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.

Microsoft commissioned Hypothesis Group, an insights, design, and strategy agency, to execute the IoT Signals research.

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.
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)
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

- Operations optimization: 56%
- Employee productivity: 47%
- Safety and security: 44%
- Supply chain management: 40%
- Quality assurance: 40%
- Asset tracking: 33%
- Sales enablement: 31%
- Energy management: 26%
- Condition-based maintenance: 25%
- Health and wellness: 18%

On the whole, BDMs and developers view IoT as a way to streamline processes and work more efficiently.
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)
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)
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).
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)
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**

<table>
<thead>
<tr>
<th>Reason</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>High cost of scaling</td>
<td>32%</td>
</tr>
<tr>
<td>Pilots demonstrate unclear business value/ROI</td>
<td>28%</td>
</tr>
<tr>
<td>Hard to justify business case without short-term impact</td>
<td>26%</td>
</tr>
<tr>
<td>No clear strategy</td>
<td>25%</td>
</tr>
<tr>
<td>Lack of necessary technology</td>
<td>24%</td>
</tr>
<tr>
<td>Lack of resources/knowledge to scale</td>
<td>24%</td>
</tr>
<tr>
<td>Too many platforms to test</td>
<td>23%</td>
</tr>
<tr>
<td>Lack of leadership support and attention</td>
<td>19%</td>
</tr>
<tr>
<td>Lack of trust in scalability platforms</td>
<td>18%</td>
</tr>
<tr>
<td>Too many use cases to prove out</td>
<td>17%</td>
</tr>
<tr>
<td>Vendors not willing to subsidize pilots</td>
<td>13%</td>
</tr>
</tbody>
</table>
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.
01 INCREASING ADOPTION OF IOT ACROSS THE ECOSYSTEM

Commercial IoT adoption is growing at an explosive rate. 85% of IoT decision makers say they are currently in IoT adoption. Though adoption takes time, many companies have been able to successfully move to the use stage—the point at which the organization can begin incorporating IoT into its processes.

Top reasons that organizations adopt IoT include streamlining processes, increasing employee productivity, and protecting information. However, IoT growth can be stunted by complexity and technical challenges, as well as lack of resources and inadequate knowledge.

IoT success is not created equal at all companies. A quarter of enterprise IoT decision makers are having high success with IoT implementation (they report a high number of projects in use, as well as low failure rates at proof of concept) while a third cite low success (low usage and/or high failure in proof of concept).

For those who are successful, their achievements hinge on having the right IoT leaders as well as talent and training. For high-success companies, IoT is typically executed by those in IT-related roles, such as IT directors, chief technology officers, and chief information officers (though C-Suite leads the strategy). Additionally, 54% of high-success companies say they have enough available skilled employees, and 55% have resources to train workers, while companies with low IoT success report a lack of talent and resources. Low-success IoT adopters cite lack of leadership buy-in, high costs, and inadequate resources as the main reasons for failure of their projects at proof of concept.

However, even adopters with lower success rates see IoT as critical to their business’ success. Over 8 in 10 say IoT is critical to their business and 78% plan to use IoT more in the next two years.
02 THE ESSENCE OF IOT SECURITY

With IoT devices becoming a gateway to homes, workplaces, and sensitive data, they also become targets for attacks. The immediate costs of a data breach can be in the millions of dollars, but damage to the brand reputation as a result of the breach can further compound these costs in the long term.

Companies implementing IoT worry about security, regardless of country or industry – 97% of enterprise IoT decision makers across the US, UK, Germany, France, Japan, and China say security is of concern with IoT. Similarly, enterprise leaders in manufacturing, transportation, retail/wholesale, healthcare, and government almost unanimously view security as a concern.

Companies have 3-4 security considerations on average, falling into four main areas: software/firmware management, device management, accounts and authentication, and training for involved employees.

Within software/firmware management, enterprise organizations are thinking about how to ensure that software, firmware, and encryption protocols are up to date and properly tested. Securing devices is another key concern, particularly provisioning, tracking, and managing devices. Additionally, IoT adopters need to establish strong user authentications and safeguard passwords/credentials to reduce the risk of data breaches.

Despite these concerns, security isn’t a top barrier to using IoT more: most businesses view security as a less challenging issue than technical complexity or lack of resources.

Even for those with significant security challenges, IoT is worth the investment, now and in the future. Among adopters who consider security a top concern, 93% are satisfied with IoT, and 84% perceive its current value as critical. They also intend to keep using IoT in the future and believe IoT will continue to be critical to the success of their company.
A company’s access to sufficient workers and resources plays a significant role in how important they believe IoT to be. It can also contribute to the eventual success or failure of IoT adoption. But even when businesses lack IoT workers and resources, they still want to use IoT.

Only one-third of IoT adopters feel their company has adequate IoT workers and resources; this is the case both globally and across industries. Nearly all adopters recognize that IoT is important to success, but those with sufficient workers and resources are especially likely to see IoT as critical (92%), compared to those with limited employees and resources, who are less likely to see IoT as critical (87%).

Adopters with enough workers and resources not only view IoT as a stronger investment—attributing 28% of their current revenue to IoT—but they also have greater success getting projects off the ground: companies with sufficient resources are able to get IoT projects up and running in less time than those with limited resources (9 months vs. 12 months).

Meanwhile, across several countries and industries, 32% of IoT adopters say their organizations do not have enough access to the talent or resources they need. This group runs into several obstructions when it comes to implementing IoT: 40% cite lack of knowledge, 39% face complexity/technical challenges, and 38% say they lack budget or staff resources. In contrast, 18% of those with sufficient workers and resources say that inadequate knowledge is a problem, and 19% say lack of budget or staff is a top challenge. In addition, companies without enough workers or resources tend to encounter more challenges—two on average—whereas those with enough resources have 1.5 on average.

Limited support can also mean a project is more likely to fail in proof of concept: 30% of projects with inadequate resources fail, compared to 25% of those with sufficient support.

Even companies with inadequate resourcing still want to use IoT going forward. 89% of organizations with too few skilled workers/resources view IoT as being critical in the future and 75% say they expect to use IoT more in the next two years.
MANUFACTURING SPOTLIGHT

The manufacturing industry is a leader in IoT adoption, and often pulls other industries along too. “IoT is a huge benefit in supply chain,” a developer we spoke with says, “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 organizations more effective.”

IoT is fast becoming indispensable to manufacturing. 87% of IoT decision makers in manufacturing have adopted IoT and the vast majority say IoT is critical to the success of their company and that they are satisfied with the technology. The retail industry is coming to the same conclusion, with 92% of decision makers viewing IoT as critical to business success, and 96% being satisfied with the value IoT adds to their company.

IoT helps companies across fields optimize operations and productivity; within manufacturing, it is also essential to supply chain management. As in other industries, manufacturing has unique use cases for IoT: 48% of manufacturers apply IoT to industrial automation, 45% to quality and compliance, and 43% to production planning and scheduling as well as supply chain and logistics.

Manufacturers use IoT to reduce costs and improve efficiency, as well as assist in predictive maintenance. A developer explains how IoT helps with a specific manufacturing task: “Our engineers say, ‘We want to know ahead of time when this motor is going to burn out to prevent downtime.’ So we put on IoT sensors and we can tell when the motor is not acting the way it should. And we can tell them, ‘You’ve got another 300 hours before this is going to need replacement.’”

Within manufacturing, IoT also positively impacts safety and automation. 21% of manufacturing companies have begun to utilize IoT for worker safety and the vast majority report that they have already started to see safety improvements. Further, 45% of manufacturing processes are becoming automated, and 85% of IoT adopters in manufacturing say IoT plays a critical role in automating processes.
In the consumer world, IoT is well used, and well understood. Examples of consumer IoT include wearable technology that monitors heart rate, internet-controlled thermostats, and voice-controlled speakers. Commercially, IoT is growing as a critical tool for business success, but fewer understand its use cases, which include applications like thermometers on trucks transporting perishable goods that can be monitored from headquarters, trackers to help employees manage inventory from anywhere in a store, and smart continuous glucose monitoring in diabetes patients.

Commercial IoT is primarily used to optimize efficiency, operations, and safety, allowing companies to streamline many different processes.

One example is a golf club manufacturing company where Dave, a business decision maker, leads a team that develops golf club heads. Dave’s team uses IoT to ensure the quality of their golf club heads as vendors produce them.

Dave believes IoT is critical to success, and estimates there are around 100 uses of IoT throughout his company. “Without IoT, our company would be behind. Our competitors would be getting things faster and producing them better.”

Within organizations, different industries have unique use cases for commercial IoT. Those in manufacturing are looking to IoT to assist with automation, quality control, production planning, supply chain logistics, and safety/security,

For retail/wholesale companies, IoT is relevant for supply chain management, but use cases around inventory optimization and loss prevention also rise to the top. In transportation and the government, IoT can be most useful when applied to equipment management and safety/surveillance, while for healthcare, IoT helps companies track patients, staff, and inventory, as well as assists with remote device monitoring and service.
THE OBJECTIVES OF THE RESEARCH INCLUDED

1. Understand 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

A 20-minute online survey was conducted with 3,233 IoT decision makers in six (6) markets – US, UK, Germany, France, China, and Japan from March 8-April 15, 2019. Respondents came from a wide range of industries, including manufacturing, retail/wholesale, government, transportation, healthcare, and others. They answered questions about IoT adoption, usage, and satisfaction, as well benefits and barriers. Five minutes of each interview were dedicated to a deep dive on manufacturing, for those in the industry.

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

OF THE OVER 3,000 IOT PROFESSIONALS INTERVIEWED

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 market
IoT Signals – Additional Learning Details

01. INCREASING ADOPTION OF IoT ACROSS THE ECOSYSTEM
   PAGE 20

02. THE ESSENCE OF IoT SECURITY
   PAGE 37

03. IoT TALENT WARS
   PAGE 44

04. MANUFACTURING SPOTLIGHT
   PAGE 54

05. TOP USE CASES IN COMMERCIAL IoT
   PAGE 70
Increasing adoption of IoT across the ecosystem

2019
WHO WE TALKED TO

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

37% UNFAMILIAR WITH IoT

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

8% DON'T HAVE INFLUENCE/DECISION MAKING POWER ON IoT STRATEGIES

92% HAVE INFLUENCE/DECISION MAKING POWER ON IoT STRATEGIES

15% NOT IN IoT ADOPTION

85% IN IoT ADOPTION

AMONG BDMS, DEVELOPERS, AND ITDMS SCREENED WHO WORK AT ENTERPRISE SIZE COMPANIES (N=10365)
Global IoT adoption rates are strong regardless of industry or market.
Though IoT adoption takes time, companies have been able to successfully move into “use”
Adopters credit IoT as critical to their company’s success.

**PERCEIVED CURRENT VALUE**

88% VERY/SOMEWHAT CRITICAL

43% Very
45% Somewhat

**VERY/SOMEWHAT CRITICAL BY MARKET**

<table>
<thead>
<tr>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>85%</td>
</tr>
<tr>
<td>UK</td>
<td>80%</td>
</tr>
<tr>
<td>DE</td>
<td>92%</td>
</tr>
<tr>
<td>FR</td>
<td>88%</td>
</tr>
<tr>
<td>JP</td>
<td>90%</td>
</tr>
<tr>
<td>CN</td>
<td>97%</td>
</tr>
</tbody>
</table>

**VERY/SOMEWHAT CRITICAL BY INDUSTRY**

<table>
<thead>
<tr>
<th>Industry</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>92%</td>
</tr>
<tr>
<td>Transportation</td>
<td>86%</td>
</tr>
<tr>
<td>Retail or wholesale</td>
<td>92%</td>
</tr>
<tr>
<td>Healthcare</td>
<td>88%</td>
</tr>
<tr>
<td>Government</td>
<td>84%</td>
</tr>
</tbody>
</table>

**AMONG THOSE IN IoT ADOPTION (N=2745)**
And adopters envision IoT to play an even bigger role in the future.

### FUTURE IMPLEMENTATION DEGREE

<table>
<thead>
<tr>
<th>Using IoT More</th>
<th>Using IoT THE SAME AMOUNT</th>
<th>Using IoT LESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>75%</td>
<td>24%</td>
<td>1%</td>
</tr>
</tbody>
</table>

Two years from now, adopters believe ROI will be 30% (inclusive of cost savings and efficiencies).

### USE IoT MORE BY MARKET

<table>
<thead>
<tr>
<th>Market</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>81%</td>
</tr>
<tr>
<td>UK</td>
<td>71%</td>
</tr>
<tr>
<td>DE</td>
<td>71%</td>
</tr>
<tr>
<td>FR</td>
<td>79%</td>
</tr>
<tr>
<td>JP</td>
<td>73%</td>
</tr>
<tr>
<td>CN</td>
<td>64%</td>
</tr>
</tbody>
</table>

### USE IoT MORE BY INDUSTRY

<table>
<thead>
<tr>
<th>Industry</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>75%</td>
</tr>
<tr>
<td>Transportation</td>
<td>76%</td>
</tr>
<tr>
<td>Retail or wholesale</td>
<td>69%</td>
</tr>
<tr>
<td>Healthcare</td>
<td>82%</td>
</tr>
<tr>
<td>Government</td>
<td>74%</td>
</tr>
</tbody>
</table>

AMONG THOSE IN IoT ADOPTION AND PLANNING TO USE IoT IN NEXT 2 YEARS (N=2652)
IoT is adopted to streamline processes and protect information

<table>
<thead>
<tr>
<th>TOP REASONS FOR IoT ADOPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong> Operations optimization</td>
</tr>
<tr>
<td>Especially important for:</td>
</tr>
<tr>
<td><strong>2</strong> Employee productivity</td>
</tr>
<tr>
<td>Especially important for:</td>
</tr>
<tr>
<td><strong>3</strong> Safety and security</td>
</tr>
<tr>
<td>Especially important for:</td>
</tr>
<tr>
<td><strong>4</strong> Supply chain management</td>
</tr>
<tr>
<td>Especially important for:</td>
</tr>
<tr>
<td><strong>5</strong> Quality assurance</td>
</tr>
<tr>
<td>Especially important for:</td>
</tr>
</tbody>
</table>
IoT is a strategic investment to increase efficiency and yield and improve quality.

**TOP IoT BENEFITS**

**1. INCREASE EFFICIENCY**
- Improves overall efficiency: 55%
- Allows team to be more productive: 42%
- Saves time for team to focus efforts elsewhere: 35%
- Helps me be better informed and make better business decisions: 33%
- Enables new types of business models: 26%

**2. INCREASE YIELD**
- Increases production capacity: 43%
- Provides my business with cost savings: 39%
- Increases revenue: 36%
- Reduces business expenses: 35%
- Enables new types of customer offerings: 27%
- Enables new revenue streams: 26%

**3. IMPROVE QUALITY**
- Reduces chance for human error: 45%
- Increases customer satisfaction: 44%
- Increases company's competitive advantage: 41%

AMONG THOSE IN IoT ADOPTION (N=2745)
Challenges around complexities, resources, and knowledge do stunt IoT growth

<table>
<thead>
<tr>
<th>TOP 5 IoT CHALLENGES</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>
And many companies experience failure at proof of concept

% IoT PROJECTS FAILED IN TRIAL/POC PHASE

- **30%**
  - **HIGH FAILURE**
  - 50%-100% of projects failed in “Trial/POC”

- **7%**
  - **NO FAILURE**
  - 0% of projects failed in “Trial/POC”

- **31%**
  - **MODERATE FAILURE**
  - 25%-49% of projects failed in “Trial/POC”

- **32%**
  - **LOW FAILURE**
  - 1%-24% of projects failed in “Trial/POC”

Among those responding and in IoT adoption (N=2181)
Currently, a quarter of enterprise IoT decision-makers are having strong success with IoT implementation – while others have room to grow.
At companies with high IoT success, IoT is executed by those in IT-related roles.

Among those responding and with high success with IoT (N=505):

IoT USE IS LED BY:

1. DIRECTOR - IT
2. CHIEF TECHNOLOGY OFFICER
3. CHIEF INFORMATION OFFICER
Adequate IoT talent and resources contribute to IoT success

Meanwhile, low success companies are more likely to say they don’t have enough workers or resources.
Successful adopters are getting to the “Use” stage more efficiently
Companies with low success rates cite lack of leadership buy-in and resources as strong reasons for POC failure.

Compared to high success companies, those with low success more often cite lack of leadership buy-in as a reason for POC failure.

Meanwhile, companies with high success are less likely to run into obstacles with getting leadership buy-in or with not understanding the business case for implementing IoT.

REASONS FOR FAILURE

1. High cost of scaling
2. Pilots demonstrate unclear business value/ROI
3. Hard to justify business case without short-term impact
4. Lack of necessary technology
5. Lack of leadership support and attention
Lack of knowledge and resources also prevent them from implementing IoT more.

Those with high success experience (on average) fewer than 2 challenges.

TOP IoT CHALLENGES

- Complexity/Technical Issues: 41%
- Lack of Knowledge: 35%
- Lack of Budget/Staff Resources: 34%

Average # of challenges experienced (N=788): 3
However, even adopters with lower success rates see IoT as critical to their business’ success, and recognize opportunity to use it more down the road.

Among those in IoT adoption with low success with IoT (N=788):

**PERCEIVED CURRENT VALUE**

**CURRENT**

84%

*Very + Somewhat Critical*

39% Very
45% Somewhat

**FUTURE IMPLEMENTATION DEGREE**

**FUTURE**

Nearly all IoT Adopters with lower success rates plan to use IoT in the next 2 years, and more than they currently are.

AMONG THOSE IN IoT ADOPTION WITH LOW SUCCESS WITH IoT (N=772)

78% More
21% Same
1% Less
The Essence of IoT Security

2019
IoT security is a concern, regardless of country or industry

97% of companies have security concerns when implementing IoT

“A big key to making the Internet of Things work properly is that the sensors used are not hackable. As these sensors get more ubiquitous and there’s more dependence on them, that security becomes so much more important.”

BDM
Security considerations center around software, devices, and users.

Types of Security Considerations

- **73%** Software/Firmware Management (e.g., updating software, hardware/software tests, encryption protocols)
- **69%** Device Management (e.g., secure provisioning, tracking, security endpoints)
- **63%** Accounts and Authentication (e.g., changing default credentials, network-level security, identity-level control)
- **33%** Training for Involved Employees

3–4 security considerations on average among those in IoT adoption with security concerns (N=2655)
Despite the concerns, security isn’t a top barrier to using IoT more
Even for those with security challenges, IoT is worth the investment.

Among the 7% of adopters who think security is a top challenge...

**IoT SATISFACTION**

- Very satisfied: 37%
- Somewhat satisfied: 56%
- Somewhat dissatisfied: 6%
- Very dissatisfied: 1%

**PERCEIVED CURRENT VALUE**

- Very critical: 93%
- Somewhat critical: 46%
- Neutral: 12%
- Somewhat/not critical: 4%

Among those in IoT adoption who say security is a top challenge (N=203)

25% of ROI attributed to IoT (inclusive of cost savings and efficiencies)
They also believe IoT will continue to be useful in the future.
Ryan is a Director of Information Security at a manufacturing company who recognizes the security risks of IoT. He believes it’s a big weakness because there’s potential for IoT devices to become easily vulnerable.

On the other hand, he says the good outweighs the bad. Some data just isn’t that sensitive, and there are so many benefits his company gets (like logistics tracking and temperature monitoring), that his company just focuses on taking extra security precautions.

Ultimately, the risk is worth the reward.
IoT Talent Wars

2019
Only one-third of IoT adopters feel their company has adequate IoT workers and resources.
All adopters recognize the role IoT plays is important to success, but those with sufficient workers/resources see IoT as especially critical.
Adopters with enough workers/resources view IoT as a stronger investment

PERCEIVED CURRENT ROI

28% of current ROI is attributed to IoT (inclusive of cost savings and efficiencies) vs. 20%

Among those in IoT adoption and enough skilled workers/resources (N=898)
Among those in IoT adoption and not enough skilled workers/resources (N=869)
They also have greater success getting numerous projects into the use stage.

<table>
<thead>
<tr>
<th>PROJECT STAGE</th>
<th>% OF PROJECTS IN</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEARN</td>
<td>28%</td>
</tr>
<tr>
<td>TRIAL/POC</td>
<td>24%</td>
</tr>
<tr>
<td>PURCHASE</td>
<td>21%</td>
</tr>
<tr>
<td>USE</td>
<td>27%</td>
</tr>
</tbody>
</table>

Among those in IoT adoption and enough skilled workers/resources (N=898):

- SUFFICIENT WORKERS/RESOURCES: 36% in LEARN, 24% in TRIAL/POC, 17% in PURCHASE, 22% in USE
- LIMITED WORKERS/RESOURCES: 28% in LEARN, 24% in TRIAL/POC, 21% in PURCHASE, 27% in USE

% IoT PROJECTS IN "USE" STAGE:

- VERY HIGH USAGE: 55% among sufficient workers/resources, 13% among limited workers/resources
- HIGH USAGE: 24% among sufficient workers/resources, 13% among limited workers/resources
- MODERATE USAGE: 8% among sufficient workers/resources, 6% among limited workers/resources
- LOW USAGE: 12% among sufficient workers/resources, 22% among limited workers/resources
With adequate resourcing, many projects reach the “use” stage in less than a year; those who do not have support need more time.
A third of IoT adopters cite their company does not have enough access to the talent or resources they need.

**TALENT AND TRAINING ASSESSMENT**

Among those in IoT adoption (N=2745)

- 33% of companies have adequate workers and resources.
- 32% of companies don’t have enough workers or resources.
- 35% mixed, or don’t know.

**BY MARKET**

- US: 27%
- UK: 34%
- DE: 36%
- FR: 34%
- JP: 41%
- CN: 27%

**BY INDUSTRY**

- Manufacturing: 38%
- Transportation: 35%
- Retail or wholesale: 27%
- Healthcare: 26%
- Government: 44%

Boxes show unique differentiators (over-indexing >115) among those in IoT adoption (N=2745)
Those without workers/resources face greater knowledge and budget restraints.

Average # of challenges experienced among those in IoT adoption and not enough skilled workers/resources (N=869):

- **Lack of Knowledge**: 40%
- **Complexity/Technical Challenges**: 39%
- **Lack of Budget/Staff Resources**: 38%

Fewer challenges (1.5 on average). Less likely to say knowledge (18%) and budget/staff (19%) are top challenges.
For those with limited support, more projects fail in POC due to limited technology and scaling challenges.

**IoT Failure in POC**

**Failure Rate Among Limited Workers/Resources**

- **30%**

**Reasons for IoT Failure**

1. High cost of scaling
2. Pilots demonstrate unclear business value/ROI
3. Lack of resources/knowledge to scale
4. No clear strategy
5. Lack of necessary technology

**25% Failure Rate Among Those in IoT Adoption and Not Enough Skilled Workers/Resources**

Among those in IoT adoption and not enough skilled workers/resources, who have had some IoT projects not make it past trial/POC (N=869). Boxes show top reasons that are unique to those with limited workers/resources.
But, even companies with inadequate resourcing are determined to use IoT more in the future.
WHO WE TAKED TO

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

42% UNFAMILIAR WITH IoT OR DON'T HAVE INFLUENCE

58% FAMILIAR WITH IoT & HAVE INFLUENCE
Familiarity: self-stated, pass a knowledge test

15% NOT IN IoT ADOPTION

85% IN IoT ADOPTION

16% IN MANUFACTURING INDUSTRY

84% IN OTHER INDUSTRIES
Manufacturing is a leading industry in IoT adoption, often pulling other industries along too

“Manufacturing is a leader because 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 them more effective.”

“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.”

“We don’t pay for the RFID tags we use to track inventory. We make our vendors pay for them. It was a challenge to convince them that it would be worth it. We had to create a business case for why IoT would result in more sales and be good for them, and then negotiate really hard.”
IoT is well used among manufacturers, similar to other industries.
IoT is critical in manufacturing companies, and ROI is similar to other industries.

<table>
<thead>
<tr>
<th>CRITICAL TO SUCCESS OF COMPANY (very/somewhat critical)</th>
<th>TOTAL</th>
<th>MANUFACTURING</th>
<th>TRANSPORTATION</th>
<th>RETAIL/WHOLESALE</th>
<th>HEALTHCARE</th>
<th>GOVERNMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>88%</td>
<td>92%</td>
<td>86%</td>
<td>92%</td>
<td>88%</td>
<td>84%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SATISFACTION (very/somewhat satisfied)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>90%</td>
<td>85%</td>
<td>90%</td>
<td>96%</td>
<td>94%</td>
<td>84%</td>
<td></td>
</tr>
</tbody>
</table>

“Our IoT projects are a no-brainer because the cost involved isn’t expensive compared to how much we’re going to gain from it.”

_BDM_
Across industries, IoT helps companies optimize operations and productivity; within manufacturing, supply chain management is more of a factor.
Each industry has unique use cases for IoT

APPLICATION OF IoT AMONG THOSE WHO HAVE ADOPTED

<table>
<thead>
<tr>
<th>MANUFACTURING</th>
<th>TRANSPORTATION</th>
<th>RETAIL/WHOLESALE</th>
<th>HEALTHCARE</th>
<th>GOVERNMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N=452</strong></td>
<td><strong>N=113</strong></td>
<td><strong>N=267</strong></td>
<td><strong>N=182</strong></td>
<td><strong>N=153</strong></td>
</tr>
<tr>
<td>Industrial automation</td>
<td>48%</td>
<td>Fleet management</td>
<td>56%</td>
<td>Supply chain optimization</td>
</tr>
<tr>
<td>Quality and compliance</td>
<td>45%</td>
<td>Security, surveillance, and safety</td>
<td>51%</td>
<td>Inventory optimization</td>
</tr>
<tr>
<td>Production planning and scheduling</td>
<td>43%</td>
<td>Manufacturing operations efficiency</td>
<td>40%</td>
<td>Surveillance and security</td>
</tr>
<tr>
<td>Supply chain and logistics</td>
<td>43%</td>
<td>Vehicle telematics and infotainment</td>
<td>38%</td>
<td>Loss prevention</td>
</tr>
<tr>
<td>Plant safety and security</td>
<td>33%</td>
<td>Predictive maintenance</td>
<td>33%</td>
<td>Energy optimization</td>
</tr>
<tr>
<td>Condition-based predictive maintenance</td>
<td>30%</td>
<td>Connected car systems monitoring</td>
<td>30%</td>
<td>In-store contextualized marketing</td>
</tr>
<tr>
<td>Condition-based monitoring and service</td>
<td>29%</td>
<td>Driver assistance</td>
<td>23%</td>
<td>Digital signage</td>
</tr>
<tr>
<td>Energy management</td>
<td>23%</td>
<td></td>
<td></td>
<td>Omni-channel operations</td>
</tr>
<tr>
<td>Worker safety</td>
<td>21%</td>
<td></td>
<td></td>
<td>JIT promotions</td>
</tr>
<tr>
<td>Process optimization</td>
<td>21%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘Connected product’ engineering</td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production flow monitoring</td>
<td>18%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product-as-a-service</td>
<td>13%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AMONG THOSE IN IoT ADOPTION IN EACH INDUSTRY (BASES VARY)
“Without IoT, our company would be behind. Our competitors would be getting things faster and producing them better.”

MANUFACTURING BDM
Within manufacturing, companies are furthest along with energy management, automation, and logistics projects.

### MANUFACTURING USE CASE DEEP DIVE

<table>
<thead>
<tr>
<th>USE CASES</th>
<th>% ADOPTION</th>
<th>% OF PROJECTS IN “USE” STAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy management</td>
<td>23%</td>
<td>41%</td>
</tr>
<tr>
<td>Industrial automation</td>
<td>48%</td>
<td>38%</td>
</tr>
<tr>
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<td>43%</td>
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<tr>
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<td>31%</td>
</tr>
<tr>
<td>Condition-based monitoring and service</td>
<td>29%</td>
<td>30%</td>
</tr>
</tbody>
</table>
IoT allows manufacturing companies to reduce costs and improve efficiency.

TOP BENEFITS OF IoT

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reducing costs</td>
<td>43%</td>
</tr>
<tr>
<td>Implementing more agile production</td>
<td>36%</td>
</tr>
<tr>
<td>Predictive maintenance and performance monitoring</td>
<td>36%</td>
</tr>
<tr>
<td>Improving processes to monitor equipment</td>
<td>35%</td>
</tr>
<tr>
<td>Supply chain/operations optimization</td>
<td>34%</td>
</tr>
<tr>
<td>Improving visibility</td>
<td>31%</td>
</tr>
<tr>
<td>Expanding value chain</td>
<td>29%</td>
</tr>
<tr>
<td>Reducing waste</td>
<td>22%</td>
</tr>
<tr>
<td>Discovering new revenue streams</td>
<td>19%</td>
</tr>
<tr>
<td>Improving field service scheduling</td>
<td>16%</td>
</tr>
</tbody>
</table>

“Our engineers say, ‘We want to know ahead of time when this motor is going to burn out to prevent downtime.’ So we put on IoT sensors and we can tell when the motor is not acting the way it should. And we can tell them, ‘You’ve got another 300 hours before this is going to need replacement.’”

DEVELOPER

AMONG THOSE IN IoT ADOPTION IN MANUFACTURING (N=452)
IoT positively impacts worker safety in manufacturing

21% of manufacturing companies use IoT for worker safety
IoT also plays a critical role in automating processes.

**IoT’s Role in Manufacturing Automation**

- **Very Critical**: 44%
- **Somewhat Critical**: 41%
- **Neutral**: 11%
- **Somewhat/Not Critical**: 5%

85% of manufacturing is automated (median). 45% of those involved in IoT adoption in manufacturing (N=452).
Despite IoT’s success in manufacturing, almost a third of projects fail in the trial/POC phase.
Complexity/technical challenges present the biggest barrier for manufacturers to use IoT more.
BRIEF
FOCUS

Usage of IoT is similar across discrete and process manufacturers.

<table>
<thead>
<tr>
<th>% IoT ADOPTERS</th>
<th>DISCRETE</th>
<th>PROCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRITICAL TO SUCCESS OF COMPANY</td>
<td>93%</td>
<td>88%</td>
</tr>
<tr>
<td>LEARN</td>
<td>35%</td>
<td>31%</td>
</tr>
<tr>
<td>TRIAL/POC</td>
<td>25%</td>
<td>24%</td>
</tr>
<tr>
<td>PURCHASE</td>
<td>18%</td>
<td>20%</td>
</tr>
<tr>
<td>USE</td>
<td>22%</td>
<td>25%</td>
</tr>
</tbody>
</table>

### TOP USE CASES

**DISCRETE**
- Operations optimization
- Supply chain management
- Employee productivity

**PROCESS**
- Operations optimization
- Supply chain management
- Employee productivity

**KEY**
- **DISCRETE**: manufacturing finished projects
- **PROCESS**: manufacturing supplies, ingredients (i.e., components of a finished product)
BRIEF

FOCUS

Both manufacturing types share benefits and most challenges

<table>
<thead>
<tr>
<th>TOP BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DISCRETE</strong></td>
</tr>
<tr>
<td>1. Reducing costs</td>
</tr>
<tr>
<td>2. Implementing more agile production</td>
</tr>
<tr>
<td>3. Improving processes to monitor equipment</td>
</tr>
<tr>
<td>4. Supply chain/operations optimization</td>
</tr>
<tr>
<td>5. Predictive maintenance and performance monitoring</td>
</tr>
<tr>
<td><strong>PROCESS</strong></td>
</tr>
<tr>
<td>Reducing costs</td>
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<tr>
<td>Implementing more agile production</td>
</tr>
<tr>
<td>Improving processes to monitor equipment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TOP CHALLENGES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DISCRETE</strong></td>
</tr>
<tr>
<td>1. Complexity/technical challenges</td>
</tr>
<tr>
<td>2. Haven’t found the right IoT solution</td>
</tr>
<tr>
<td>3. Lack of budget/staff resources</td>
</tr>
<tr>
<td>4. Lack of knowledge</td>
</tr>
<tr>
<td>5. Still implementing current solutions</td>
</tr>
<tr>
<td><strong>PROCESS</strong></td>
</tr>
<tr>
<td>Complexity/technical challenges</td>
</tr>
<tr>
<td>Haven’t found the right IoT solution</td>
</tr>
<tr>
<td>Lack of knowledge</td>
</tr>
<tr>
<td>Still implementing current solutions</td>
</tr>
<tr>
<td>Security</td>
</tr>
</tbody>
</table>

AMONG THOSE IN IoT ADOPTION IN DISCRETE MANUFACTURING (N=287) AND PROCESS MANUFACTURING (N=160)
Top Use Cases in Commercial IoT

2019
In the consumer world, IoT in ‘smart devices’ is well understood and used.

**EXAMPLES OF CONSUMER IoT**

- **WEARABLE TECHNOLOGY** that monitors heart rate and step count
- **THERMOSTATS** that can be controlled from any Internet-connected device
- **VOICE-CONTROLLED SPEAKERS** that can look up and repeat information from the Internet
Commercially, IoT is becoming a critical tool for business success, but, fewer understand its use cases, compared to those in the consumer world.

**EXAMPLES OF COMMERCIAL IoT**

- **THERMOMETERS** on trucks transporting perishable goods, that can be monitored from HQ.
- **IN-STORE TRACKER** to help employees track inventory from anywhere in the store.
- **SMART CONTINUOUS GLUCOSE MONITORING** in diabetes patients.
Commercial IoT is primarily used to optimize efficiencies, operations, and safety.
However, different industries have unique uses for commercial IoT

### Top Applications of Commercial IoT within Industry

<table>
<thead>
<tr>
<th>Manufacturing</th>
<th>Transportation</th>
<th>Retail/Wholesale</th>
<th>Healthcare</th>
<th>Government</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Industrial automation</td>
<td>Fleet management</td>
<td>Supply chain optimization</td>
<td>Tracking patient, staff, and inventory</td>
<td>Public Safety</td>
</tr>
<tr>
<td>2. Quality and compliance</td>
<td>Security, surveillance, and safety</td>
<td>Inventory optimization</td>
<td>Remote device monitoring and service</td>
<td>Infrastructure and facilities management</td>
</tr>
<tr>
<td>3. Production planning and scheduling</td>
<td>Manufacturing operations efficiency</td>
<td>Surveillance and security</td>
<td>Remote health monitoring and assistance</td>
<td>Regulations and compliance management</td>
</tr>
<tr>
<td>4. Supply chain and logistics</td>
<td>Vehicle telematics and infotainment</td>
<td>Loss prevention</td>
<td>Safety, security, and compliance</td>
<td>Fleet and asset management</td>
</tr>
<tr>
<td>5. Plant safety and security</td>
<td>Predictive maintenance</td>
<td>Energy optimization</td>
<td>Facilities management</td>
<td>Incident response</td>
</tr>
</tbody>
</table>

*Among those in IoT adoption in each industry (bases vary)*
“Manufacturing is a leader because 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 them more effective.”

DEVELOPER

“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.”

BDM
Dave is a business decision maker at a golf club manufacturing company where his team develops golf club heads.

They use IoT to ensure the quality of their golf club heads as they’re being produced by vendors.

He believes IoT is critical to success and estimates there are around 100 uses of IoT throughout his company.

“Without IoT, our company would be behind. Our competitors would be getting things faster and producing them better.”
The Journey of a Golf Club

On Dave’s team, IoT plays a key role in ensuring a successful product development cycle.

**DEVELOPMENT**
Product development team creates a concept and specs for a new golf club head

**TEST BATCH**
Specs are sent to overseas vendors and used to produce a test batch of the new product

**VALIDATION**
Dave’s team checks the test batch against their specs, ensuring that durability and performance are up to standards

*IoT USE CASE*
Using numerous internet-connected machines at the vendors’ sites, Dave’s team can get real-time data to complete their validation

*45% of manufacturing companies use IoT for quality and compliance*
Among manufacturers in IoT adoption (N=452)

IoT USE CASE
Sensors are placed on equipment to monitor when they need maintenance

IoT USE CASE
Sensors are placed on each shipment for Dave’s company to keep track of inventory

30% of manufacturing companies use IoT for predictive maintenance

43% of manufacturing companies use IoT for supply chain/logistics

The Journey of a Golf Club

After any changes are made during validation, updated specs go to the quality assurance team to do final checks.

Vendor partners produce golf clubs and send them back to Dave’s company, who then assemble the final product – full golf clubs.

The final products are shipped out to customers and sellers.

04 QUALITY ASSURANCE
05 MASS PRODUCTION/ASSEMBLY
06 DISTRIBUTION
At Dave’s company, IoT plays a multi-faceted role with numerous benefits.

Dave cites a few benefits of IoT:

1. Increasing efficiency in the development and manufacturing process (55%)
2. Ensuring vendors are being compliant (51%)
3. Giving the company a competitive edge (41%)
4. Saving money (39%)

“It’s in our vendors’ best interest to ship as much product as they can because that’s how they get paid, so getting real-time data through IoT lets us make sure our vendors are meeting requirements and not massaging the data.”

Among those in IoT adoption (N=2745)
And Dave believes their IoT use will only continue to increase.

Dave’s vision for the future of IoT at his company involves:

<table>
<thead>
<tr>
<th>Optimizing current uses of IoT through automation</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Converting IoT-connected production machinery and equipment from hard-wired to WiFi-based</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Applying the validation system to other components of golf club manufacturing (e.g., shafts, grips)</th>
</tr>
</thead>
</table>

“I absolutely think our use of IoT will increase. My goal is to make it as automated as possible and as seamless as we can so that we are getting quick data as the product is created.”

Among those in IoT adoption and planning to use IoT in Next 2 Years (N=2652):

75% of companies in adoption plan to use IoT more in 2 years.