Digitization Delivers
for Manufacturers

Industry 4.0 Increases Productivity, Revenues, and Profitability around the Globe

MPI 2021 Industry 4.0 Study
Executive Summary

The MPI Group

People. Purpose. Profits.

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Introduction

Manufacturers' engagement with Industry 4.0 increased significantly last year, as leaders leveraged digitization to not only survive the pandemic, but to position their firms for the economic recovery to follow.

The *MPI 2021 Industry 4.0 Study* — which examines the extent to which manufacturers deploy Industry 4.0 in their organizations, supply chains, and new products — was conducted by The MPI Group in June and July 2021, with 445 manufacturers from around the globe participating. This Executive Summary highlights the dramatic impact of Industry 4.0 on manufacturers worldwide:

Corporate strategy *(page 2)***:** Manufacturers expect a significant impact from Industry 4.0 on their industries and businesses, and are applying it across their enterprises. Yet many Industry 4.0 initiatives aren't as effective as they could be — indicating requirements for better planning and deployment.

Plants, processes, and supply chains *(page 7)***:** Industry 4.0 is delivering dramatic benefits — improved productivity and profitability. But challenges remain, including identifying digitization opportunities and upgrading/overhauling network infrastructures.

Smart products *(page 14)***:** Most manufacturers are planning or have developed Industry 4.0-enabled products — but the percentage of these products dropped over the past year, as did margins. Intelligent products can deliver increased revenues and profits, but manufacturers need to step up their ideation and technology capabilities to guarantee success.

To learn more — and to benchmark your organization's digital progress — read on.

John Brandt
CEO
The MPI Group

Strategy

Manufacturing leaders have recognized the competitive advantages possible via Industry 4.0 and want their companies to be digital innovators. Yet many manufacturers also are still challenged by deployment strategies — and execution — of Industry 4.0 initiatives.
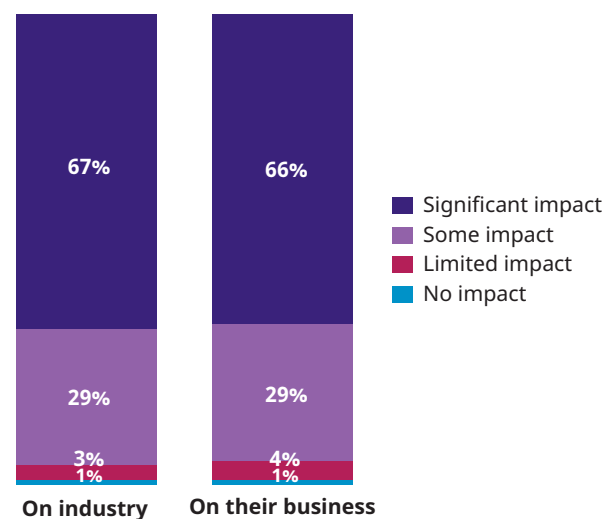
Industry 4.0 continues to grow

Nearly all manufacturing executives report that Industry 4.0 is important to their companies — 57% report "extremely important" (up from 45% in 2020 study) and 35% "very important." Two-thirds of executives indicate that Industry 4.0 will have "significant impact" on their industries and their businesses in the next five years *(Figure 1)* — up from 59% and 56% in 2020.

More than half of executives (61%) report that Industry 4.0 is already a competitive differentiator, and another 37% say it will be. Nearly a third describe their companies as "Industry 4.0 leaders" (up from 21% in 2020), and 54% as "Industry 4.0 competitive."

Some 54% of manufacturers have "significant companywide understanding" of Industry 4.0 and how to apply it to their businesses (up from 43% in 2020), and another 39% report "some company-wide understanding."

An increasing percentage of companies have developed *and* implemented strategies to apply Industry 4.0 technologies to their processes (58%, up from 47% in 2020), and to embed Industry 4.0 technologies into their products (47%, up from 37% in 2020).

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

Legend:
- Significant impact
- Some impact
- Limited impact
- No impact

On industry: 67%, 29%, 3%, 1%
On their business: 66%, 29%, 4%, 1%

> More than half of executives (61%) report that Industry 4.0 is already a competitive differentiator, and another 37% say it will be.

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[1] Due to rounding of decimals, some data in this report will not sum to 100%. Questions with multiple responses possible also will not sum to 100%.

Application and benefits of Industry 4.0

Use cases for Industry 4.0 vary widely among manufacturers; the most common is factory asset intelligence/performance management *(Figure 2)*.

A majority of functional teams receive actionable, real-time, role-based data for their decision-making, although usage varies by function *(Figure 3)*.

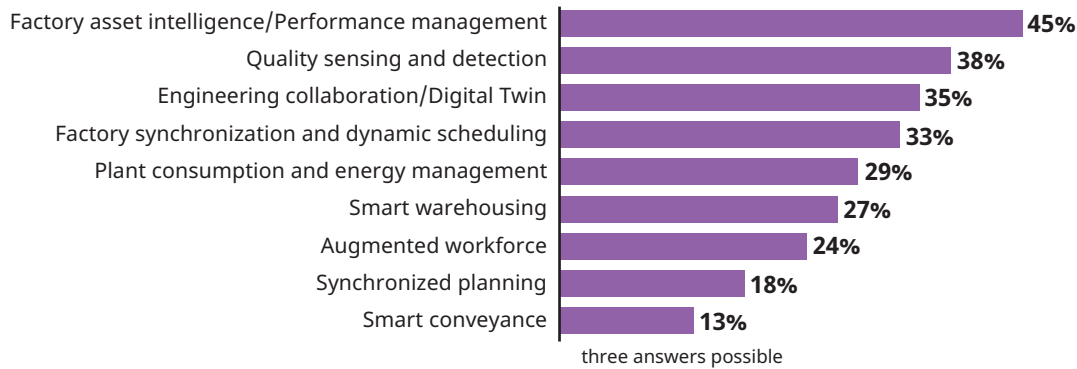**Figure 2. Most relevant Industry 4.0 use cases (% of manufacturers)**

Use case	%
Factory asset intelligence/Performance management	45%
Quality sensing and detection	38%
Engineering collaboration/Digital Twin	35%
Factory synchronization and dynamic scheduling	33%
Plant consumption and energy management	29%
Smart warehousing	27%
Augmented workforce	24%
Synchronized planning	18%
Smart conveyance	13%

three answers possible

Figure 3. Use of actionable, real-time, role-based data for their decision-making (% of manufacturers)

	Currently using	Plan to use within 1 year	Plan to use within 3 years	No plans to use
R&D/product development	58%	27%	9%	5%
Board of directors	57%	24%	10%	9%
Supply-chain management	57%	26%	13%	3%
Maintenance	55%	28%	13%	4%
Logistics	53%	30%	14%	4%
Mid-management/plant management	51%	35%	11%	3%
Warehouse	51%	31%	11%	7%
Senior-management/cross-plant operations	48%	34%	13%	5%
Plantfloor	40%	36%	12%	12%
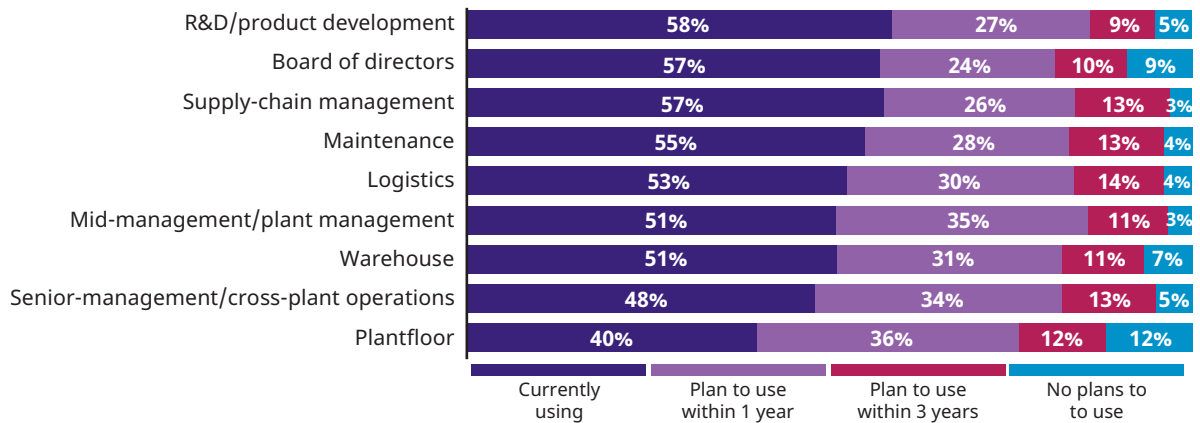
The roles most likely to lead Industry 4.0 initiatives are head of manufacturing, head of engineering, and head of R&D *(Figure 4)*. The top benefits that Industry 4.0 can provide are improved quality, increased production capacity, and reduced operations costs *(Figure 5)*.

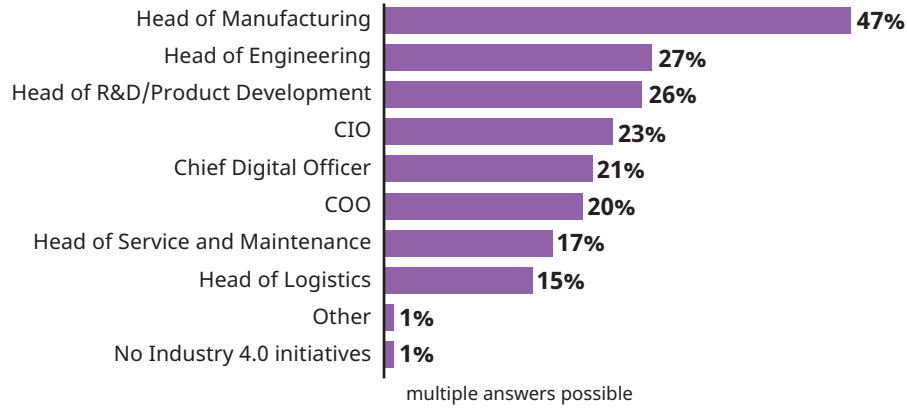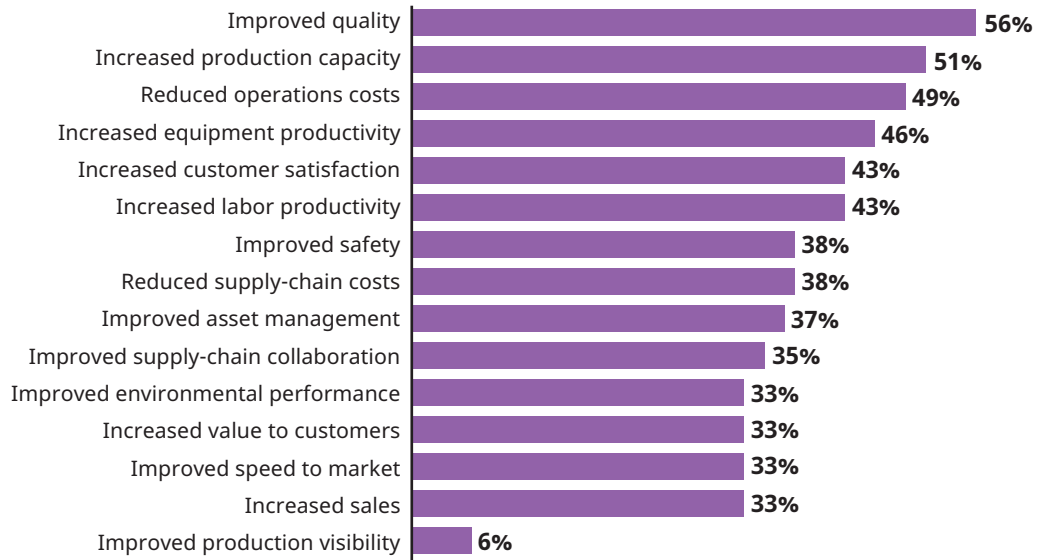**Figure 4. Leading an Industry 4.0 initiative (% of manufacturers)**

Head of Manufacturing	47%
Head of Engineering	27%
Head of R&D/Product Development	26%
CIO	23%
Chief Digital Officer	21%
COO	20%
Head of Service and Maintenance	17%
Head of Logistics	15%
Other	1%
No Industry 4.0 initiatives	1%

multiple answers possible

Figure 5. Most significant benefits that 4.0 can provide (% of manufacturers)

Improved quality	56%
Increased production capacity	51%
Reduced operations costs	49%
Increased equipment productivity	46%
Increased customer satisfaction	43%
Increased labor productivity	43%
Improved safety	38%
Reduced supply-chain costs	38%
Improved asset management	37%
Improved supply-chain collaboration	35%
Improved environmental performance	33%
Increased value to customers	33%
Improved speed to market	33%
Increased sales	33%
Improved production visibility	6%

Technologies

The technologies most widely considered as components of Industry 4.0 are factory automation, artificial intelligence, and Internet of Things (IoT) platforms *(Figure 6)*.

Computing platforms by which technologies are deployed vary by the type of technology: production technologies are most commonly deployed via on-premises platforms, while planning and management and administration technologies are most commonly deployed via cloud computing *(Figure 7)*.

Figure 6. Technologies most likely considered to make up Industry 4.0 (% of manufacturers)
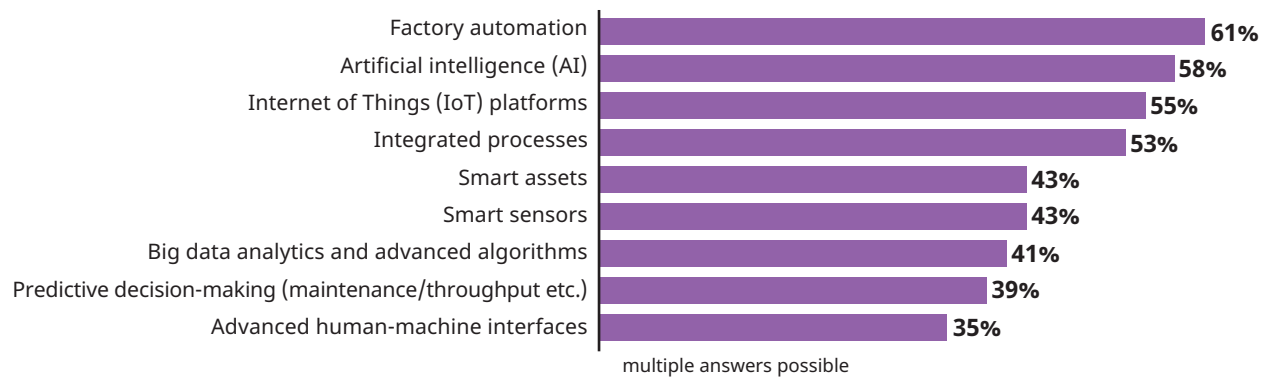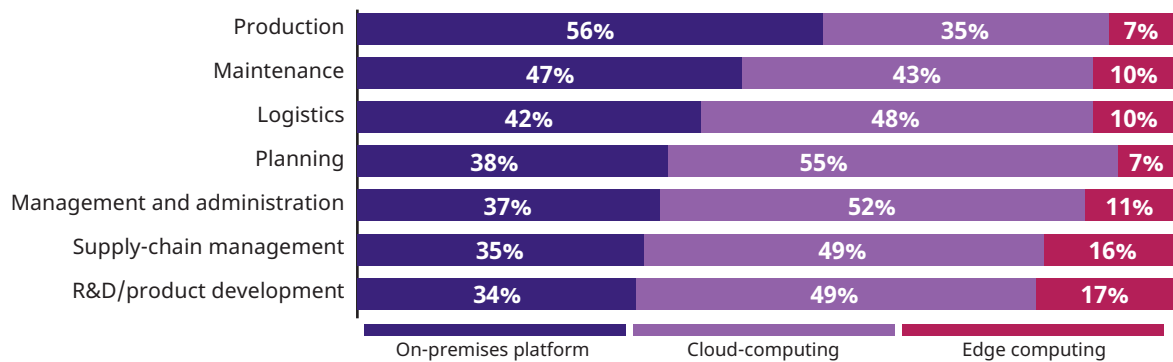
Technology	%
Factory automation	61%
Artificial intelligence (AI)	58%
Internet of Things (IoT) platforms	55%
Integrated processes	53%
Smart assets	43%
Smart sensors	43%
Big data analytics and advanced algorithms	41%
Predictive decision-making (maintenance/throughput etc.)	39%
Advanced human-machine interfaces	35%

multiple answers possible

Figure 7. Computer platforms by which functions deploy technologies (% of manufacturers)

Function	On-premises platform	Cloud-computing	Edge computing
Production	56%	35%	7%
Maintenance	47%	43%	10%
Logistics	42%	48%	10%
Planning	38%	55%	7%
Management and administration	37%	52%	11%
Supply-chain management	35%	49%	16%
R&D/product development	34%	49%	17%

The technologies most widely considered as components of Industry 4.0 are factory automation, artificial intelligence, and Internet of Things (IoT) platforms.

Achieving Industry 4.0 objectives

Many manufacturers struggle to achieve strategic objectives with their Industry 4.0 initiatives *(Figure 8)* and/or fail to complete the initiatives on-time and on-budget:

- *On schedule:* 40% on schedule — but 9% significantly later and 32% somewhat later

- *On budget:* 45% on budget — but 7% significantly over budget and 38% somewhat over budget.
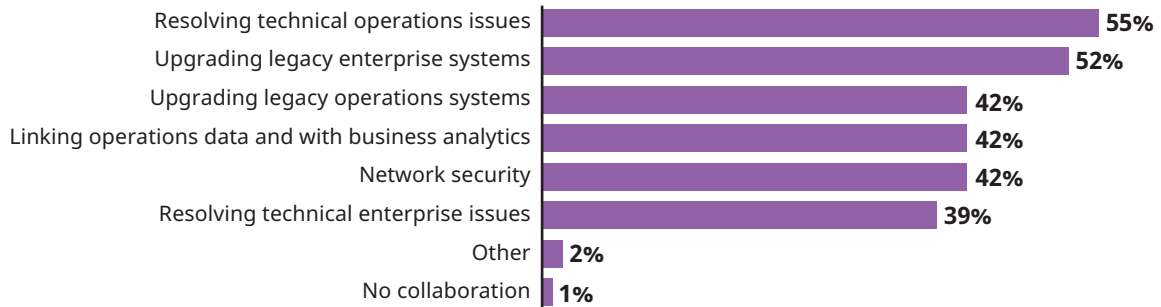
A significant obstacle to many Industry 4.0 implementations — this year as in the past — is a failure of information technology (IT) and operations technology (OT) departments to collaborate. The only rates of IT-OT collaboration above 50% are for resolving technical operations issues (i.e., firefighting) and upgrading legacy enterprise systems *(Figure 9)*.

Figure 8. Industry 4.0 initiatives achieve strategic objectives (% of manufacturers)

- 1%
- 2%
- 1%
- 21%
- 26%
- 48%

■ Achieving all strategic objectives
■ Achieving most strategic objectives
■ Achieving some strategic objectives
■ Achieving no strategic objectives
■ No strategic objectives were set prior to implementation
■ No Industry 4.0

Figure 9. Operations technology and information technology collaboration (% of manufacturers)

Resolving technical operations issues	55%
Upgrading legacy enterprise systems	52%
Upgrading legacy operations systems	42%
Linking operations data and with business analytics	42%
Network security	42%
Resolving technical enterprise issues	39%
Other	2%
No collaboration	1%

Industry 4.0 Strategy — Digital Acceleration

The ability to efficiently develop *and deploy* an Industry 4.0 strategy becomes more critical with each passing day. As Industry 4.0 proliferates around the globe, manufacturers need to digitize *now* — because competitors are already improving operations, lowering costs, and earning new profits via 4.0-enabled processes and products.

Manufacturing leaders who haven't yet deployed an Industry 4.0 strategy must:

1. Develop a strategy *now*.

2. Establish a cross-functional Industry 4.0 team *now* to prioritize deployment vs. major weaknesses and opportunities.

3. Embed Industry 4.0 as the digital core of the organization's continuous improvement program, upgrading processes and technologies to remain competitive.

Industry 4.0-Enabled Plants, Processes, and Supply Chains

The volume of real-time production data flowing within plants — often linked to customers and suppliers — continues to grow. Yet even as new insights increase productivity and profitability, many manufacturers struggle with significant technology and implementation issues.
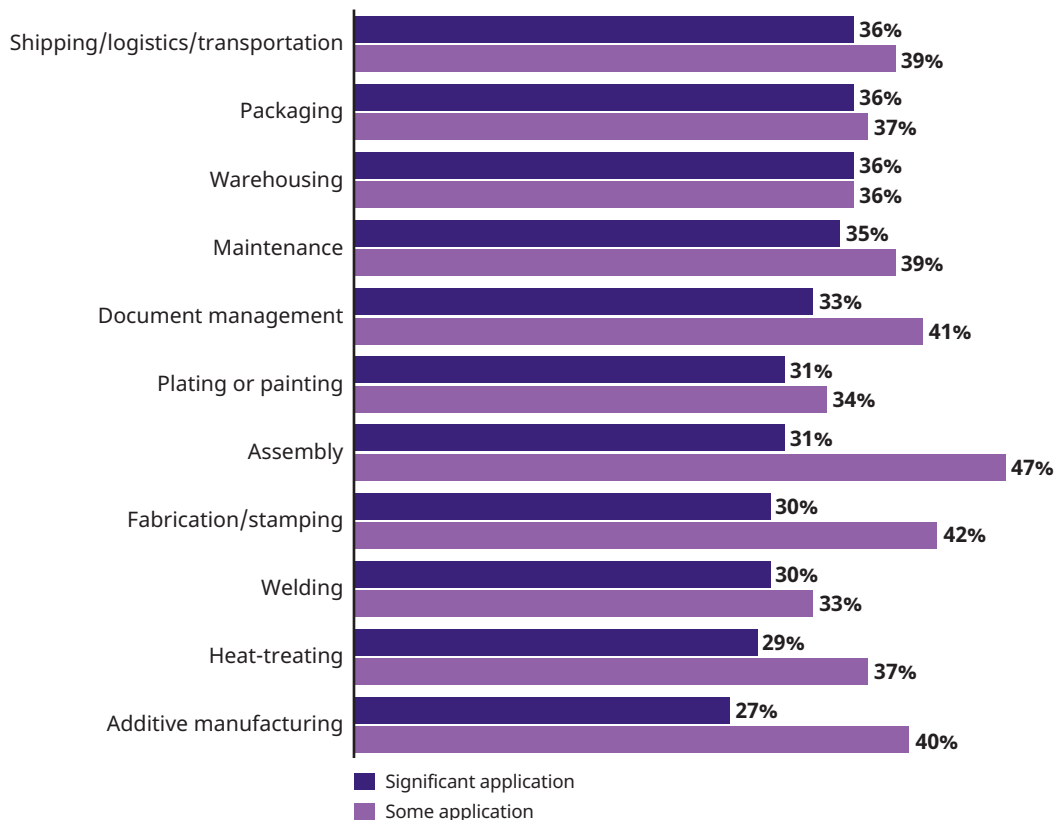
Applying smart devices and/or embedded technologies

Manufacturers have incorporated smart devices and/or embedded intelligence into 45% (average) of their *production processes and equipment,* an increase from 41% in the 2020 study. Nearly all expect that percentage to increase in the next two years (46% "increase significantly" and 48% "somewhat").

Manufacturers have also incorporated smart devices or embedded intelligence into 38% (average) of their *non-production processes* (e.g., back office), an increase from 33% in 2020. Similarly, most manufacturers expect that percentage to increase in the next two years (42% "increase significantly" and 50% "somewhat").

Many production and office processes incorporate smart devices and/or embedded intelligence, with the most significant applications occurring in shipping/logistics/transportation, packaging, and warehousing *(Figure 10).* Industry 4.0 initiatives for plant and process applications are most likely to be led by IT leadership (29%), a dedicated Industry 4.0 department/function (23%), C-level team (18%), or operations leadership (18%).

Figure 10. Application of smart devices/embedded intelligence to processes (% of manufacturers)

Process	Significant application	Some application
Shipping/logistics/transportation	36%	39%
Packaging	36%	37%
Warehousing	36%	36%
Maintenance	35%	39%
Document management	33%	41%
Plating or painting	31%	34%
Assembly	31%	47%
Fabrication/stamping	30%	42%
Welding	30%	33%
Heat-treating	29%	37%
Additive manufacturing	27%	40%

■ Significant application
■ Some application

Mobile devices, cloud computing, and Industry 4.0/ Internet of Things technologies are among the top technologies that manufacturers are currently using on the plantfloor *(Figure 11)*. A majority of manufacturers (59%) have applied sensors and devices to clothing or machinery to specifically improve safety, and another 31% plan to do so.

The expansion of Industry 4.0 to processes is driving hiring decisions, with 50% or more of manufacturers requiring more information technology staff and data analysts *(Figure 12)*.

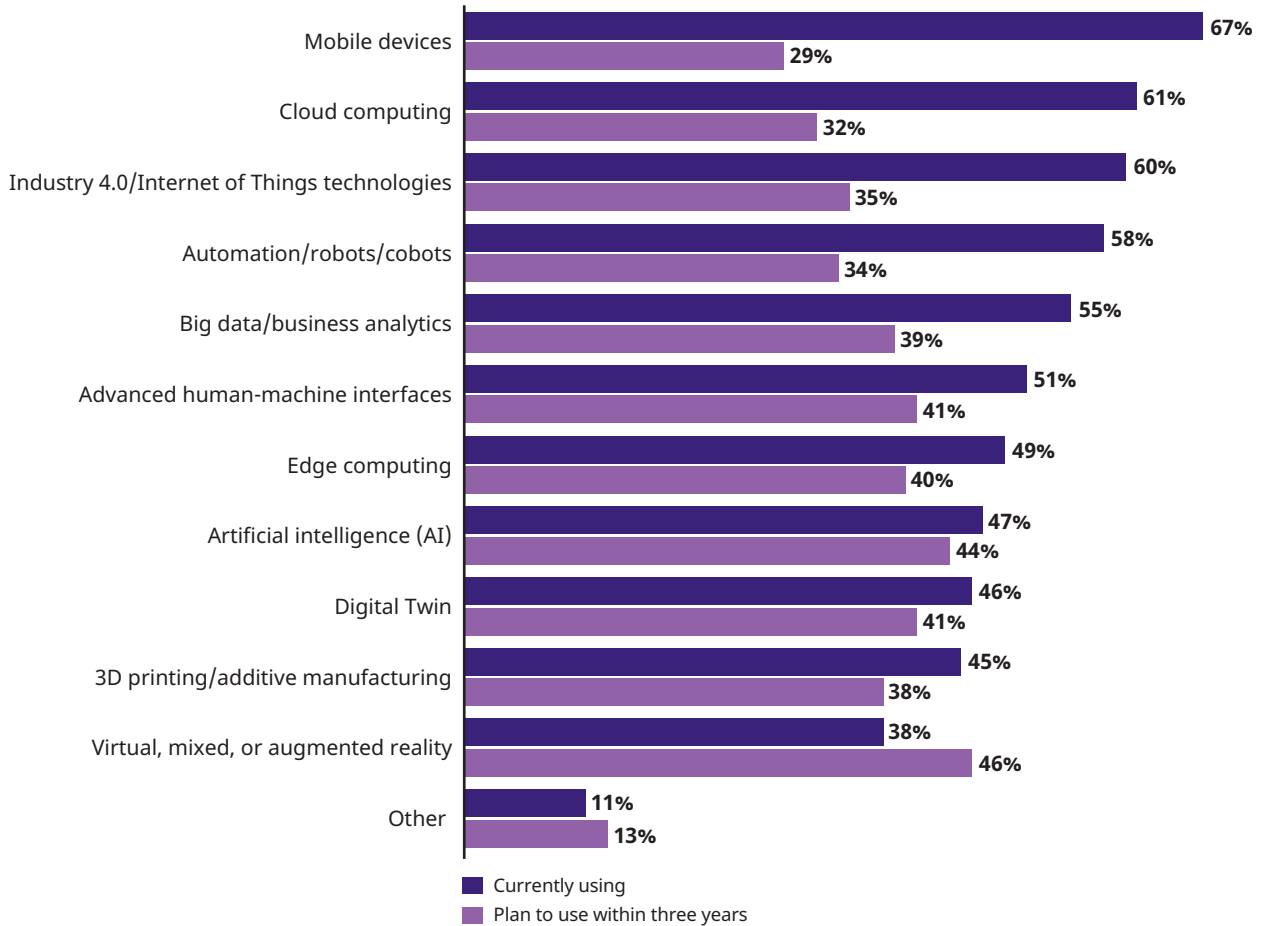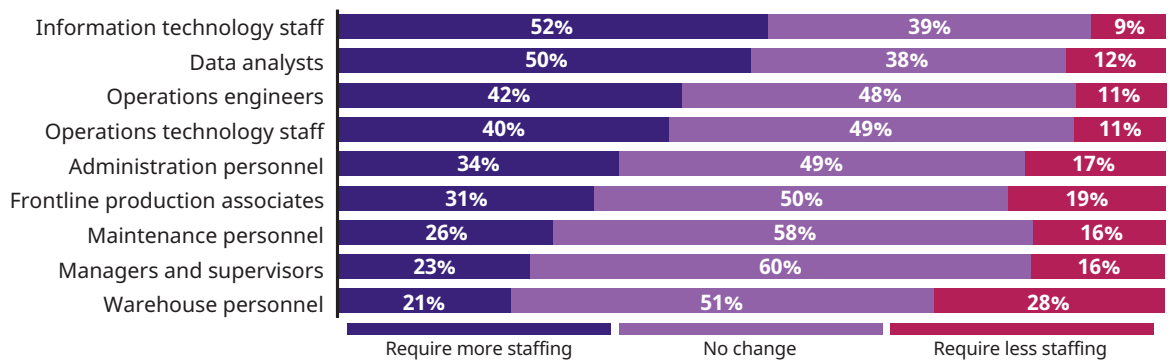**Figure 11. Use of plantfloor technologies (% of manufacturers)**

Technology	Currently using	Plan to use within three years
Mobile devices	67%	29%
Cloud computing	61%	32%
Industry 4.0/Internet of Things technologies	60%	35%
Automation/robots/cobots	58%	34%
Big data/business analytics	55%	39%
Advanced human-machine interfaces	51%	41%
Edge computing	49%	40%
Artificial intelligence (AI)	47%	44%
Digital Twin	46%	41%
3D printing/additive manufacturing	45%	38%
Virtual, mixed, or augmented reality	38%	46%
Other	11%	13%

■ Currently using
■ Plan to use within three years

Figure 12. Roles affected by availability of real-time information and automation (% of manufacturers)

Role	Require more staffing	No change	Require less staffing
Information technology staff	52%	39%	9%
Data analysts	50%	38%	12%
Operations engineers	42%	48%	11%
Operations technology staff	40%	49%	11%
Administration personnel	34%	49%	17%
Frontline production associates	31%	50%	19%
Maintenance personnel	26%	58%	16%
Managers and supervisors	23%	60%	16%
Warehouse personnel	21%	51%	28%

Extending Industry 4.0 to supply-chain partners

Most manufacturers report that suppliers have the Industry 4.0 capabilities necessary to support them — 32% describe suppliers as "Industry 4.0 leaders," and 51% as "Industry 4.0 competitive." In addition, most suppliers help to advance manufacturers' Industry 4.0 capabilities, with IT and OT hardware and software vendors leading the way *(Figure 13)*.

Manufacturers are most likely to digitally engage with suppliers for real-time sharing of quality metrics, production schedules, and new product plans *(Figure 14)*. With customers, manufacturers are most likely to share new product plans (52%), production schedules (47%), quality metrics (46%), sales forecasts (34%), and financial metrics (32%).

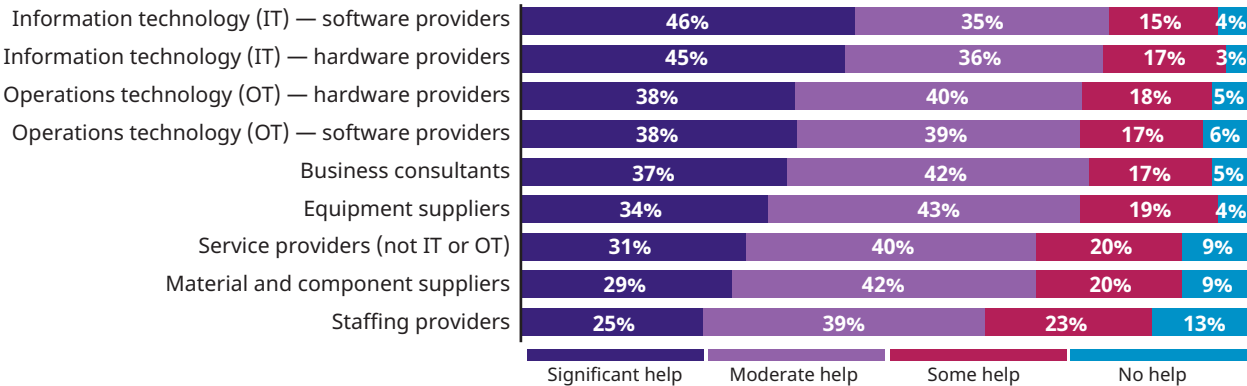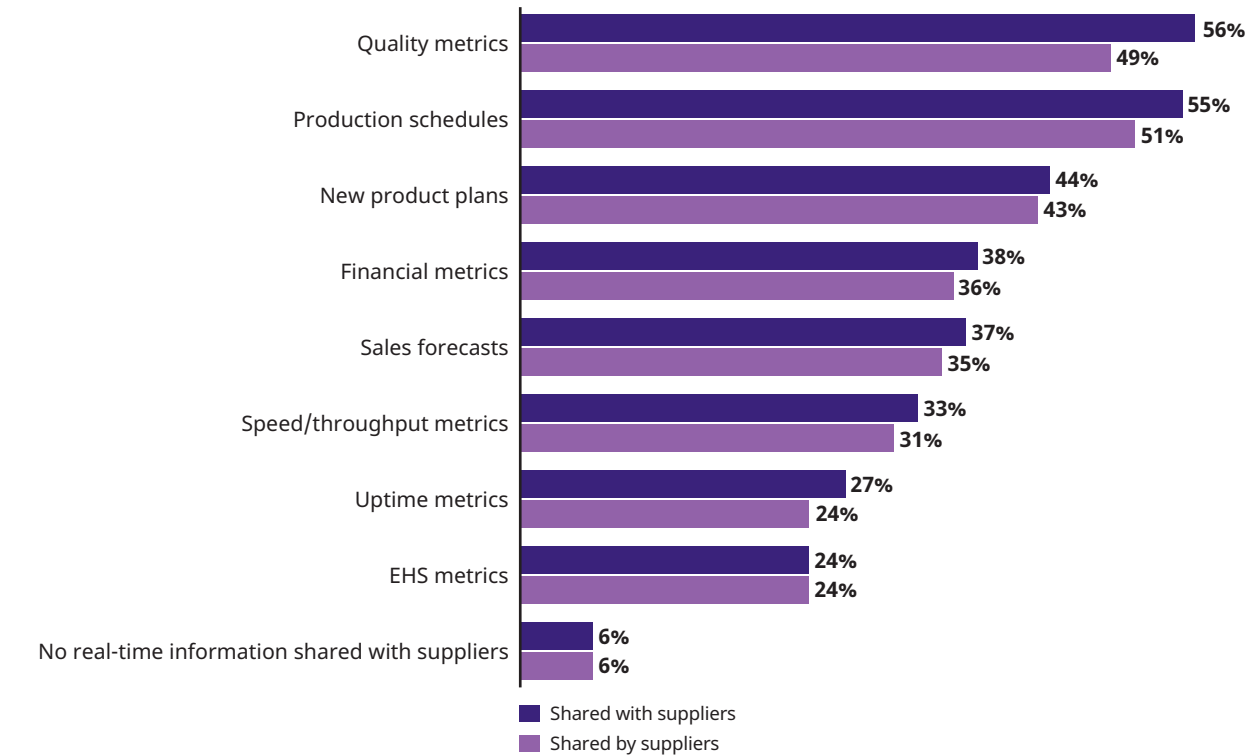**Figure 13. Suppliers help advance Industry 4.0 capabilities (% of manufacturers)**

	Significant help	Moderate help	Some help	No help
Information technology (IT) — software providers	46%	35%	15%	4%
Information technology (IT) — hardware providers	45%	36%	17%	3%
Operations technology (OT) — hardware providers	38%	40%	18%	5%
Operations technology (OT) — software providers	38%	39%	17%	6%
Business consultants	37%	42%	17%	5%
Equipment suppliers	34%	43%	19%	4%
Service providers (not IT or OT)	31%	40%	20%	9%
Material and component suppliers	29%	42%	20%	9%
Staffing providers	25%	39%	23%	13%

Figure 14. Real-time information sharing with and by suppliers (% of manufacturers)

	Shared with suppliers	Shared by suppliers
Quality metrics	56%	49%
Production schedules	55%	51%
New product plans	44%	43%
Financial metrics	38%	36%
Sales forecasts	37%	35%
Speed/throughput metrics	33%	31%
Uptime metrics	27%	24%
EHS metrics	24%	24%
No real-time information shared with suppliers	6%	6%

Benefits from the application of Industry 4.0

Industry 4.0 in plants, processes, and supply chains has dramatically impacted productivity and profitability, with 63% of manufacturers reporting increased profitability of more than 5% over the past year *(Figures 15 and 16)*. Notably, percentages of manufacturers with productivity and profitability increases are comparable across regions, with Latin/ South America and Asia more likely to report increases above 10%.

Figure 15. Impact of Industry 4.0 to plants, processes, and supply chain on productivity and profitability in past year (% of manufacturers)

- Increased more than 10%: 19% / 21%
- Increased 6-10%: 47% / 42%
- Increased 1-5%: 27% / 27%
- No change: 5% / 9%
- Decreased: 0% / 0%
- No Industry 4.0 currently or planned: 2% / 2%
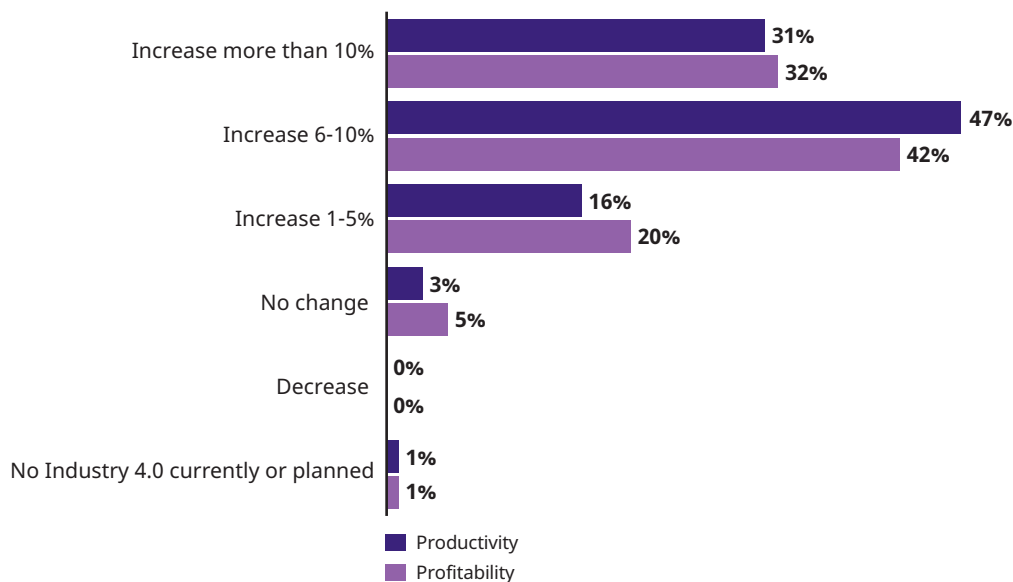
■ Productivity
■ Profitability
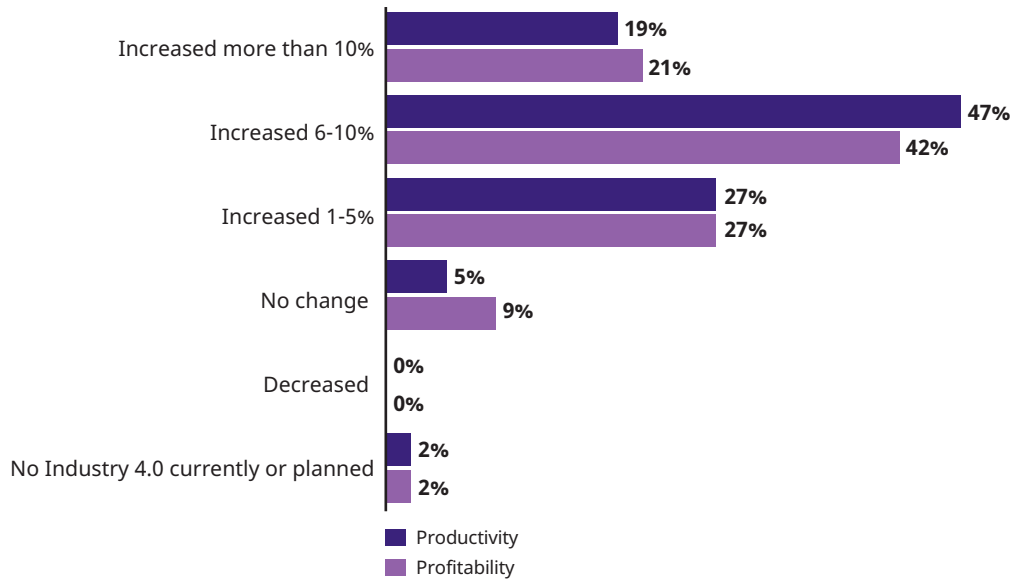
Figure 16. Impact of Industry 4.0 to plants, processes, and supply chain on productivity and profitability over the next five years (% of manufacturers)

- Increase more than 10%: 31% / 32%
- Increase 6-10%: 47% / 42%
- Increase 1-5%: 16% / 20%
- No change: 3% / 5%
- Decrease: 0% / 0%
- No Industry 4.0 currently or planned: 1% / 1%

■ Productivity
■ Profitability

Performance and business activities have improved via Industry 4.0 initiatives for a large majority of manufacturers worldwide *(Figures 17 and 18)*.

Figure 17. Effects from the application of smart devices and/or embedded intelligence on performance (% of manufacturers)

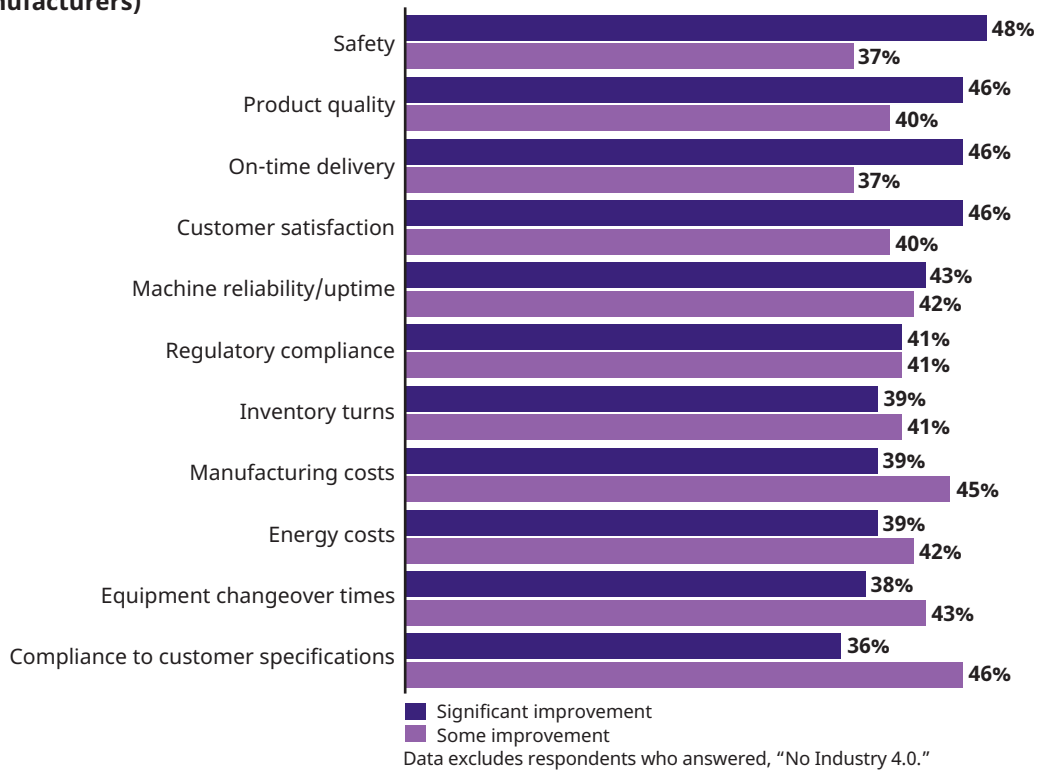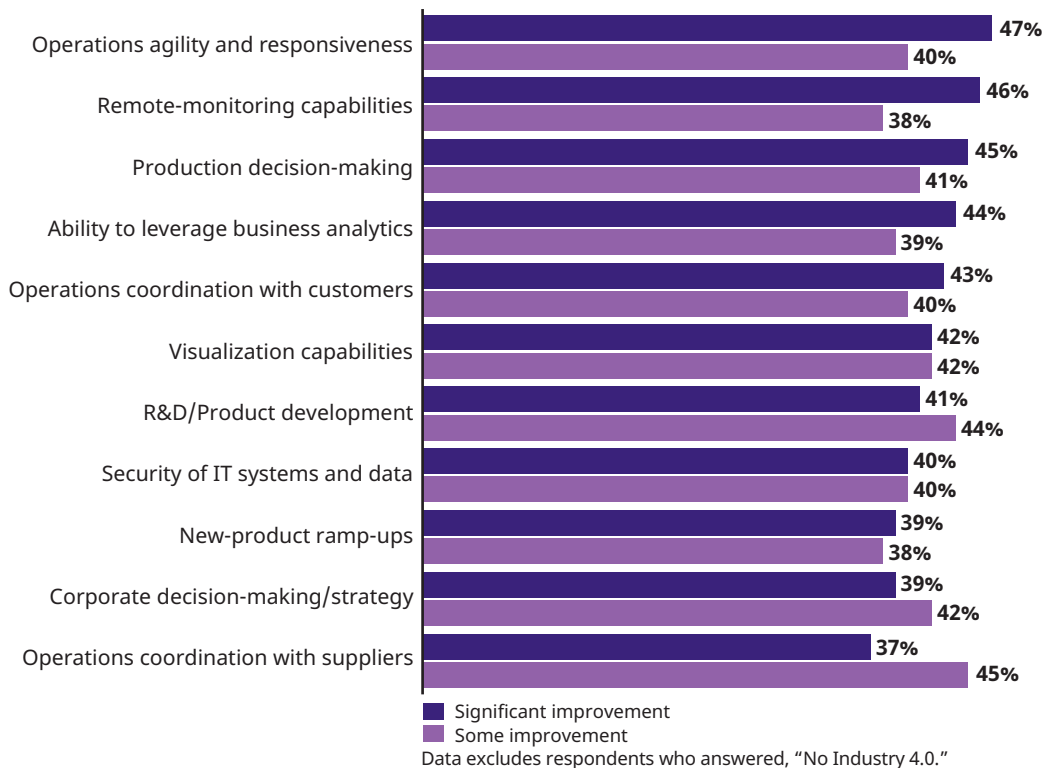|	Significant improvement	Some improvement
Safety	48%	37%
Product quality	46%	40%
On-time delivery	46%	37%
Customer satisfaction	46%	40%
Machine reliability/uptime	43%	42%
Regulatory compliance	41%	41%
Inventory turns	39%	41%
Manufacturing costs	39%	45%
Energy costs	39%	42%
Equipment changeover times	38%	43%
Compliance to customer specifications	36%	46%

■ Significant improvement
■ Some improvement
Data excludes respondents who answered, "No Industry 4.0."

Figure 18. Effects from the application of smart devices and/or embedded intelligence on business activities and objectives(% of manufacturers)

	Significant improvement	Some improvement
Operations agility and responsiveness	47%	40%
Remote-monitoring capabilities	46%	38%
Production decision-making	45%	41%
Ability to leverage business analytics	44%	39%
Operations coordination with customers	43%	40%
Visualization capabilities	42%	42%
R&D/Product development	41%	44%
Security of IT systems and data	40%	40%
New-product ramp-ups	39%	38%
Corporate decision-making/strategy	39%	42%
Operations coordination with suppliers	37%	45%

■ Significant improvement
■ Some improvement
Data excludes respondents who answered, "No Industry 4.0."

Industry 4.0 challenges and investments

Manufacturers still confront an array of Industry 4.0 obstacles. For example, many manufacturers have network infrastructures incapable of Industry 4.0 communications:

- *Machine to machine:* 13% require significant upgrades or network overhaul; 39% require some upgrades.

- *Machines to enterprise IT systems:* 16% require significant upgrades or network overhaul; 48% require some upgrades.

- *Machines to supplier IT systems:* 27% require significant upgrades or network overhaul; 40% require some upgrades.

- *Machines to customer IT systems:* 29% require significant upgrades or network overhaul; 38% require some upgrades.

Network issues exclude many executives and partners from access to Industry 4.0-enabled data:

- *Company executives:* Just 43% of all who need data have access.

- *Customers:* Just 20% of all who need data have access.

- *Suppliers:* Just 20% of all who need data have access.

Manufacturing leaders are "very confident" (42%) or "confident" (53%) that their cyber risk management programs address Industry 4.0. Their confidence, however, may be unjustified given the lack of common best practices to improve security *(Figure 19)*.

Manufacturers also face other challenges with Industry 4.0; the top concern is "identifying opportunities/ benefits of Industry 4.0" *(Figure 20)*.

Figure 19. Steps taken in past 12 months to improve security of Industry 4.0 environment (% of manufacturers)
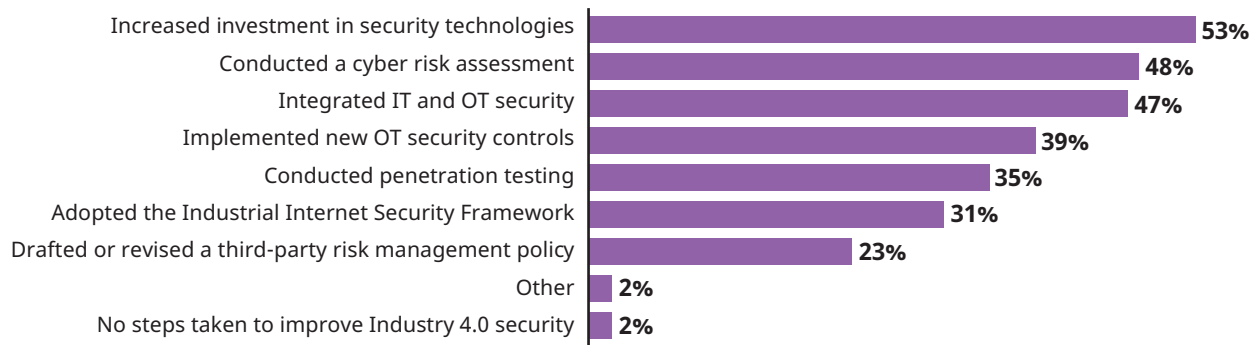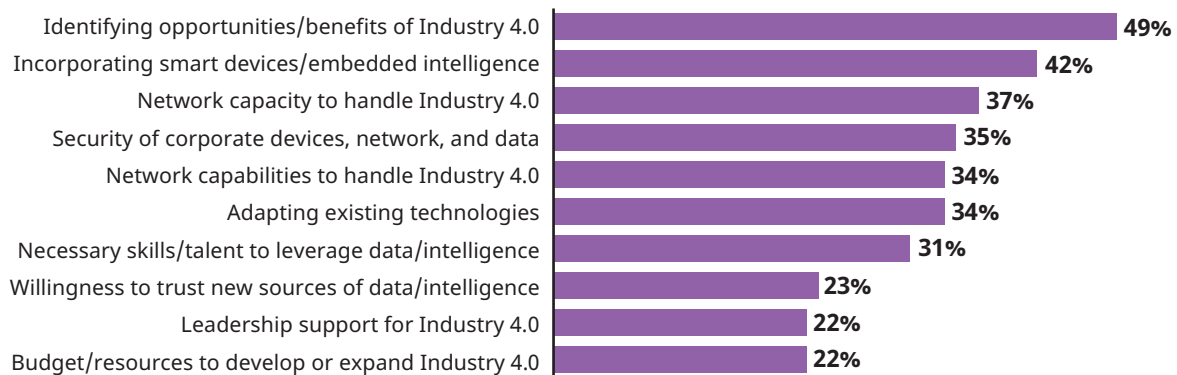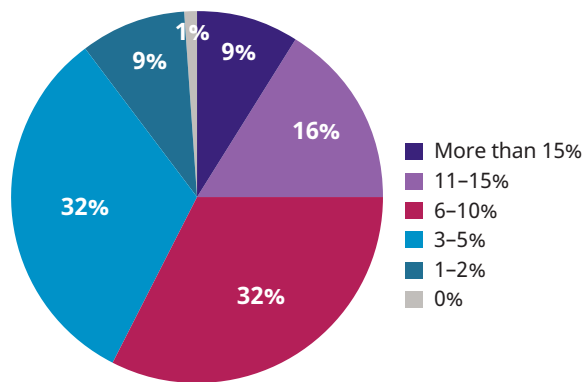
Step	%
Increased investment in security technologies	53%
Conducted a cyber risk assessment	48%
Integrated IT and OT security	47%
Implemented new OT security controls	39%
Conducted penetration testing	35%
Adopted the Industrial Internet Security Framework	31%
Drafted or revised a third-party risk management policy	23%
Other	2%
No steps taken to improve Industry 4.0 security	2%

Figure 20. Challenges with Industry 4.0 (% of manufacturers)

| Challenge	%
Identifying opportunities/benefits of Industry 4.0	49%
Incorporating smart devices/embedded intelligence	42%
Network capacity to handle Industry 4.0	37%
Security of corporate devices, network, and data	35%
Network capabilities to handle Industry 4.0	34%
Adapting existing technologies	34%
Necessary skills/talent to leverage data/intelligence	31%
Willingness to trust new sources of data/intelligence	23%
Leadership support for Industry 4.0	22%
Budget/resources to develop or expand Industry 4.0	22%

Although a fifth of manufacturers indicate that "budget/resources to develop or expand Industry 4.0" is a challenge, most are investing heavily in digitization. More than half of manufacturers have invested more than 5% of sales in implementing an Industry 4.0 strategy in their plants, processes, and supply chains in the past year *(Figure 21)*, and 94% will increase that investment in the next two years (12% will increase investments by more than 20%).

In addition, more than half are directing 20% or more of their overall technology budget toward Industry 4.0 *(Figure 22)*, and 59% expect to invest that much annually in two to five years.

Figure 21. Company investment (% of sales) in implementing an Industry 4.0 strategy into plants, processes, and supply chains in the past year (% of manufacturers)

- More than 15%
- 11–15%
- 6–10%
- 3–5%
- 1–2%
- 0%

Figure 22. Percentage of overall technology transformation budget directed to Industry 4.0 investments in the current year (% of manufacturers)

- More than 50%
- 41–50%
- 31–40%
- 21–30%
- 11–20%
- 0–10%
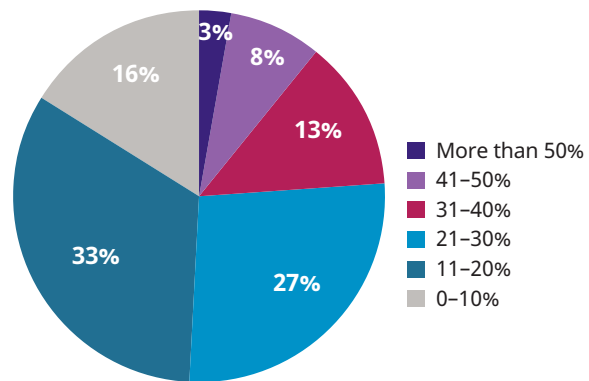
Industry 4.0 Plants, Processes, and Supply Chains — Digital Acceleration

Almost half of all production processes and equipment now incorporate smart devices and/or intelligence — driving improvements at facilities around the globe.

Yet many other manufacturers still struggle with the basics of Industry 4.0, failing to:

- Deploy a strategy and goals for Industry 4.0;
- Build a reliable network infrastructure; or to
- Establish effective OT-IT collaboration for digitization initiatives.

This can't continue. Industry 4.0 laggards run the risk of falling permanently behind unless they immediately:

1. Commit to investing time and resources into a multi-year Industry 4.0 strategy.
2. Upgrade existing technologies — networks, devices, robotics, business analytics — especially those vulnerable to cyberattacks.
3. Enlist the support of suppliers and customers in end-to-end digitization workflow analyses and improvements.

Intelligent Products

Most manufacturers are planning to or have developed products that embed smart devices and/or intelligence — but the percentage of these products dropped over the past year, as did margins. These issues aren't slowing investments in Industry 4.0-enabled products, but manufacturers that resolve them are likely to reap market rewards.
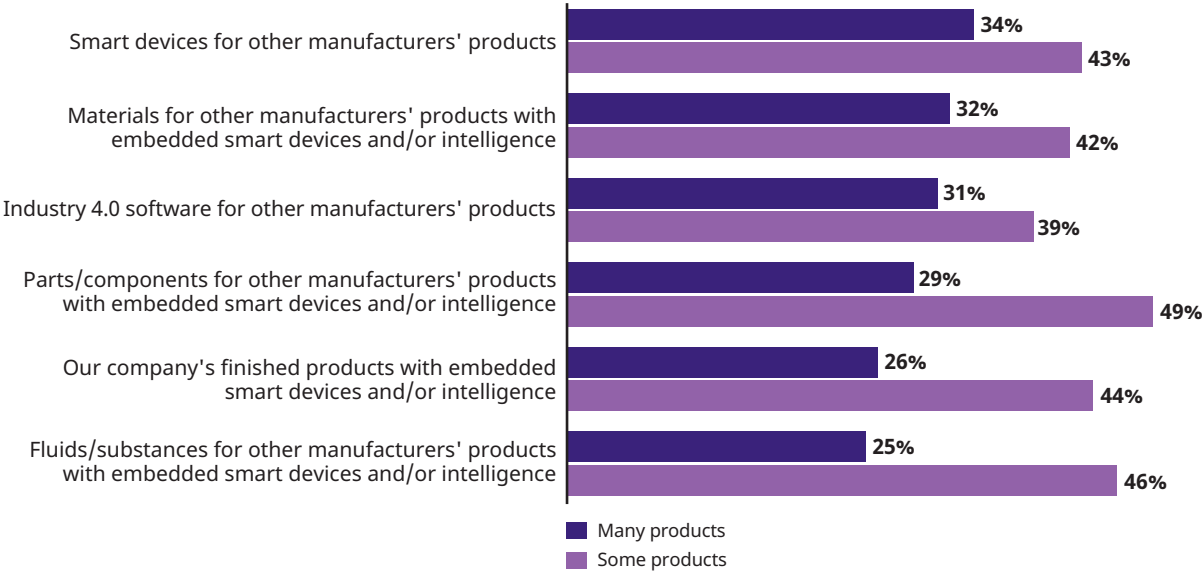
Industry 4.0-enabled products

Approximately 42% of manufacturers report that embedding smart devices and/or intelligence into products is a significant focus of their production innovation plans, and another 39% have some plans to do so.[2] Currently, a large majority of manufacturers have embedded smart devices and/or intelligence into at least some products — including their own finished goods as well as materials, parts, and software for other manufacturers *(Figure 23)*.

Manufacturers are generating 33% (average) of product sales from goods with embedded smart devices and/or intelligence, down from 38% in 2020. Profit margins on products with embedded smart devices and/or intelligence (27% average) are higher than those of other products (26% average).

Figure 23. Types of Industry 4.0 products created (% of manufacturers)

	Many products	Some products
Smart devices for other manufacturers' products	34%	43%
Materials for other manufacturers' products with embedded smart devices and/or intelligence	32%	42%
Industry 4.0 software for other manufacturers' products	31%	39%
Parts/components for other manufacturers' products with embedded smart devices and/or intelligence	29%	49%
Our company's finished products with embedded smart devices and/or intelligence	26%	44%
Fluids/substances for other manufacturers' products with embedded smart devices and/or intelligence	25%	46%

[2] 7% of manufacturers answered, "No plans to embed smart devices in products" or "Not applicable to our products." These respondents did not answer other questions in the Industry 4.0 Intelligent Products category.

Benefits from Industry 4.0-enabled products

Manufacturers are improving their performances and capabilities via products with embedded smart devices and/or intelligence; most likely to be significantly improved are access to data from products or services in the field and branding/market awareness *(Figure 24)*.

More importantly, intelligent products have increased revenues and profitability in the past year *(Figure 25)*, with more increases expected over the next five years *(Figure 26)*. Percentages of manufacturers with revenue and profitability increases are comparable across regions.

Figure 24. Impact to products to business performance and capabilities from embedding smart devices and/or intelligence into (% of manufacturers)

	Significant improvement	Some improvement
Access to data from products or services in the field	42%	42%
Branding/market awareness	41%	39%
Customer support	39%	42%
Access to new markets/sectors	37%	45%
Differentiating products in the market	36%	46%
Revenue from new products	35%	48%
Market share	35%	45%
Profit margins per product	34%	46%

■ Significant improvement
■ Some improvement

Figure 25. Impact of the application of Industry 4.0 to products in past year (% of manufacturers)

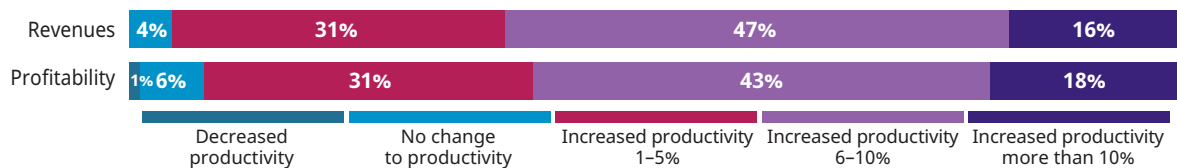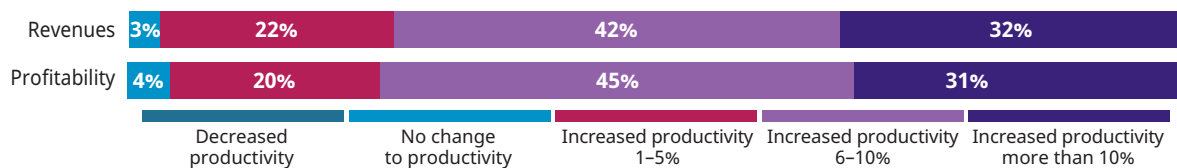|	Decreased productivity	No change to productivity	Increased productivity 1–5%	Increased productivity 6–10%	Increased productivity more than 10%
Revenues		4%	31%	47%	16%
Profitability	1%	6%	31%	43%	18%

Figure 26. Impact of the application of Industry 4.0 to products in over next five years (% of manufacturers)

	Decreased productivity	No change to productivity	Increased productivity 1–5%	Increased productivity 6–10%	Increased productivity more than 10%
Revenues		3%	22%	42%	32%
Profitability		4%	20%	45%	31%

Smart product challenges and investments

Manufacturers face similar challenges in embedding smart devices and/or intelligence into products as they do when applying these technologies to plants, processes, and supply chains. For example, knowing what to do — "identifying the opportunities/benefits of Industry 4.0 products" — ranks high among the challenges.

Despite these challenges, manufacturers are investing heavily into development of smart products. Approximately half have invested more than 5% of sales in embedding Industry 4.0 technologies into their products in the past year *(Figure 28)*, and 96% will increase their investments in the next two years (15% will increase investments by more than 20%).

Figure 27. Top challenges associated with Industry 4.0-enabled products (% of manufacturers)

| Challenge	%
Technologies needed to embed smart devices into products	48%
Identifying opportunities/benefits of Industry 4.0 products	48%
Keeping up with the pace of smart-device technology changes	33%
Suppliers capable of delivering high-quality smart devices	33%
Clear understanding on customer needs/value	31%
R&D and innovation skills/talent in this area	30%
Budget/resources to develop Industry 4.0-enabled products	30%

Figure 28. Company investment (% of sales) in implementing an Industry 4.0 strategy into plants, processes, and supply chains in the past year (% of manufacturers)

Legend:
- More than 15% — 7%
- 11–15% — 15%
- 6–10% — 29%
- 3–5% — 32%
- 1–2% — 16%
- 0% — 1%
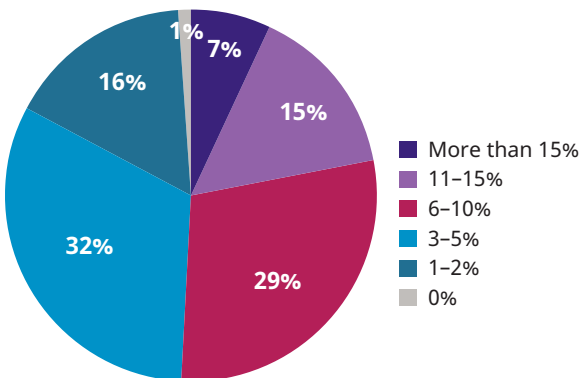
Intelligent Products — Digital Acceleration

Most manufacturers sell at least *some* products that incorporate smart devices and/or intelligence. Yet others still struggle to develop products that leverage Industry 4.0 technologies, missing opportunities to improve functionality and customer value. Even goods that seem far-removed from new technologies — food, beverages, textiles — can incorporate smart devices in packaging to monitor product characteristics and location.

Manufacturers lagging their competitors in sales of smart/intelligent products risk losing both market share *and* margins unless they immediately:

1. Challenge their R&D/product development departments to ideate multiple scenarios in which their products can incorporate intelligence.

2. Rapidly develop prototypes to be trialed with customers.

3. Invest quickly in the most promising prototypes, committing resources, talent, and marketing budgets to a new generation of smart products.

Industry 4.0 Study Participants

A majority of manufacturing executives participating in the study (62%) have titles of VP or higher *(Figure 29)*. These executives have detailed knowledge of Industry 4.0 activities involving manufacturing/production (86%), R&D/product development (35%), supply chain (32%), and maintenance/asset management (20%).

The top manufacturing categories represented in the study are machinery manufacturing, fabricated metal product manufacturing, and food manufacturing *(Figure 30)*. The top markets into which manufacturers sell are manufacturing (73%), construction (18%), wholesale (17%), and retail (16%).

Participating manufacturers are located around the globe *(Figure 31)*, representing a range of annual revenues:
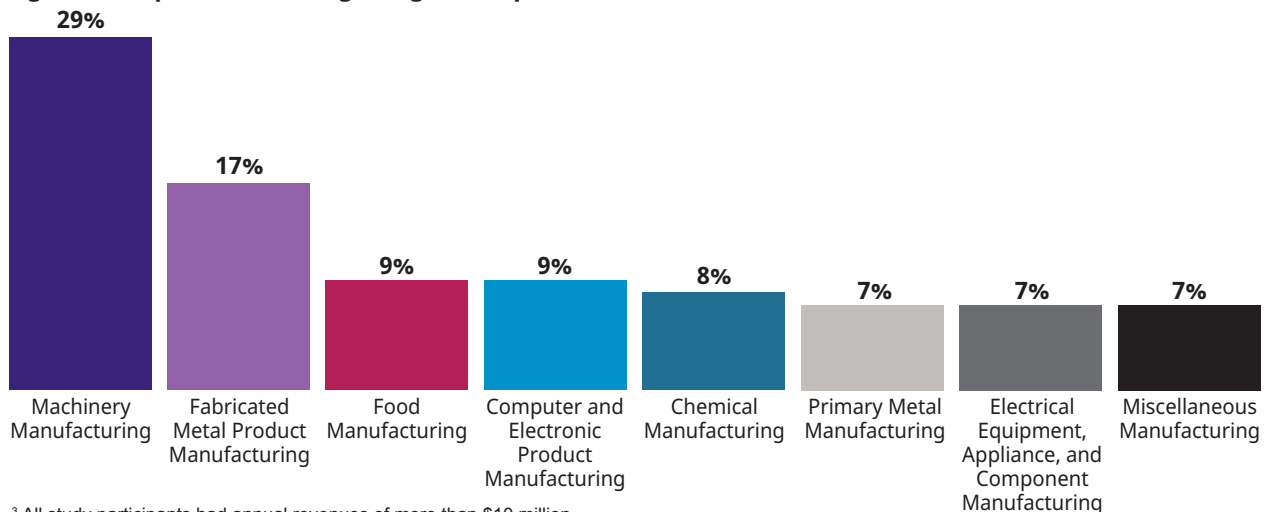
• 24% have revenues of $10 million to $100 million;

• 30% have revenues of $101 million to $500 million; and

• 46% have revenues that exceed $500 million.[3]

Some 81% of the companies are privately held, and 53% have been in business for more than 20 years.
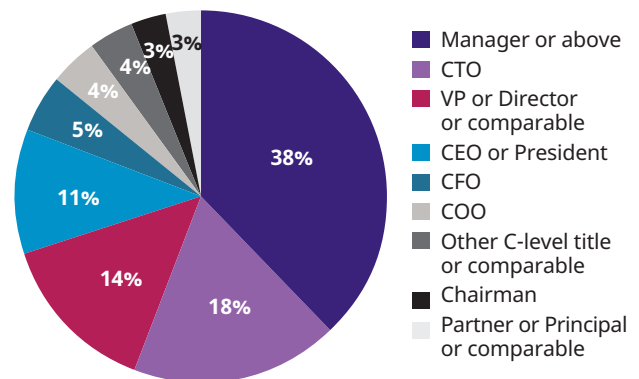
The production operations at these companies are:

• Process/batch manufacturing (47%);

• Discrete manufacturing (28%); and

• Both discrete and batch manufacturing (25%).

Figure 29. Title (% of manufacturers)

- Manager or above — 38%
- CTO — 18%
- VP or Director or comparable — 14%
- CEO or President — 11%
- CFO — 5%
- COO — 4%
- Other C-level title or comparable — 4%
- Chairman — 3%
- Partner or Principal or comparable — 3%

More than half of the companies have either made significant progress toward (60%) or fully achieved (15%) world-class manufacturing status.

Figure 31. Country or region where company is located (% of manufacturers)

- United States — 29%
- China — 10%
- Brazil — 9%
- Japan — 9%
- France — 7%
- Germany — 7%
- Italy — 7%
- Spain — 7%
- UK — 7%
- Other Asia — 7%
- Other — 1%

Figure 30. Top manufacturing categories represented (% of manufacturers)

Machinery Manufacturing	Fabricated Metal Product Manufacturing	Food Manufacturing	Computer and Electronic Product Manufacturing	Chemical Manufacturing	Primary Metal Manufacturing	Electrical Equipment, Appliance, and Component Manufacturing	Miscellaneous Manufacturing
29%	17%	9%	9%	8%	7%	7%	7%

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

Methodology

The *MPI 2021 Industry 4.0 Study* was conducted by The MPI Group using an online question-naire promoted by a panel company to manufacturing plant executives and managers. The MPI Group received 445 valid participants in June and July 2021. Responses were entered into a database, edited, and cleansed to ensure answers were plausible, where necessary. All respondent answers to the survey are anonymous.

MPI Manufacturing Study questions consisted of:

• Directive single-answer questions for which respondents were asked to "check one" answer category

• Directive multiple-answer questions for which respondents were asked to "check all that apply"

• Open-ended numeric questions for which respondents were asked to respond with a number.

For this report, tables and charts for "check one" and "check all" answer categories are presented either in the format presented on the survey or, where more meaningful, in descending order based on the percentage of responses for a particular answer category (i.e., the answer category with the highest percentage is listed first). Data for directive questions is presented with the percentage of responses for each answer category.

Tables and charts for open-ended questions are presented with the median and average statistics. *Note:* The median is the "typical" measure, not distorted by a few unusually high or low values in the sample due to special circumstances. The median figure represents the midpoint of the figures for a particular measure, with one-half of participants reporting figures above it and one-half below.

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In addition to the *Industry 4.0 Study,* MPI conducts other public research studies, exploring strategies, best practices, operational measures, and profitability across new management opportunities, technologies, and methodologies, including the *MPI Manufacturing Study* and the *MPI Disruptive Technologies Study.*

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