What a Difference a Year Makes:

Manufacturers Around the World Are Now Profiting from the IoT

(Are You?)

The MPI Group

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Introduction

The inaugural *MPI Internet of Things Study* was designed to evaluate the readiness of manufacturers to incorporate smart devices and embedded intelligence within their plants and processes. That effort, reported in 2016, examined executives' plans to improve business performance via the Internet of Things (IoT), and efforts in developing and selling products with embedded intelligence. This year's report looks at those same issues — from a global perspective — as well as opportunities and challenges.

The data reveals a *vastly* greater understanding and use of the IoT by manufacturers — resulting in one-year increases in productivity, revenues, and *profits* for those firms in the vanguard of IoT implementation.

The 2017 *MPI Internet of Things Study* was conducted by The MPI Group, and sponsored by BDO and SAS Institute Inc. In November and December 2016, 374 manufacturers participated in the study.

This Executive Summary highlights:

- *IoT Awareness and Expectations (page 2):* Manufacturers rate their companies' awareness of the IoT and the expectations they have for the IoT to impact business and their companies.

- *Intelligent Plants and Processes (page 3):* Manufacturers detail the extent to which smart devices and embedded intelligence are incorporated into their operations.

- *Intelligent Products (page 9):* Manufacturers discuss plans to develop IoT-enabled products.

- *IoT Study Participants (page 12)*: Manufacturer participants are described by type and age of company, revenues, industry, markets, location of facilities, and progress toward world-class manufacturing status.

Last year, we wrote that the IoT had arrived, but manufacturers weren't ready. This year, many manufacturers have caught up. Find out if your company is ready — or falling behind — by reading on.
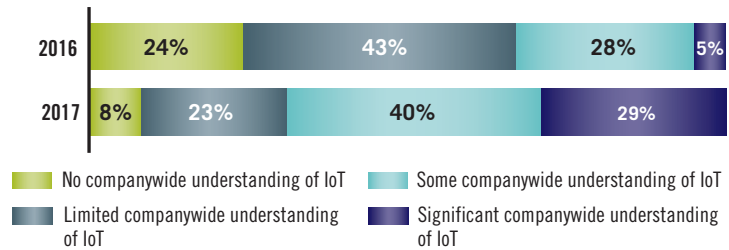
John R. Brandt
CEO
The MPI Group

Interest in the IoT Growing

Discussion of the "Internet of Things" (IoT) — whether labeled *IoT, Industrial Internet of things (IIoT), Industry 4.0,* or the *Fourth Wave of the Internet,* etc., etc. — is ubiquitous in the business media, at industry conferences, and in manufacturing plants and board rooms. It's not surprising, then, that understanding of the IoT and how to implement it has increased substantially in the last year (*Figure 1*). 90% of manufacturing executives believe that the IoT will have a significant or some impact on business *in general* over the next five years (up from 71% in the 2016 summary).

Approximately 84% of executives believe that the IoT will have a significant or some impact on *their businesses* over the next five years (up from 64%).

The percentages of manufacturers with *implemented* IoT strategies for processes
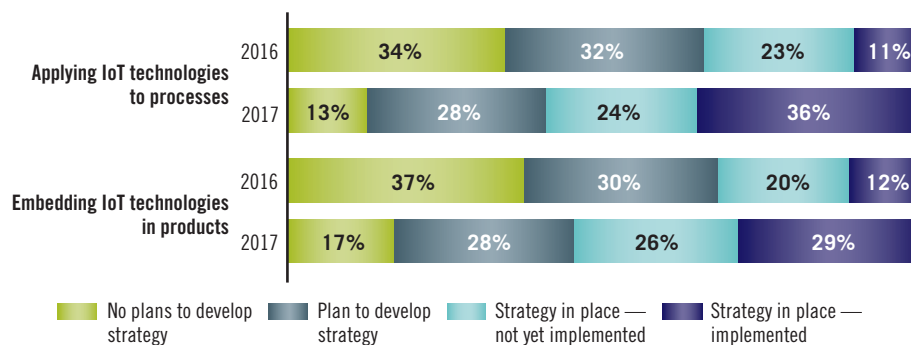
Figure 1. Company's understanding of IoT and how to apply it to the business (% of manufacturers)

- No companywide understanding of IoT
- Limited companywide understanding of IoT
- Some companywide understanding of IoT
- Significant companywide understanding of IoT

and products have risen significantly in the past year. And while a handful of manufacturers are still ignoring the IoT technologies, a majority now have *at least* a strategy (*Figure 2*).

Approximately 14% of manufacturers describe their company as an "IoT leader," and 51% see their organizations as "IoT competitive." Another 23% are playing "IoT catchup," while 12% have *no* IoT capabilities.

Figure 2. IoT process and product strategies (% of manufacturers)

- No plans to develop strategy
- Plan to develop strategy
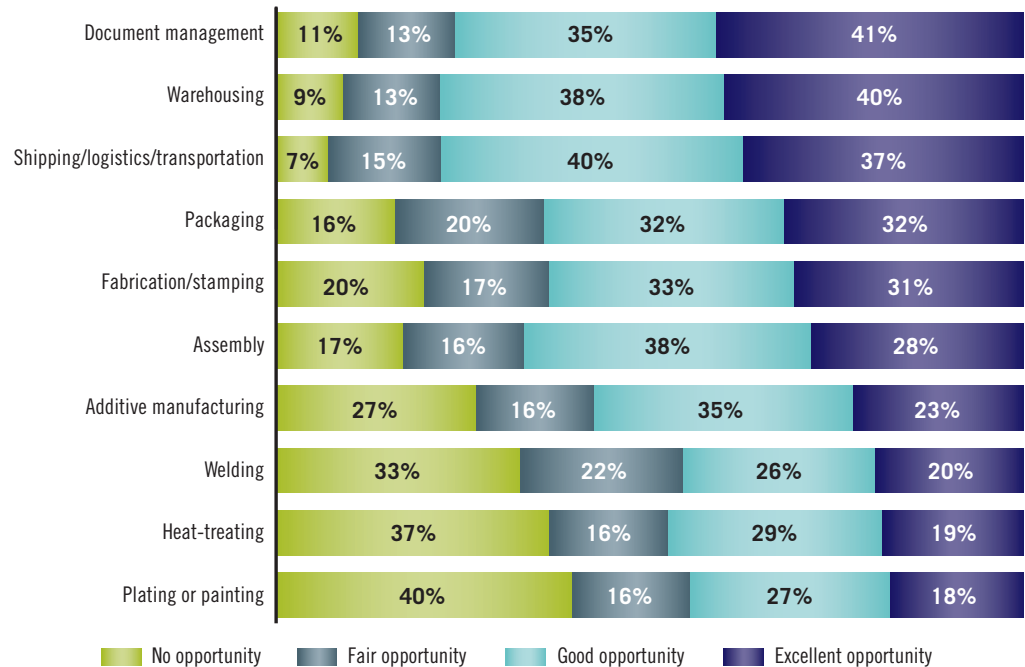- Strategy in place — not yet implemented
- Strategy in place — implemented

Application of IoT

Manufacturers have incorporated smart devices or embedded intelligence in 50% (median) of their production processes and equipment — up from 25% (median) last year. Smart devices are now used in 42% of non-production processes (e.g., back office) — up from 25% (medians).
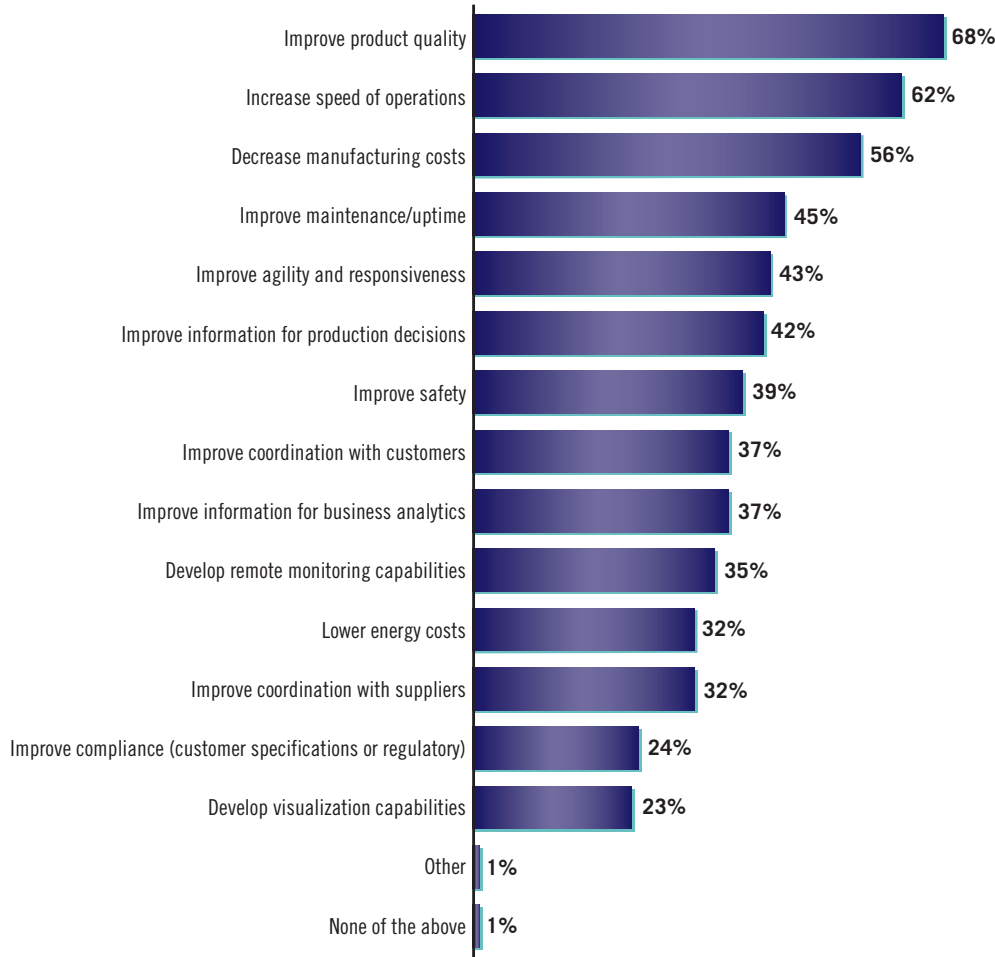
Even more impressive, 88% of manufacturers will *increase* their deployments of smart devices or embedded intelligence in production processes, and 84% will *increase* their use in non-production processes. Document management, warehousing, and shipping are the most common uses of IoT technologies in plant operations (*Figure 3*).

Figure 3. Processes that represent best opportunities to leverage the IoT (% of manufacturers)

	No opportunity	Fair opportunity	Good opportunity	Excellent opportunity
Document management	11%	13%	35%	41%
Warehousing	9%	13%	38%	40%
Shipping/logistics/transportation	7%	15%	40%	37%
Packaging	16%	20%	32%	32%
Fabrication/stamping	20%	17%	33%	31%
Assembly	17%	16%	38%	28%
Additive manufacturing	27%	16%	35%	23%
Welding	33%	22%	26%	20%
Heat-treating	37%	16%	29%	19%
Plating or painting	40%	16%	27%	18%

The top objectives for incorporating smart devices and/or embedded intelligence into plants and processes are similar to those in 2016, and continue to focus on manufacturing quality, speed, and costs (*Figure 4*).

Figure 4. Plan to accomplish by incorporating smart devices and/or embedded intelligence into operations (% of manufacturers)

Objective	%
Improve product quality	68%
Increase speed of operations	62%
Decrease manufacturing costs	56%
Improve maintenance/uptime	45%
Improve agility and responsiveness	43%
Improve information for production decisions	42%
Improve safety	39%
Improve coordination with customers	37%
Improve information for business analytics	37%
Develop remote monitoring capabilities	35%
Lower energy costs	32%
Improve coordination with suppliers	32%
Improve compliance (customer specifications or regulatory)	24%
Develop visualization capabilities	23%
Other	1%
None of the above	1%

The top objectives for incorporating smart devices and/or embedded intelligence into plants and processes... focus on manufacturing quality, speed, and costs.
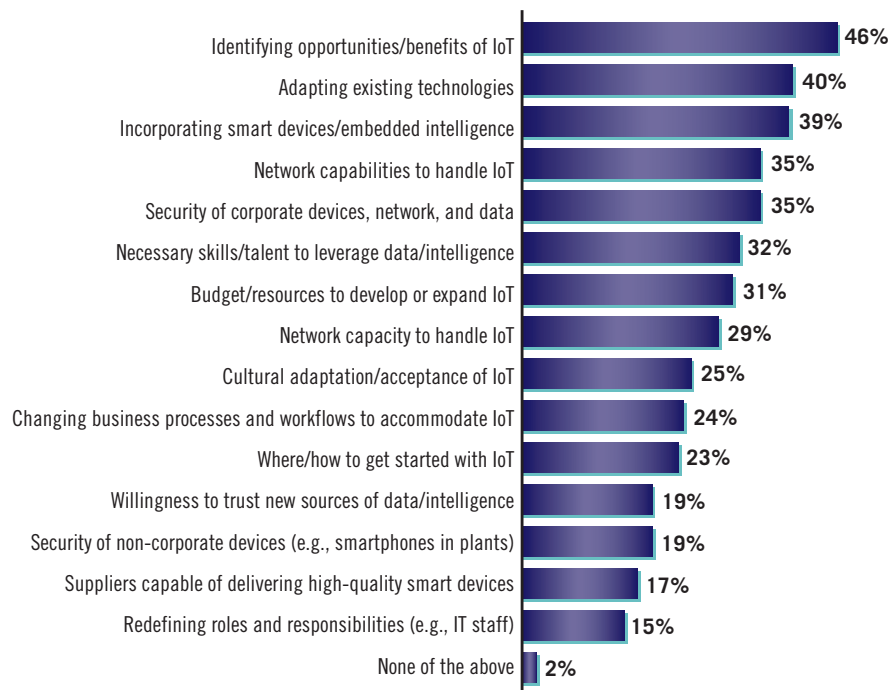
IoT Challenges and Security Concerns

The top IoT challenges are similar to those reported on in 2016. Once again, the biggest challenge is identifying how and where to get started with the IoT *(Figure 5)*.

Security is a concern for many manufacturers, yet most report that application of smart devices and/or embedded intelligence has improved the security of IT systems and data: 20% enjoy significantly improved security, while 43% experience somewhat improved security. Only 7% report that the IoT had weakened security.

In addition, most manufacturing executives (81%) are confident or very confident in their cyber risk management programs (including risk assessment, monitoring, incident response planning/testing, business recovery, etc.) with regard to the IoT.

Only 19% of executives believe that security of non-corporate devices (e.g., smartphones in plants) is an IoT challenge. This may be because 53% of firms have a BYOD (bring your own device) policy — up from 39% last year.

Figure 5. IoT capabilities that present the biggest challenges for company (% of manufacturers)

Capability	%
Identifying opportunities/benefits of IoT	46%
Adapting existing technologies	40%
Incorporating smart devices/embedded intelligence	39%
Network capabilities to handle IoT	35%
Security of corporate devices, network, and data	35%
Necessary skills/talent to leverage data/intelligence	32%
Budget/resources to develop or expand IoT	31%
Network capacity to handle IoT	29%
Cultural adaptation/acceptance of IoT	25%
Changing business processes and workflows to accommodate IoT	24%
Where/how to get started with IoT	23%
Willingness to trust new sources of data/intelligence	19%
Security of non-corporate devices (e.g., smartphones in plants)	19%
Suppliers capable of delivering high-quality smart devices	17%
Redefining roles and responsibilities (e.g., IT staff)	15%
None of the above	2%

IoT Networks and Access to Data

Manufacturers have improved their network infrastructures to accommodate IoT machine-to-machine communications (e.g., sensors in one machine trigger actions of another machine) and machine-to-enterprise communications (i.e., machine sensors send data to corporate business systems). Yet only a quarter of networks are *currently* capable (*Figure 6*), up from 10% and 13%, respectively, in 2016.
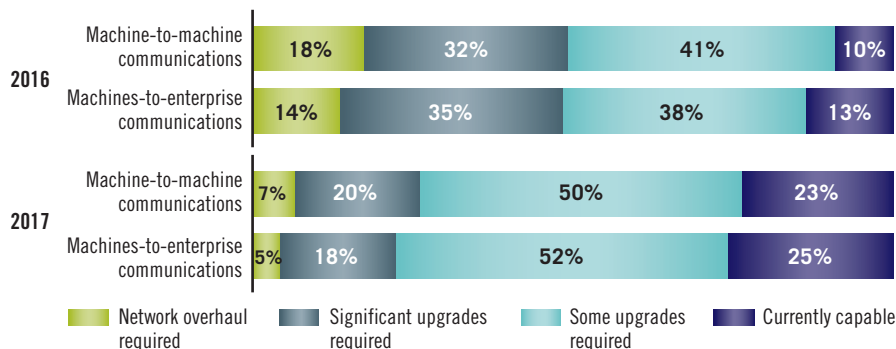
Manufacturers are utilizing IoT plant data more effectively: The application of smart devices and/or embedded intelligence in plants and processes has improved manufacturers' abilities to leverage big data/business analytics (*Figure 7*). Just as important, many who need IoT-enabled data are getting it:
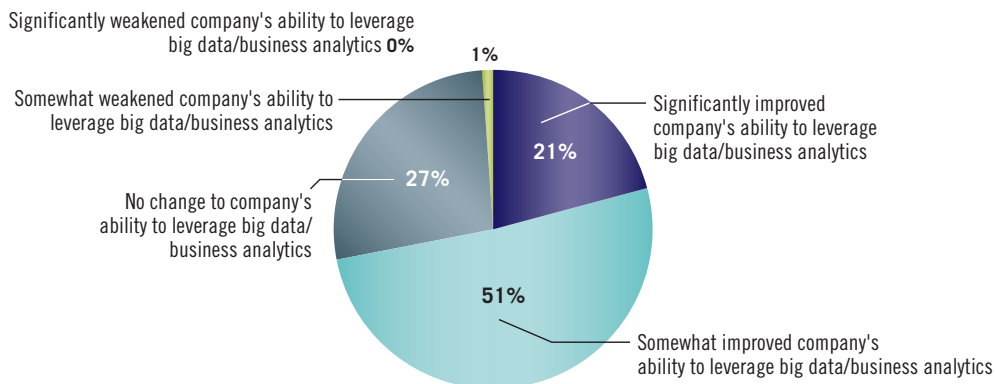
- 63% report that all or most company executives have access to IoT-enabled data
- 35% report that all or most customers have access to IoT-enabled data
- 37% report that all or most suppliers have access to IoT-enabled data

Figure 6. Current capability of network infrastructure (% of manufacturers)

	Network overhaul required	Significant upgrades required	Some upgrades required	Currently capable
2016 Machine-to-machine communications	18%	32%	41%	10%
2016 Machines-to-enterprise communications	14%	35%	38%	13%
2017 Machine-to-machine communications	7%	20%	50%	23%
2017 Machines-to-enterprise communications	5%	18%	52%	25%

Figure 7. Effect of smart devices and/or embedded intelligence in plants and processes on ability to leverage big data/business analytics (% of manufacturers)

- Significantly weakened company's ability to leverage big data/business analytics **0%**
- 1%
- Somewhat weakened company's ability to leverage big data/business analytics
- No change to company's ability to leverage big data/business analytics — 27%
- Somewhat improved company's ability to leverage big data/business analytics — 51%
- Significantly improved company's ability to leverage big data/business analytics — 21%

Managing and Investing in the IoT

Effective use of the IoT requires more than just technology: Operations technology (OT) staff need to collaborate with information technology (IT) staff to ensure that secure data moves rapidly to where it's required. Unfortunately, OT and IT departments don't partner well at most companies (*Figure 8*).

As manufacturers increase their IoT investments, more are tasking their IT departments to lead their IoT implementations — 34% in 2017 vs. 17% in 2016; operations leadership of IoT initiatives fell from 26% to 20%.

Nearly half of manufacturers invested more than 5% of sales last year in implementing the IoT (*Figure 9*). Even more significant, 89% of manufacturers expect to increase investments in the next two years.

Figure 8. Information technology staff and operations technology staff collaboration (% of manufacturers)

	2016	2017
Upgrading legacy enterprise systems	45%	54%
Resolving technical operations issues	53%	53%
Network security	50%	48%
Linking operations data and with business analytics	45%	43%
Resolving technical enterprise issues	37%	42%
Upgrading legacy operations systems	45%	41%
Other	1%	2%
No collaboration	8%	4%

Figure 9. Company investment (% of sales) in implementing an IoT strategy into plants and processes in the past year (% of manufacturers)

	2016	2017
0%	30%	10%
1–2%	38%	20%
3–5%	15%	22%
6–10%	12%	26%
11–15%	4%	15%
More than 15%	1%	8%

IoT Process ROI

A majority of manufacturers benefitted over the past year by the application of the IoT to their plants and processes (*Figure 10*):
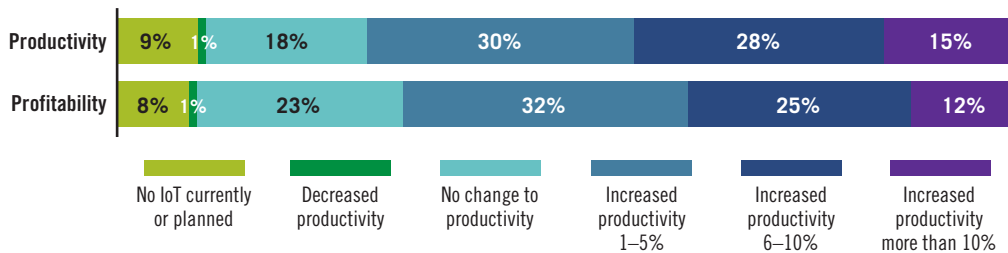
- 72% increased productivity via the IoT

- 69% increased profitability via the IoT.

Yet manufacturing executives strongly believe that they are only at the start of
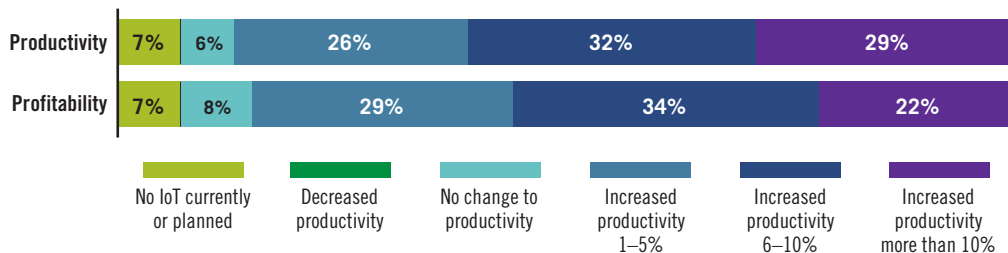
IoT-enabled improvement: Over the next five years (*Figure 11*):

- 88% expect increases to productivity via application of the IoT to plants and processes

- 86% expect increases to profitability via application of the IoT to plants and processes.

Figure 10. Impact of IoT to plants and processes on productivity and profitability in past year (% of manufacturers)

Productivity	9%	1%	18%	30%	28%	15%
Profitability	8%	1%	23%	32%	25%	12%

No IoT currently or planned	Decreased productivity	No change to productivity	Increased productivity 1–5%	Increased productivity 6–10%	Increased productivity more than 10%

Figure 11. Impact of IoT to plants and processes on productivity and profitability over the next five years (% of manufacturers)

Productivity	7%	6%	26%	32%	29%
Profitability	7%	8%	29%	34%	22%

No IoT currently or planned	Decreased productivity	No change to productivity	Increased productivity 1–5%	Increased productivity 6–10%	Increased productivity more than 10%

IoT Product Plans and Challenges

As examples of IoT-enabled products proliferate — from shoes to light bulbs to concrete(!) — so, too, does interest among other manufacturers: One-third of product dollar sales (median) were derived from products with embedded smart devices/intelligence,[1] and 68% of manufacturers now have significant or some plans to embed smart devices or intelligence into their products (*Figure 12*).

Approximately a third of product sales (by dollar volume, median) come from products with embedded smart devices or intelligence. For now, manufacturers are focusing primarily on their own finished products, but other innovations are increasing in popularity (*Figure 13*).

Figure 12. Company effort to embed smart devices and/or intelligence in products
(% of manufacturers)

	2016	2017
Significant focus of our product innovation plans	14%	29%
Some plans to embed smart devices in products	26%	39%
Limited plans to embed smart devices in products	30%	15%
No plans to embed smart devices in products	30%	17%

Figure 13. Types of products that represent excellent or good opportunities for IoT-enabled products
(% of manufacturers)

	2016	2017
Our company's finished products	59%	71%
Technologies for other manufacturers' products	29%	60%
Devices for other manufacturers' products	29%	56%
Software for other manufacturers' products	26%	55%
Materials for other manufacturers' products	23%	52%
Fluids/substances for other manufacturers' products	15%	48%

[1] Not asked in previous year.

Yet despite executive interest in IoT-enabled products, challenges in developing them remain considerable. Just as in 2016, the biggest problem for most manufacturers is simply *identifying* opportunities to develop these products (*Figure 14*).

Figure 14. Aspects of IoT-enabled products that present the biggest challenges (% of manufacturers)

	2016	2017
Identifying opportunities/benefits of IoT products	44%	49%
Technologies needed to embed smart devices into products	35%	43%
R&D and innovation skills/talent in this area	27%	28%
Clear understanding on customer needs/value	36%	28%
Suppliers capable of delivering high-quality smart devices[2]	—	26%
Where/how to get started with IoT products	29%	26%
Budget/resources to develop IoT-enabled products	32%	25%
Keeping up with the pace of smart-device technology changes	22%	24%
Liabilities/risks of embedded devices	24%	23%
Systems and applications (e.g., modeling) to support R&D efforts	19%	14%
Other	1%	1%
None of the above	11%	6%

Despite executive interest in IoT-enabled products, challenges in developing them remain considerable.

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[2] Not asked in previous year.

IoT Product Investments and Objectives

The percentage of manufacturers investing in IoT-enabled products increased dramatically in the past year (from 59% to 80%), and more manufacturers are investing higher percentage of sales into their development (*Figure 15*). Just as significant, 81% of manufacturers expect investments in IoT products will increase in the next two years.

The reasons for embedding smart devices or intelligence into products are similar to last year, although expectations of improved profits rose considerably:

- Increase revenue from new products (48% in 2017 vs. 39% in 2016)
- Increase profit margins per product (46% vs. 34%)
- Increase market share (43% vs. 39%)
- Improve branding/market awareness (35% vs. 27%)

- Access new markets/sectors (33% vs. 26%)
- Access data from products or services in the field (30% vs. 34%)
- Differentiate products in market (29%[3]).

Roughly 80% of manufacturers report that application of the IoT to their products increased revenue in the past year, and 80% believe that IoT products will increase revenues over the next five years.

Two-thirds of manufacturers (65%) report that application of the IoT to products increased profits in the past year, despite the fact that these products had lower margin: 27% profit on IoT-enabled products vs. 32% for other products (medians). It may be that manufacturers are only beginning to recoup development costs of their IoT innovations.

Figure 15. Company investment (% of sales) in embedding IoT technologies into products in the past year (% of manufacturers)

2016	41%	35%	15%	5%	1% 2%	
2017	20%	20%	25%	22%	8%	5%

Legend: 0% | 1–2% | 3–5% | 6–10% | 11–15% | More than 15%

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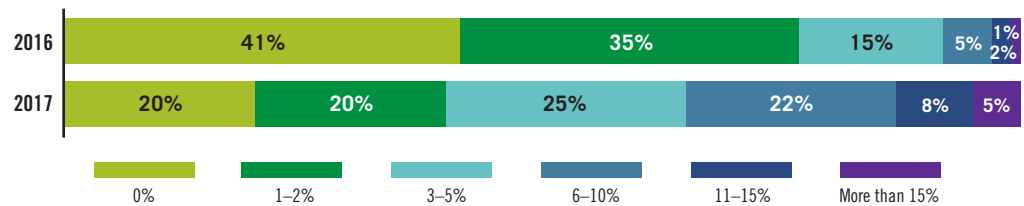
[3] Not asked in previous year.

IoT Study Participants

Some 72% of study participants are private companies (up from 60% in 2016), and 64% have been in business for more than 20 years (down from 84% in 2016).

Participants represent a range of annual revenues: 38% have revenues of $10 million to $100 million; 31% have revenues of $101 million to $500 million; and 31% have revenues that exceed $500 million.[3]

The industries and markets represented in the study are similar to those in 2016. The top two industries are machinery manufacturing (22%) and fabricated metal products (16%). The top two markets are manufacturing (67%) and construction (25%). The majority of participants were located in the United States *(Figure 16)*.[4] As in 2016, most participants also had facilities in the United States (70%, down from 96% in 2016) as well as elsewhere in the world; other top regions for facilities were Europe (35%), China (32%), and Mexico (25%).

More than half of participants have made significant progress toward (51%) or fully achieved (15%) world-class manufacturing status. The operational metrics reported by IoT Study participants can be found in *Figure 17*.

Figure 16. Country or region where company is located (% of manufacturers)

| **57%** United States | **14%** China | **13%** Europe | **7%** Mexico | **5%** South America | **4%** Other |
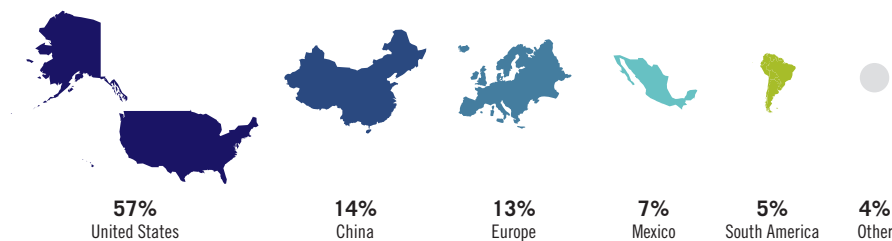
Figure 17. Operations performances

	Median	Mean
Cost of goods sold (as % of sales) — current year	52.0%	52.2%
Cost of goods sold (as % of sales) — three years ago	50.0%	51.6%
Machine availability (as % of scheduled uptime) — current year	71.0%	67.2%
Machine availability (as % of scheduled uptime) — three years ago	63.0%	61.1%
First-pass yield (average % for all plant processes) — current year	75.0%	69.5%
First-pass yield (average % for all plant processes) — three years ago	67.0%	64.6 %
Sales per employee	$120,000	$221,971

[4] Note: The findings in this Executive Summary are based on participants with annual revenues of greater than $10 million (in 2016, 10% had revenues of less than $10 million). Another difference between 2017 and 2016 is the inclusion of manufacturers located/headquartered outside of the United States.

The MPI Group

The MPI Group (MPI) serves leaders with research, advice, and performance-targeted solutions that provide a competitive advantage in today's fierce marketplace. MPI combines the disciplines of research, strategic advice, knowledge development, and hands-on leadership to create a difference — in performance, in profits, and in the people who make them possible.

In addition to the *MPI Internet of Things Study,* MPI has conducted the MPI Manufacturing Study for more than a decade — benchmarking research focused on manufacturing plant performances and best practices. MPI also conducts the Distribution and Logistics Study, a site-specific assessment of distribution centers and warehouse facilities used by numerous types of businesses.

MPI CEO John Brandt offers presentations on the IoT study data and other MPI research, via webinars and in-person events. To learn more about the *MPI Internet of Things Study,* schedule an IoT presentation, or to find out more about other research conducted by MPI, contact:

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