Industry 4.0 Drives Productivity — and Profitability — for Manufacturers

Findings from the MPI 2020 Industry 4.0 Study

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Introduction

The MPI 2020 Industry 4.0 Study examines the extent to which manufacturers are leveraging Industry 4.0 — embedding intelligence and/or smart devices into their operations and connecting them to the enterprise and supply chain, as well as offering new products that incorporate embedded intelligence. The MPI Group (MPI) has been studying manufacturers' engagement with Industry 4.0 for years, and the changes over time are clear: leaders recognize that their firms must digitize now — or become vulnerable to competition.

Since this study began in 2016, manufacturers have increasingly implemented Industry 4.0 technologies and best practices — resulting in enhanced productivity, revenues, profits, and competitive advantages.

It's important to note that this study was conducted in February 2020, prior to the COVID-19 pandemic and ensuing economic disruption, for two reasons:

- First, large majorities of manufacturing executives from around the globe reported that Industry 4.0 dramatically improved their productivity and profitability, both in their facilities and in how they develop and deliver smart products.

- Second, these executives' insights into how to leverage Industry 4.0 will be critical for other manufacturers as they navigate through the COVID-19 crisis toward the opportunities beyond. This executive summary, based on data from 679 manufacturers in regions across the world, provides proof of that:

- *The Importance of Industry 4.0 (page 2):* Manufacturers highlight the expectations they have for Industry 4.0, and how it's changing their strategies and competitive positioning. *Industry 4.0 is already a competitive differentiator for more than half of companies.*

- *Industry 4.0-Enabled Plants and Processes (page 4):* Manufacturers detail how they're incorporating smart devices and embedded intelligence into their operations — and the performance improvements and profits they're earning by doing so. *Industry 4.0 improved profitability at more than half of manufacturers over the past year.*

- *Smart Products (page 7):* Manufacturers discuss development of smart products — and the R&D innovations and profits they're generating by doing so. *Profit margins are higher for products with embedded smart devices and/or intelligence.*

- *Study Participants (page 10):* Study participants are listed by corporate characteristics, including company location, corporate revenues, industries, and markets. *The MPI study shows the wide range of industries and companies improving their businesses with Industry 4.0.*

Industry 4.0 has arrived. Are you ready for the journey?

John Brandt
CEO
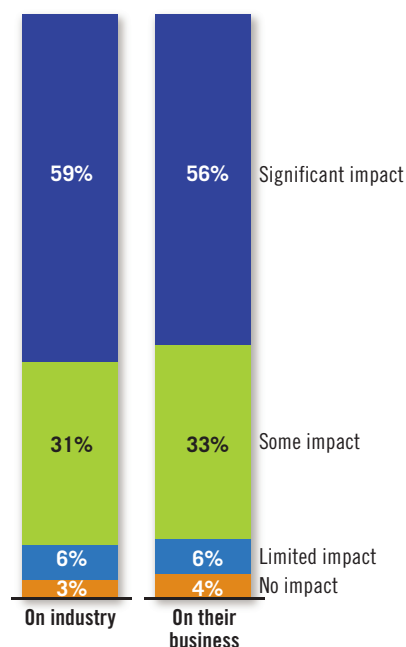The MPI Group

The Importance of Industry 4.0

Nearly all manufacturing executives report that Industry 4.0 is important to their companies — 45 percent say it's "extremely important" and 38 percent "very important." More than half of executives indicate that Industry 4.0 will have "significant impact" on their industries and their businesses in the next five years *(Figure 1).*

Approximately half of executives report that Industry 4.0 is a competitive differentiator today, and another 42 percent say it will be in the future. Nearly a quarter of executives described their companies as "Industry 4.0 leaders" and 54 percent as "Industry 4.0 competitive." The race for digital supremacy is on. Some manufacturers have a head start, and the gap between Industry 4.0 haves and have-nots will likely widen.

Industry 4.0 is altering the competitive landscape of manufacturing because it improves financial, operational, and brand value across a range of functions/ departments. Industry 4.0 provides the most *financial* value for supply-chain activities (50 percent); the most *operational* value to operations (63 percent); and the most *brand* value to sales and marketing (46 percent). Even departments distant from production and product development — e.g., human resources — are finding value in Industry 4.0.

Figure 1. Impact of Industry 4.0 in next five years
(percent of manufacturers)[1]

On industry	On their business	
59%	56%	Significant impact
31%	33%	Some impact
6%	6%	Limited impact
3%	4%	No impact

With such high expectations for Industry 4.0, it's no surprise that manufacturers have invested time into developing strategies for applying Industry 4.0 technologies to their processes and products. Some 43 percent of manufacturers have a "significant companywide understanding" of Industry 4.0 and how to apply it to their businesses, with another 40 percent reporting "some companywide understanding." Nearly half of manufacturers (47 percent) have strategies implemented to apply Industry 4.0 to processes, but only 37 percent have done so for their products.

[1] Due to rounding of decimals, some data in this report will not sum to 100%.

As with any organizational transformation, research and planning are critical components for success with Industry 4.0. The individuals most likely to lead these initiatives are the head of manufacturing, head of engineering, and the CIO.

Manufacturers differ in opinion regarding the technologies that comprise Industry 4.0. They agree *most* commonly on factory automation (62 percent) and artificial intelligence (62 percent), and *least* commonly on fog, edge, and cloud computing (22 percent) *(Figure 2)*.

Manufacturers also vary considerably in their abilities to achieve strategic objectives and to deliver Industry 4.0 initiatives on-time and on-budget:

- *Achieving strategic objectives:* 24 percent achieve all strategic objectives, and 38 percent most strategic objectives.

- *On schedule:* 42 percent on schedule — but 10 percent significantly later and 28 percent somewhat later.

- *On budget:* 50 percent on budget — but 8 percent significantly over budget and 30 percent somewhat over budget.

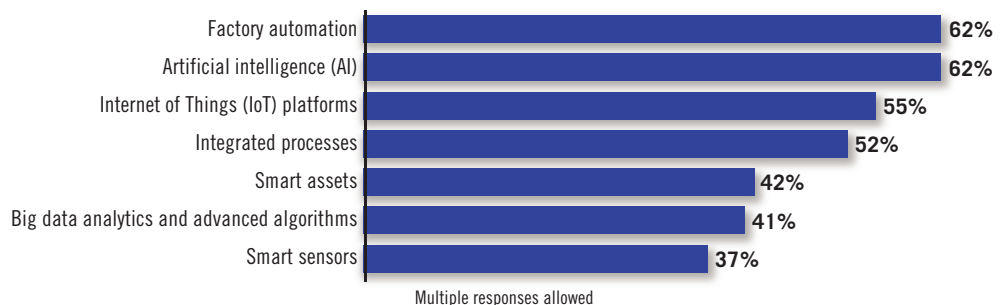Industry 4.0 initiatives can require considerable effort and investment, depending on company size and the number of processes involved. These initiatives typically start with integration of intelligent sensors and controls into equipment and/or converting source data from analog to digital signals.

This allows plant floors to connect Industry 4.0 data to many departments and functions — unless network infrastructures prevent communication. Unfortunately, 54 percent of networks require upgrades for even machine-to-machine communications, and 67 percent require upgrades for machine-to-enterprise communications.

Another significant factor in delayed or over-budget Industry 4.0 implementations — and affecting the state of network infrastructures — is likely the failure of information technology (IT) and operations technology (OT) staffs to collaborate on plant-to-enterprise network issues. In fact, the highest rate of IT-OT collaboration is resolving technical operations issues (essentially firefighting) — but this happens at just 55 percent of companies. These percentages have barely changed since MPI's initial Industry 4.0 study.

Manufacturers are bullish on Industry 4.0. But it will take more than optimism to efficiently achieve objectives of Industry 4.0 initiatives — it will take defined strategies, specific goals, and precise execution.

Figure 2. Technologies most likely considered to make up Industry 4.0 (percent of manufacturers)

Technology	Percent
Factory automation	62%
Artificial intelligence (AI)	62%
Internet of Things (IoT) platforms	55%
Integrated processes	52%
Smart assets	42%
Big data analytics and advanced algorithms	41%
Smart sensors	37%

Multiple responses allowed

Industry 4.0-Enabled Plants and Processes

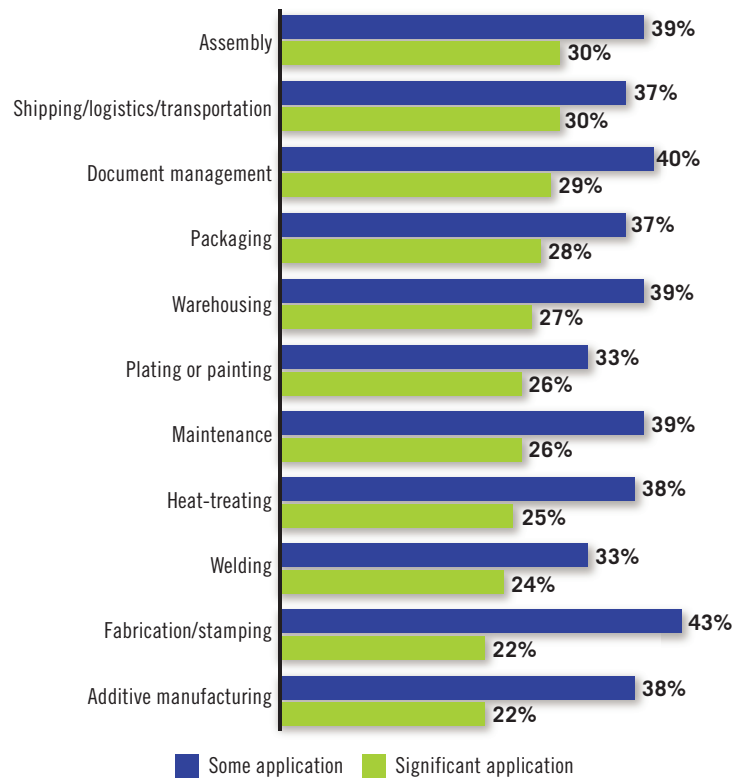**M**anufacturers have incorporated smart devices or embedded intelligence into 41 percent (average) of their *production processes and equipment;* 88 percent expect that percentage to increase in the next two years (39 percent "increase significantly" and 49 percent "somewhat"). Manufacturers have also incorporated smart devices or embedded intelligence into 33 percent (average) of their *non-production processes* (e.g., back office); 86 percent expect that percentage to increase in the next two years (36 percent "increase significantly" and 50 percent "somewhat"). The volume of real-time production data flowing from plant floors is unprecedented — and growing.

Industry 4.0 initiatives for plants and processes are most likely to be led by IT (31 percent), operations leadership, (19 percent), or a dedicated Industry 4.0 department/function (18 percent).

Smart devices or embedded intelligence are most likely to have "significant application" in assembly and shipping/logistics/transportation processes *(Figure 3).*

Figure 3. Process in which smart devices and/or embedded intelligence have been applied (percent of manufacturers)

Process	Some application	Significant application
Assembly	39%	30%
Shipping/logistics/transportation	37%	30%
Document management	40%	29%
Packaging	37%	28%
Warehousing	39%	27%
Plating or painting	33%	26%
Maintenance	39%	26%
Heat-treating	38%	25%
Welding	33%	24%
Fabrication/stamping	43%	22%
Additive manufacturing	38%	22%

■ Some application ■ Significant application

Despite the widespread application of smart devices and/or embedded intelligence, many executives and business partners don't yet have access to Industry 4.0 data:
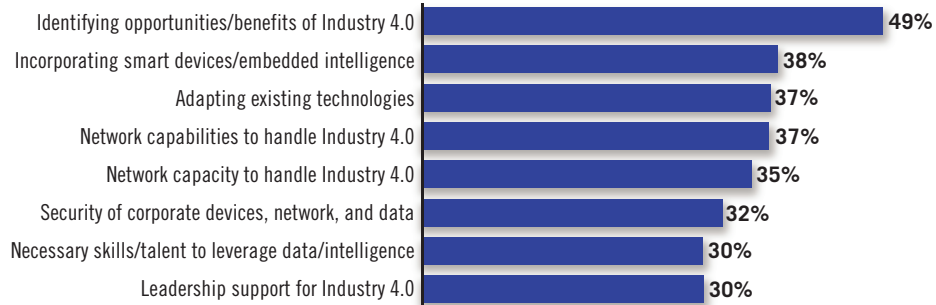
- *Company executives:* Just 46 percent of companies provide access to all who need it. Many executives who could be using Industry 4.0 data for analytics and planning don't yet have it.

- *Customers:* Just 23 percent of companies provide access to all who need it. Customers increasingly expect to see order status in real time as goods are produced — e.g., timeliness, specifications, quality. If they don't get insights and updates from one vendor, they may seek them elsewhere.

- *Suppliers:* Just 24 percent of companies provide access to all who need it. The ability for suppliers to track demand in real time improves their performances — and those of customers. These critical connections can improve end-to-end supply chain responsiveness.

Manufacturers also face other challenges in implementing Industry 4.0. Tops on the list is identifying opportunities/benefits of Industry 4.0 *(Figure 4)*.

Some 86 percent of manufacturing executives are confident that their cyber risk management programs address the Industry 4.0 environment. Yet implementation of best practices for improving security has lagged in the last 12 months. For example, only 40 percent of manufacturers have conducted cyber risk assessments.

Figure 4. Top challenges with Industry 4.0 (percent of manufacturers)

Challenge	Percent
Identifying opportunities/benefits of Industry 4.0	49%
Incorporating smart devices/embedded intelligence	38%
Adapting existing technologies	37%
Network capabilities to handle Industry 4.0	37%
Network capacity to handle Industry 4.0	35%
Security of corporate devices, network, and data	32%
Necessary skills/talent to leverage data/intelligence	30%
Leadership support for Industry 4.0	30%

Implementation of best practices for improving security has lagged in the last 12 months.

Despite these challenges, Industry 4.0 initiatives in plants and processes are driving improvements:

- The performances most improved by Industry 4.0 were machine reliability/uptime (85 percent of manufacturers), product quality (84 percent); and customer satisfaction (83 percent).

- The workplace capabilities most improved by Industry 4.0 were production decision-making (85 percent of manufacturers), operations agility and responsiveness (85 percent), and remote-monitoring capabilities (85 percent).

- Productivity — improved productivity at 88 percent of manufacturers *(Figure 5)*.

- Profitability — improved profitability at 84 percent of manufacturers *(Figure 5)*.

The impact of Industry 4.0 has been enormous, as digital changes to operational activities drive performance gains now — and over the next five years *(Figure 6)*.

Manufacturers are moving aggressively to capture the benefits of digitization. Approximately half have invested more than 5 percent of sales in implementing an Industry 4.0 strategy in their plants and processes in the past year, and 91 percent will increase that investment in the next two years (11 percent will increase investments by more than 20 percent).

Industry 4.0 promises to change the nature and productivity of production processes; massive investments now and over the next five years offer the promise of even greater improvements.

The impact of Industry 4.0 has been enormous, as digital changes to operational activities drive performance gains now — and over the next five years.

Figure 5. Impact of Industry 4.0 to plants and processes on productivity and profitability in past year (percent of manufacturers)

	Productivity	Profitability
Increased more than 10 percent	19%	15%
Increased 6-10 percent	42%	38%
Increased 1-5 percent	27%	31%
No change	7%	11%
Decreased	1%	1%
No Industry 4.0 currently or planned	5%	5%

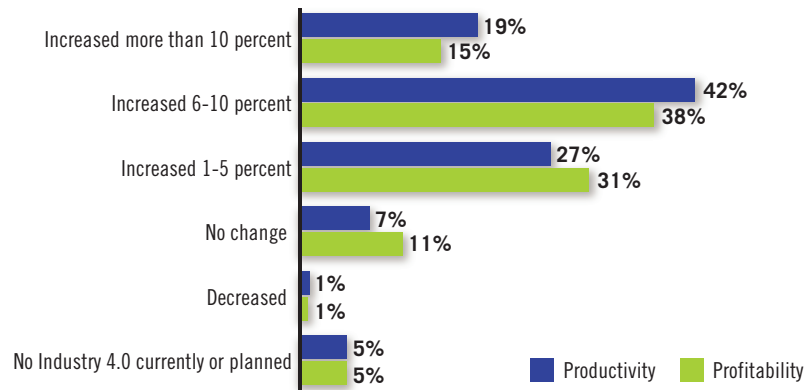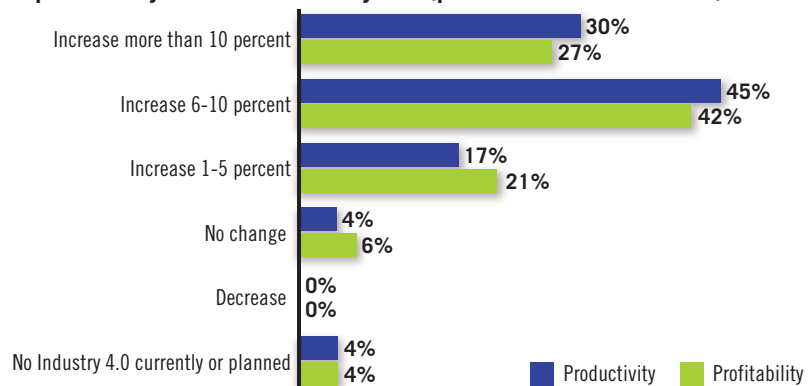**Figure 6. Impact of Industry 4.0 to plants and processes on productivity and profitability over the next five years (percent of manufacturers)**

	Productivity	Profitability
Increase more than 10 percent	30%	27%
Increase 6-10 percent	45%	42%
Increase 1-5 percent	17%	21%
No change	4%	6%
Decrease	0%	0%
No Industry 4.0 currently or planned	4%	4%

Smart Products

Products with intelligence are proliferating. For 46 percent of manufacturers, embedding smart devices and/or intelligence into products is a significant focus of production innovation plans, and another 37 percent have some plans to do so. Approximately two-thirds of manufacturers are embedding smart devices and/or intelligence into products, including finished goods, materials, and software *(Figure 7)*.

Manufacturers are generating 38 percent (average) of product sales from goods with embedded smart devices and/or intelligence. Smart products generate a profit margin of 36 percent (average) vs. 33 percent (average) for other products. B2B customers and consumers have

recognized the value that embedded smart devices and/or intelligence offer — and they're willing to pay a premium for it.

But as manufacturers develop intelligent products, they face a series of obstacles. The top challenges in embedding smart devices and/or intelligence into products are identifying the opportunities/benefits of smart products (53 percent) and accessing required technologies (45 percent) *(Figure 8)*. In part, this reflects the reality that manufacturers must develop new competencies to deliver smart products: finding new vendors; creating new processes; and building new service models to leverage data from smart products. R&D/product-development leaders who proactively address these

Figure 7. Types of Industry 4.0 products created (percent of manufacturers)
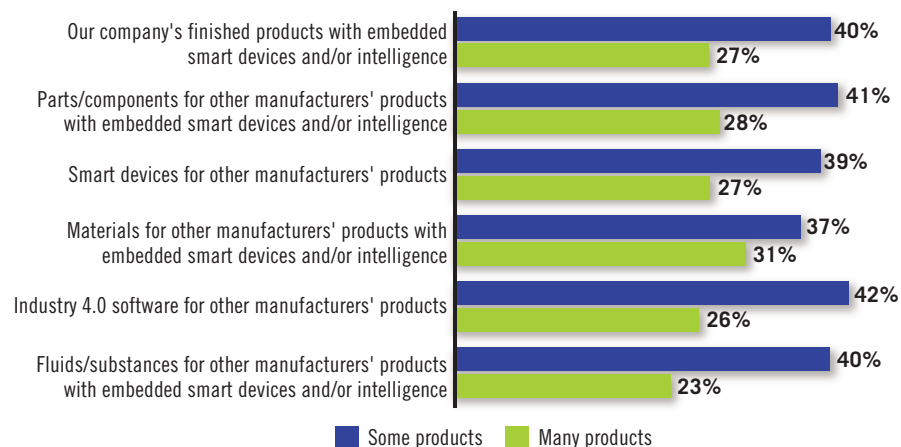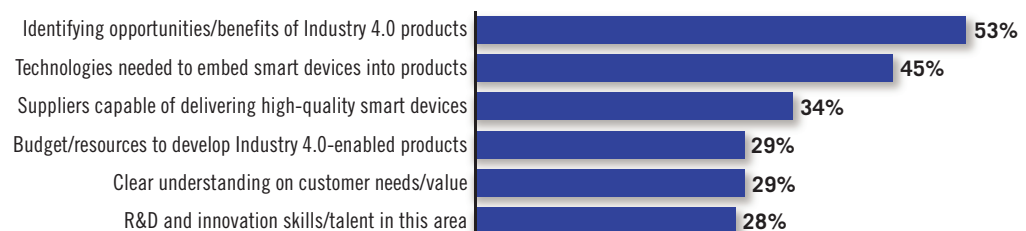
Category	Some products	Many products
Our company's finished products with embedded smart devices and/or intelligence	40%	27%
Parts/components for other manufacturers' products with embedded smart devices and/or intelligence	41%	28%
Smart devices for other manufacturers' products	39%	27%
Materials for other manufacturers' products with embedded smart devices and/or intelligence	37%	31%
Industry 4.0 software for other manufacturers' products	42%	26%
Fluids/substances for other manufacturers' products with embedded smart devices and/or intelligence	40%	23%

Legend: ■ Some products   ■ Many products

Figure 8. Aspects of smart products that present the biggest challenges (percent of manufacturers)

Category	Percent
Identifying opportunities/benefits of Industry 4.0 products	53%
Technologies needed to embed smart devices into products	45%
Suppliers capable of delivering high-quality smart devices	34%
Budget/resources to develop Industry 4.0-enabled products	29%
Clear understanding on customer needs/value	29%
R&D and innovation skills/talent in this area	28%

requirements are likely to see the greatest gains in smart-product market share.

Embedding smart devices and/or intelligence into products has improved performance and capabilities at most companies. Most likely to be improved are customer support and branding/market awareness
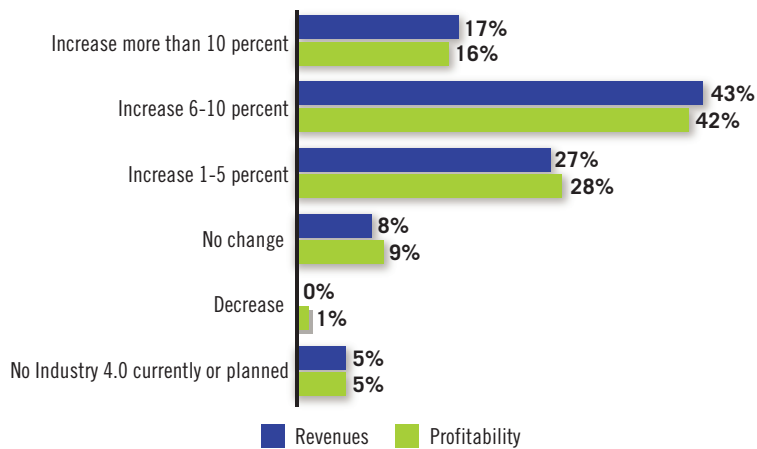
(both at 42 percent "significant improvement") *(Figure 9)*.

Most importantly, intelligent products have increased revenues and profitability in the past year *(Figure 10)*, with further increases expected over the next five years *(Figure 11 on next page)*.

Figure 9. Impact of Industry 4.0 products business performance and capabilities (percent of manufacturers)

Category	Some improvement	Significant improvement
Customer support	41%	42%
Branding/market awareness	40%	42%
Differentiating products in the market	44%	41%
Access to data from products or services in the field	41%	40%
Access to new markets/sectors	41%	40%
Revenue from new products	44%	40%
Market share	45%	35%
Profit margins per product	45%	34%

■ Some improvement　■ Significant improvement

Data excludes respondents who answered "No products with embedded smart devices and/or intelligence"

Figure 10. Impact of the application of Industry 4.0 to products in past year (percent of manufacturers)

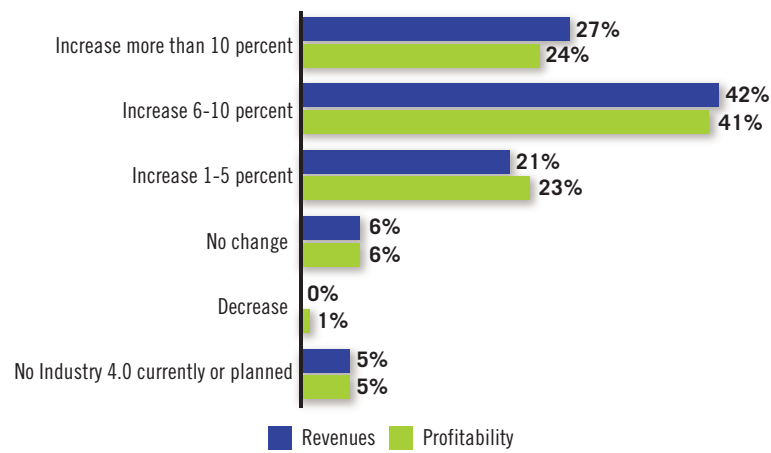| Category	Revenues	Profitability
Increase more than 10 percent	17%	16%
Increase 6-10 percent	43%	42%
Increase 1-5 percent	27%	28%
No change	8%	9%
Decrease	0%	1%
No Industry 4.0 currently or planned	5%	5%

■ Revenues　■ Profitability

Manufacturers are driving these gains with massive investments. Roughly half have invested more than 5 percent of sales in embedding Industry 4.0 technologies into their products in the past year, and 89 percent will increase that investment in the next two years (13 percent will increase investments by more than 20 percent).

Manufacturers have the technologies to embed intelligence into most any product — but many still struggle to identify customer use cases for them.

Figure 11. Impact of the application of Industry 4.0 to products in over next five years (percent of manufacturers)

	Revenues	Profitability
Increase more than 10 percent	27%	24%
Increase 6-10 percent	42%	41%
Increase 1-5 percent	21%	23%
No change	6%	6%
Decrease	0%	1%
No Industry 4.0 currently or planned	5%	5%

Building an Industry 4.0 Future

The Industry 4.0 Study highlights manufacturers' enthusiastic embrace of these technologies prior to the COVID-19 pandemic, and offers hope for how Industry 4.0 might hasten the recovery of manufacturing in its aftermath. But for that to occur, manufacturers will need to:

• Develop enterprise-wide strategies to optimize their Industry 4.0 implementations,

• Efficiently manage Industry 4.0 initiatives vs. strict return-on-investment criteria,

• Think creatively about how Industry 4.0 can improve agility and productivity in factories and facilities, and

• Partner with customers to embed intelligence into products that drive higher revenues, margins, and satisfaction.

Industry 4.0 Study Participants

Some 84 percent of study participants are private companies, and 50 percent have been in business for more than 20 years. Manufacturing executives participating in the study represented a range of titles *(Figure 12)* and reported detailed knowledge of Industry 4.0 activities dealing with manufacturing/production (90 percent), R&D/product development (30 percent), and maintenance/asset management (20 percent).

Participating manufacturers represent a range of annual revenues: 28 percent have revenues of $10 million to $100 million; 25 percent have revenues of $101 million to $500 million; and 47 percent have revenues that exceed $500 million.[3]

The top industries represented in the study are machinery manufacturing (22 percent), fabricated metal product manufacturing (12 percent), computer and electronic product manufacturing (11 percent), and primary metal manufacturing (10 percent).

The nature of production operations at these companies was process/batch manufacturing (49 percent), discrete manufacturing (31 percent), and both discrete and batch manufacturing (21 percent). The top markets in which manufacturers sell products are manufacturing (72 percent), wholesale (17 percent), retail (14 percent), and construction (14 percent).

Participating manufacturers were located around the globe *(Figure 13)*. More than half of participants have made significant progress toward (43 percent) or fully achieved (20 percent) world-class manufacturing status.

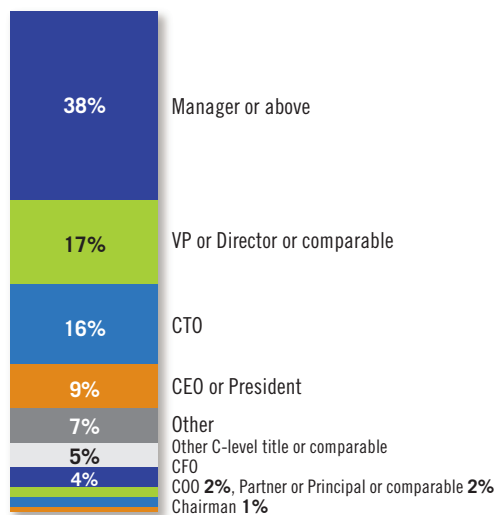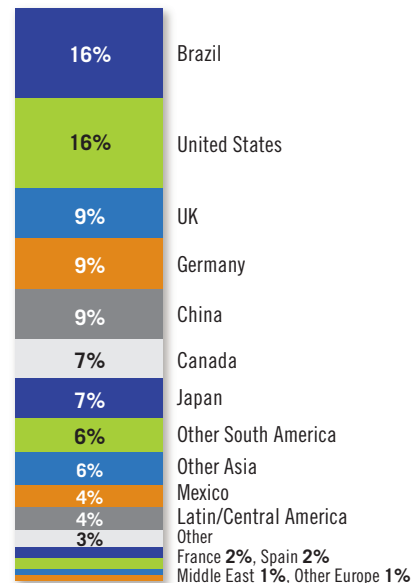### Figure 12. Title
(percent of manufacturers)

38%	Manager or above
17%	VP or Director or comparable
16%	CTO
9%	CEO or President
7%	Other
5%	Other C-level title or comparable
4%	CFO
	COO **2%**, Partner or Principal or comparable **2%**
	Chairman **1%**

Figure 13. Country or region where company is located (percent of manufacturers)

16%	Brazil
16%	United States
9%	UK
9%	Germany
9%	China
7%	Canada
7%	Japan
6%	Other South America
6%	Other Asia
4%	Mexico
4%	Latin/Central America
3%	Other
	France **2%**, Spain **2%**
	Middle East **1%**, Other Europe **1%**

[3] All study participants had annual revenues of more than $10 million.

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 Industry 4.0 Study, MPI conducts an ambitious series of other public research studies, exploring strategies, best practices, operational measures, and profitability across new management opportunities, technologies, and methodologies including:

• Innovation

• Disruptive Technologies

• Sustainable Business Practices

• Process Improvement

• Manufacturing Metrics

• Supply Chain Performance

And …

• Nincompoopery! (Customer Value Creation — and Destruction).

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The MPI Group

mpi-group.com

+1 (216) 991-8390

jbrandt@mpi-group.com