expensive or the bottom-line benefits are unclear. Among those who have had IoT projects stall in the trial stage, the top reason is the high cost of scaling—32% of businesses cited this as the main issue with getting their projects off the ground. In other cases, it’s difficult to justify moving forward on a project when the business benefits are not well enough defined: 28% of organizations reported that their projects failed because their pilots demonstrated unclear business value or ROI, and 26% of companies found it hard to justify a business case without short-term impact. (See Exhibit 13)

Additionally, lack of resources, IoT experience, and leadership buy-in can contribute to lower IoT success – companies who fall short in these areas have higher rates of POC failure and fewer projects in use versus those that don’t.

**EXHIBIT 13**

**REASONS FOR IoT FAILURE IN POC**

- High cost of scaling: 32%
- Pilots demonstrate unclear business value/ROI: 28%
- Hard to justify business case without short-term impact: 26%
- No clear strategy: 25%
- Lack of necessary technology: 24%
- Lack of resources/knowledge to scale: 24%
- Too many platforms to test: 23%
- Lack of leadership support and attention: 19%
- Lack of trust in scalability platforms: 18%
- Too many use cases to prove out: 17%
- Vendors not willing to subsidize pilots: 13%
WHO DRIVES IoT ADOPTION?

Because of IoT’s complexity, an IoT strategy requires leaders to bridge organizational boundaries, communicate the strategic vision for IoT, and achieve broad alignment across all participating teams. Having a technology leader with end-to-end accountability can be critical to achieving success with IoT.

While C-suite buy-in is essential to get projects off the ground (and they are often the champions of IoT projects), IT and operations leaders as well as developers are important to facilitating and executing IoT use. As a business decision maker mentioned, “IT plays a large role in generating business stories for IoT and developing it.”

FINAL THOUGHTS

Globally and across industries, IoT adoption enables companies to become more efficient, productive, and safe. However, there are also complexity, security, and talent challenges to overcome. Businesses with sufficient IoT knowledge, workers, resources, and leadership buy-in are more likely to get their projects past proof of concept, but even those with lower success rates are still committed to using IoT now and in the future, especially since ROI is projected to increase in the coming years. IoT is becoming indispensable to commercial organizations and, considering these findings as a whole, it’s safe to say that the future looks bright for IoT.
Manufacturing Spotlight
01. **IoT IS BECOMING INDISPENSABLE TO MANUFACTURING**
Among the manufacturer IoT decision-makers we spoke to, almost all are using or looking to use IoT solutions and the majority say IoT is critical to their company’s continued success.

02. **IoT OPTIMIZES OPERATIONS TO REDUCE COSTS AND INCREASE EFFICIENCY**
Manufacturers are using IoT for a variety of use cases, primarily around improved operations and supply chain management. For this, numerous benefits are being actualized, including gains in employee efficiency and cost savings.

03. **IoT CAN MAKE A POSITIVE IMPACT ON WORKER SAFETY AND AUTOMATION**
IoT has the strong potential to improve worker safety, according to most manufacturing decision-makers. Automation is another key area of opportunity - nearly half of manufacturing processes are automated, and the majority see IoT as essential to automating manufacturing work.

04. **CHALLENGES EXIST, BUT IoT USE IS STILL EXPECTED TO GROW**
To get more IoT projects off the ground, manufacturing decision-makers need to break through the technical complexities as well as increase their resources, knowledge, and budget. Additionally, failures at PoC (proof of concept) are also holding IoT advances back. This said, manufacturers expect IoT use to become more entrenched in years to come.
WHO WE TALKED TO – MANUFACTURING SPOTLIGHT

BDMs, Developers, and ITDMs
who work at enterprise-size manufacturing companies (1000+ employees)

70% FAMILIAR WITH IoT
Self-stated, pass a knowledge test

99% HAVE INFLUENCE/DECISION-MAKING POWER ON IoT STRATEGIES

NOT IN IoT ADOPTION 13%

IN IoT ADOPTION 87%
IoT IS BECOMING INDISPENSABLE TO MANUFACTURING

Manufacturing is seeing great success with IoT technology – among the manufacturers we surveyed, 87% of decision makers have adopted IoT tech (either in learning, trial/PoC, purchase or use phase), with most adopters having at least one project in use (See Exhibit 1). Overall, 20% of the projects IoT decision-makers are currently working on are fully implemented (and the remainder in different stages of ramping up). On average, it typically takes a manufacturing project 16 months to reach the use phase. 92% of adopters tell us IoT is crucial to the advancement of their company (See Exhibit 1).

EXHIBIT 1
% IoT DECISION-MAKERS IN ADOPTION

87%

% IoT IS CRITICAL TO OVERALL SUCCESS

92%

43% Very
49% Somewhat
IoT OPTIMIZES OPERATIONS TO REDUCE COSTS AND INCREASE EFFICIENCY

IoT use is widespread in the manufacturing industry, especially for making both systems and workers more efficient. According to adopters, key uses include operations optimization, supply chain management, and employee productivity. Other common uses specific to manufacturing include industrial optimization (48%), ensuring quality and compliance (45%), production planning and scheduling (43%), and supply chain/logistics (43%) (See Exhibit 2). “IoT is a huge benefit in supply chain. You can automate, get more efficient, use more data, and get faster. There's all kinds of applications that can be fed back to manufacturing to make us more effective,” a developer affirmed.

<table>
<thead>
<tr>
<th>IoT Use Case</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial automation</td>
<td>48%</td>
</tr>
<tr>
<td>Quality and compliance</td>
<td>45%</td>
</tr>
<tr>
<td>Production planning and scheduling</td>
<td>43%</td>
</tr>
<tr>
<td>Supply chain and logistics</td>
<td>43%</td>
</tr>
<tr>
<td>Plant safety and security</td>
<td>33%</td>
</tr>
<tr>
<td>Condition-based predictive maintenance</td>
<td>30%</td>
</tr>
<tr>
<td>Condition-based monitoring and service</td>
<td>29%</td>
</tr>
<tr>
<td>Energy management</td>
<td>23%</td>
</tr>
<tr>
<td>Worker safety</td>
<td>21%</td>
</tr>
<tr>
<td>Process optimization</td>
<td>21%</td>
</tr>
<tr>
<td>‘Connected product’ engineering</td>
<td>20%</td>
</tr>
<tr>
<td>Production flow monitoring</td>
<td>18%</td>
</tr>
<tr>
<td>Product-as-a-service</td>
<td>13%</td>
</tr>
</tbody>
</table>
The chief advantage of IoT is cost savings - nearly half of adopters in manufacturing report this benefit. Other key benefits include improved production agility (36%) and advantages to maintenance and monitoring as well as supply chain and operations optimization (See Exhibit 3). A developer explains how IoT helps with performance monitoring: “To prevent downtime, we want to know ahead when a motor may burn out. With IoT sensors, we can tell when the motor is not acting right; then we know we’ve got 300 hours before we need to replace.”
**IoT CAN MAKE A POSITIVE IMPACT ON WORKER SAFETY AND AUTOMATION**

Manufacturers see great potential for IoT when it comes to improving safety – half believe that improving physical safety is a top benefit provided by IoT (See Exhibit 4). 83% of IoT adopters say that the implementation of IoT has positively impacted worker safety (See Exhibit 4).

---

**EXHIBIT 4**

<table>
<thead>
<tr>
<th>% IoT CAN IMPROVE PHYSICAL SAFETY</th>
<th>IMPACT OF IoT ON IMPROVING WORKER SAFETY</th>
</tr>
</thead>
<tbody>
<tr>
<td>50%</td>
<td>Very Positive: 34%</td>
</tr>
<tr>
<td></td>
<td>Somewhat Positive: 49%</td>
</tr>
<tr>
<td></td>
<td>Neutral: 16%</td>
</tr>
<tr>
<td></td>
<td>83%</td>
</tr>
</tbody>
</table>
IoT is also becoming essential to manufacturing automation. 85% identify IoT as critical, with almost half saying it’s very critical in the automation of their work and other company processes (See Exhibit 5). Today, on average, 45% of manufacturing processes are automated, underscoring IoT’s importance in this central use case. (See Exhibit 5).
**CHALLENGES EXIST, BUT USAGE IS STILL EXPECTED TO GROW**

Key barriers must be overcome for adopters to increase their implementation of IoT. The chief barriers today are complexity and technical challenges (38%), which should be addressed in current IoT tech solutions and simplified in the future. Budgetary and staffing concerns also play a role in limiting growth (31%), as does lack of knowledge, both technical and in terms of solutions deployment training (30%) *(See Exhibit 6).*
While IoT has achieved widespread success, 30% of IoT projects fail in proof of concept (PoC), with 93% having experienced the failure of a project at this stage (See Exhibit 7). Reasons for failure are varied, but common contributors involve a lack of funds, time, or planning/strategy (See Exhibit 8).
IoT, which is already central to process optimization for the manufacturing sector, will achieve near-universal use in the next two years (92%) (See Exhibit 9). 75% of adopters will use IoT more in the future, as they continue to see IoT as critical to future success (See Exhibit 9). A business decision-maker explained it well: “You want to stay above the curve in manufacturing, so your product stays relevant. And I think IoT can be the catalyst for keeping products relevant.”
FINAL THOUGHTS

IoT helps manufacturers optimize everything from operations, to supply chain management, to employee productivity and process automation – resulting in cost savings and production agility. However, the technology is not without its challenges, such as complexity and technical issues, and a lack of resources or budget. Most have experienced an IoT project failure in proof of concept, often due to a lack of funds, time, or strategic planning. Still, manufacturers anticipate adopting IoT even more widely in the years to come, as it remains critical to doing business. Examining the research as a whole, we can conclude that manufacturers will only expand their use of the technology in the coming years.
THE OBJECTIVES OF THE RESEARCH INCLUDED

1. Explore the benefits and the challenges of IoT adoption
2. Understand the revenue impact of adopting vs not adopting IoT
3. Project future adoption and uses of IoT

TO MEET THE SCREENING CRITERIA, IoT PROFESSIONALS NEEDED TO BE:
A business decision maker, IT decision maker, or developer at their company
Employed full-time at an enterprise-level company (1,000 employees or more)
Ages 18–66
Familiar with IoT
Involved in decision making for IoT
Within the Manufacturing Spotlight, respondents also needed to work in the manufacturing industry

OF THE MORE THAN 3,000 IoT PROFESSIONALS INTERVIEWED FOR THE INITIAL RESEARCH WAVE IN FEBRUARY 2019
In the US, approximately 1,000 Decision Makers and 200 Developers were interviewed
In Germany, Japan, China, France, and the UK: approximately 300 Decision Makers and 100 Developers were interviewed in each country

OF THE 521 MANUFACTURING IoT PROFESSIONALS INTERVIEWED, ACROSS BDMS, ITDMS, AND DEVELOPERS
144 were in the US, 40 in the UK, 46 in France, 62 in Germany, 146 in Japan, and 83 in China