



2019 Deloitte and MAPI Smart Factory Study

Capturing value through the digital journey

Smart factories represent the culmination of a myriad of technologies and business approaches to production in manufacturing environments today. They are a “sum of the parts” and, in their complete form, smart factories are flexible systems that can self-optimize performance across a broader network of factories, suppliers, and partners; self-adapt to and learn from new conditions in near-to-real time; and autonomously run entire production processes.

Achieving the smart factory is a tall order, and often can seem insurmountable for manufacturers grappling with how to transform their existing production assets into smart factories. But it is a challenge worth pursuing. To know more, visit us at [Deloitte.com](https://www.deloitte.com).

Contents

Introduction	2
The smart factory: Initiatives that accelerate value, led by accurate investment decisions	5
It's all in the mindset: Three types of smart factory initiative takers	9
Winning approaches along the pathway to adoption	11
People first: It is the people that make (or break) an initiative	13
Obstacles along the way: Challenges and risks	16
The playbook: Pathways to value realization	18
Final thoughts	21
Endnotes	22

Introduction

Factories are not new to absorbing technologies. Since at least 1913, when Henry Ford’s assembly line first started rolling,¹ factories have ingested the latest technologies to manufacture products faster, better, and more cost-efficiently.



However, manufacturing productivity appears to be stuck now, despite notable advances in factory equipment, new software, and manufacturing processes. Labor productivity continues to perplex most manufacturers, posting annual growth of around 0.7 percent between 2007 and 2018, in a stark contrast to the 3.6 percent average annual growth rate seen between 1987 and 2006.² Simply put, economic output is moving in lockstep with the number of hours people work, rather than rising as it did for much of the last seven decades.³

This brings us to one of the promises of the Fourth Industrial Revolution—to accelerate operational improvements by connecting machines, people, data, and value chains. This can be achieved by building a digital fabric across the traditional factory (enter the smart factory) and, eventually, the entire factory network.

What if the smart factory could ignite stalled labor productivity and unlock the key to productivity for manufacturers? And, considering that the manufactured goods value chain plus manufacturing for

other industries’ supply chains account for about one-third of GDP and employment in the United States, what if smart factory initiatives could spark economywide gains in productivity?⁴

In April 2019, Deloitte and the Manufacturer’s Alliance for Productivity and Innovation (MAPI) launched a joint study to determine the value of smart factory initiatives to make the business case for investment. The aim was to identify the top use cases of smart factory technology, common adoption patterns, gains manufacturers are already seeing, and how they measure value from smart factory initiatives. Qualitative and quantitative analyses revealed five major findings:

- Every manufacturer—whether already “running smart” or yet to invest in smart factory technologies—can harvest business value from smart factory initiatives.
- Smart factory initiatives typically accelerate business value creation. Companies report on average 10–12 percent gains in areas such as

manufacturing output, factory utilization, and labor productivity after they invested in smart factory initiatives.

- There is a direct and established connection—primarily through investment and use cases—between smart factory initiatives and the business value realized. What’s more, any manufacturer can use this connection.
- While there are risks, primarily operational and financial, they are generally outweighed by the smart factory’s value contribution. Also, most risks can be mitigated through rational stakeholder selection, an efficient change management strategy, measurable proof-of-concepts, and incremental investments.
- An identified cohort—we call it Trailblazers—is outperforming with smart factory initiatives.

RESEARCH METHODOLOGY

Deloitte and MAPI jointly launched a study in April 2019 with the intent to quantify the impact of smart factories on US manufacturing productivity. The study included an online survey of more than 600 executives at manufacturing companies with headquarters in the United States and a global factory footprint, interviews with more than a dozen executives from manufacturing companies, and focus group discussions with finance and operations leaders at manufacturing companies. Additionally, the study team analyzed secondary data and used economic projections from Deloitte’s global economic team. Here is how we calculated the impact of smart factory adoption on labor productivity growth through 2030.

We made the following key assumptions:

- Baseline manufacturing productivity growth will remain at historical levels (2007–2018 BLS data) of 0.7 percent from 2019 to 2030 based on smart factory adoption rates discovered through the survey.
- All US manufacturers, spanning discrete and process sectors will likely have adopted some smart factory initiative(s) by the end of the forecast period (2030).
- Accelerated smart factory adoption will occur from 2025 as most manufacturers will likely be leveraging advanced technologies. As such, we classified the adoption of smart factories into two phases—phase 1 (2019–2024) that will likely experience relatively slower adoption and phase 2 (2025–2030) that will likely experience accelerated adoption.

Based on the level of smart factory adoption reported by the respondents, we classified the sample into two segments:

- Group A: traditional manufacturers (no ongoing smart factory initiatives; 49 percent of the sample).
- Group B: manufacturers adopting smart factories (some form of ongoing smart factory initiatives; 51 percent of the sample).

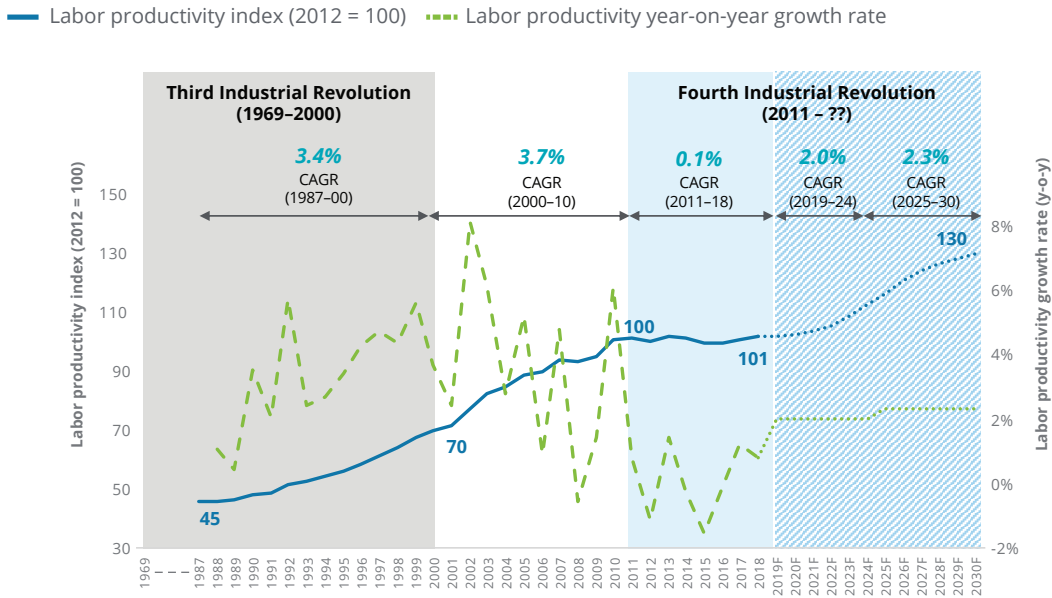
Only three percent of the sample indicated full-scale smart factory adoption.

To forecast the manufacturing labor productivity growth rate during 2019–2030, we used Oxford’s Global Economic Model, data from the BLS, and responses from the 2019 Deloitte and MAPI Smart Factory Survey (figure 1).

FIGURE 1

Smart factory initiatives that are part of fourth industrial revolution could ignite labor productivity growth

Manufacturing labor productivity, forecast, 1987-2030 (2012 index = 100)



Sources: Data from Bureau of Labor Statistics, Deloitte and MAPI Smart Factory Survey, and Deloitte Analysis.

- BLS data indicates that during 2015–2018, the overall US manufacturing labor productivity increased by 2 percent, or 0.66 percent per year.
- Manufacturers in Group B observed average annual productivity gains of 3.3 percent during 2015–2018.
- We assume that productivity index for manufacturers in Group A likely declined 2.3 percent per year to equal the overall manufacturing labor productivity annual rate of 0.66 percent during 2015–2018.
- Group B expects additional labor productivity growth of approximately 0.68 percent during the next three years (over 2019–2022). Group B will likely experience a net productivity growth of 1.38 percent over 2019–2030, the sum of 0.70 percent due to US baseline manufacturing labor productivity gains and 0.68 percent due to smart factory–driven labor productivity gains.
- Manufacturers in Group A are likely to observe annual labor productivity growth of 4 percent as they first adopt smart factory initiatives starting in 2019. This rate will taper to 1.38 percent after five years, leveling to the rate Group B is experiencing.
- This translates to a compound annual growth rate for labor productivity of 2.0 percent from 2019 to 2024 and 2.3 percent from 2025 to 2030.

The smart factory: Initiatives that accelerate value, led by accurate investment decisions

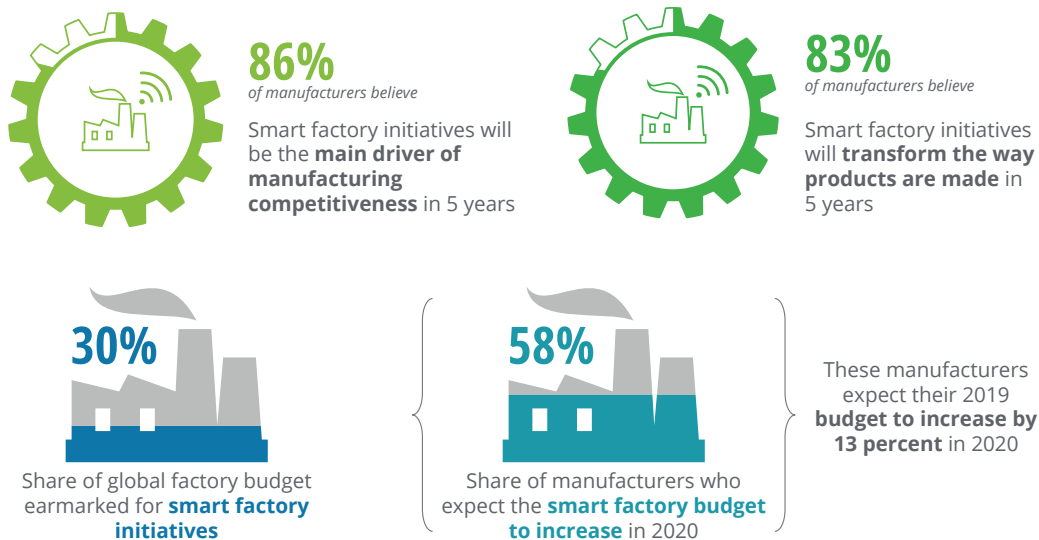
IN ITS MOST mature form, a smart factory is the “sum of the parts”—it is a flexible system that can self-optimize performance across a broader network of factories, suppliers, and partners; self-adapt to and learn from new conditions in near-to-real time; and autonomously run the production processes.⁵ That being said, smart factory transformation is not a “Big Bang,” but rather a concerted effort over a number of years to identify, invest in, implement, and refine specific use cases (see sidebar, “Categories of use cases for advanced technology”) for applying advanced technology to existing processes and workstreams. As such,

realizing the smart factory vision is a tall order. But our research results reveal it can be a goal worth pursuing—smart factories can deliver *measurable* business results, with the potential to transform the role of manufacturing in the global economy. More than 85 percent of respondents, for example, believe that smart factory initiatives will be the main driver of manufacturing competitiveness in the next five years (figure 2).

Transformational change does not happen all at once, though—to start with, smart factory initiatives generally need targeted investments.

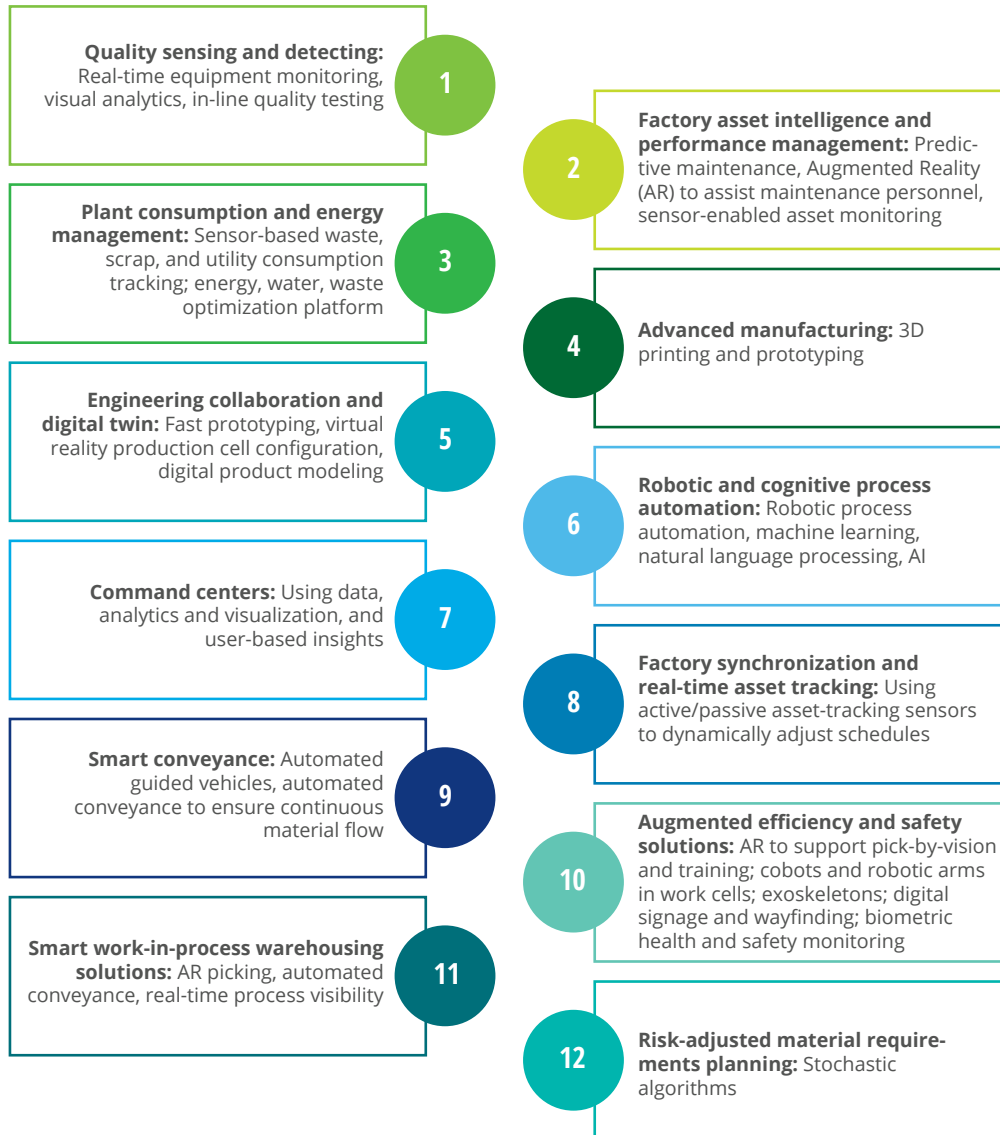
FIGURE 2

Manufacturers recognize that smart factory initiatives are important



Source: Deloitte analysis of the 2019 Deloitte and MAPI Smart Factory Study data.

CATEGORIES OF USE CASES FOR ADVANCED TECHNOLOGY IN EXISTING PROCESSES AND WORKSTREAMS





While manufacturers typically have an appetite for investing in smart factory initiatives, what they should work on is linking such investments with the business value they can deliver. Once investments are committed, companies can see positive results. Since 2015, many companies that have implemented smart factory initiatives have seen an increase in their key performance indicators (figure 3), validating that early adopters often see early payoffs.

Additionally, the last metric—employee productivity—can make a significant impact on manufacturing’s contribution to economic output. Given manufacturing’s direct and indirect contribution (via its own value chain and other industries’ supply chains) accounts for about one-third of GDP and employment in the United States, productivity gains through smart factory initiatives could spark economywide gains.⁶

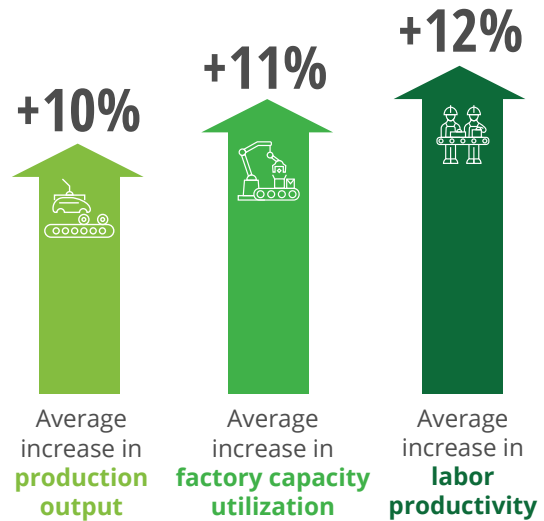
Overall, the primary goals that most manufacturers expect to achieve from initiatives related to smart

factory are both financial and operational (figure 4). Therefore, it may not be very surprising that most smart factory initiatives are targeted first at existing facilities rather than on building new factories. Brownfield developments come with their unique set of challenges that require executives to make technology investments based on the existing infrastructure. Careful calculations are needed to mitigate risks while retrofitting for the promise of smart factories. Therefore, the decision-makers’ attitude toward factory digital transformation can play an important role in the success of any initiative.

FIGURE 3

Smart factory initiatives triggered double-digit growth in key performance indicators between 2015 and 2018

Over the past three years, companies running smart factory initiatives have seen encouraging results:



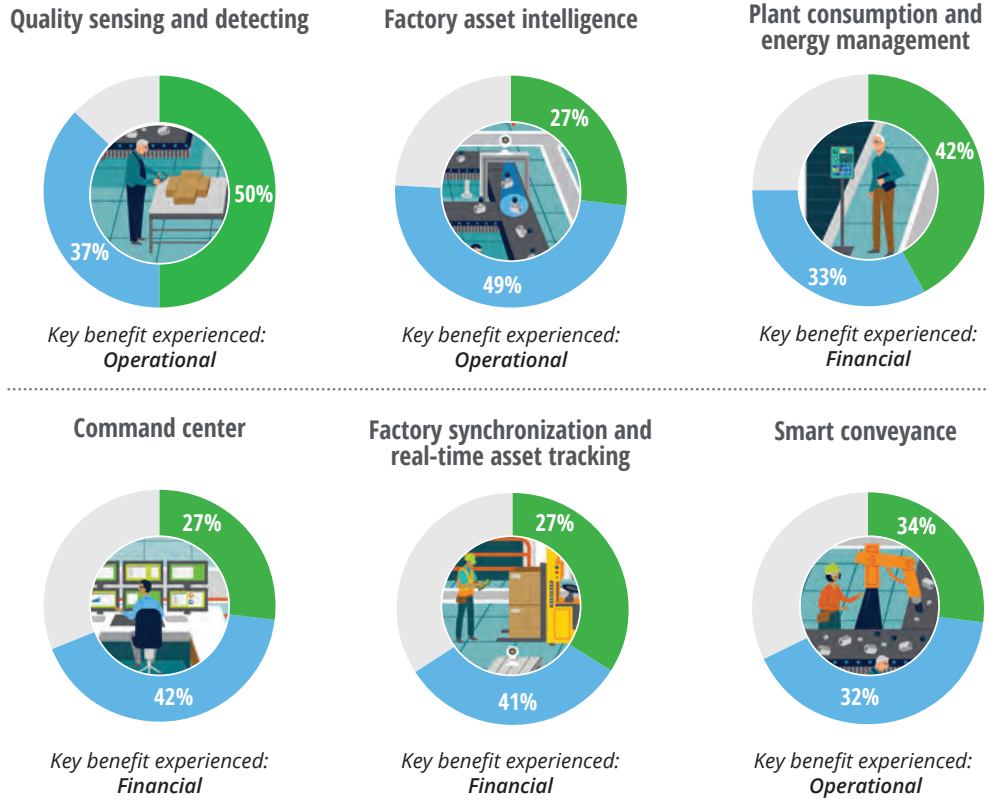
Source: Deloitte analysis of the 2019 Deloitte and MAPI Smart Factory Study data.

FIGURE 4

Use cases of advanced technology in existing processes and workstreams and their benefits

Manufacturers report operational and financial benefits after adopting the following use cases

■ In use ■ Piloting



It's all in the mindset: Three types of smart factory initiative takers

ONE OF THE key findings of the 2019 Deloitte and MAPI Smart Factory Study is that there are *three distinct cohorts of adopters of smart factory initiatives*. We call them **Trailblazers, Explorers, and Followers**

(figure 5). Each cohort represents a different approach toward smart factory adoption, and based on survey responses, we could determine the mindset of each cohort and how their decisions influenced their smart factory maturity.

FIGURE 5
A deep dive into the traits of Trailblazers, Explorers, and Followers

The 2019 Deloitte MAPI Smart Factory Study identifies three distinct cohorts of adopters—Trailblazers, Explorers, and Followers—each representing a different mindset toward smart factory adoption, and determines how their mindset and decisions influence their maturity in smart factory initiatives.

COHORTS WE IDENTIFIED			
	TRAILBLAZERS	EXPLORERS	FOLLOWERS
Proportion	18%	55%	27%
Maturity level	<i>Moving toward complete transformation of at least one factory</i>	<i>Currently implementing initiatives related to smart factory</i>	<i>On the smart factory journey</i>
Budget share	65%	19%	13%
Use case in action	More than 10	More than 9	More than 5
Benefits observed*	20%	10%	8%

Parameters we identified: Approach toward smart factory initiatives; share of smart factory budget; number of ongoing use cases; benefits seen over the last 3 years.

* Average reported changes: Change in production output, factory capacity utilization, and employee productivity from smart factory initiatives in the last 3 years.

FIGURE 5 *continues*

THREE COHORTS—TRAILBLAZERS, EXPLORERS, AND FOLLOWERS—EACH REPRESENTING A DIFFERENT MINDSET TOWARD SMART FACTORY ADOPTION

TRAILBLAZERS: Pioneering the adoption of smart factory initiatives

When it comes to factory-related innovation, Trailblazers are “the first to innovate.” They have identified the potential value that smart factory can deliver and have stepped up to invest in that potential.



INVESTMENTS

On average, Trailblazers dedicate a whopping 65 percent of their global factory budget to smart factory initiatives.



USE CASES

Trailblazers invest in multiple initiatives; on average, they have more than 10 use cases at a given time.



ADOPTION LEVEL

Trailblazers are transforming at least one facility into a smart factory. They are 3X as likely to be transforming the entire factory footprint than others.



BENEFITS OBSERVED

Between 2015 and 2018, Trailblazers’ smart factory initiatives led to twice the benefits than others.

Ecosystem—Trailblazers connect up and down their value chains, from inside (engineering) out to suppliers and customers, indicating they understand the importance of a connected ecosystem to succeed in their smart factory initiatives.



EXPLORERS: Navigating new territories and charting a course

Like Trailblazers, Explorers are well underway with their smart factory initiatives, but they have adopted a “moderated approach” toward investment and use cases. In terms of adoption, most Explorers seem to “be a leader, but not the first.” While they are cautious and take small smart factory initiatives, they have begun to see some benefits.



INVESTMENTS

On average, Explorers dedicate 19 percent of their global factory budget to smart factory initiatives. What’s more, 64 percent of Explorers report average potential increase of 12 percent in the coming year.



USE CASES

Explorers’ lower budget allocation yields fewer than 10 use cases, but these investments are still spread across all 12 categories.



ADOPTION LEVEL

Explorers exhibit a lower adoption level, with the majority currently implementing initiatives at the single asset or production line.



BENEFITS OBSERVED

The steady progress of Explorers has delivered measurable benefits—factory capacity utilization and employee productivity have increased, both by 10 percent on average during the past three years.

Ecosystem—Explorers are connecting with their ecosystem for smart factory initiatives, albeit at a slower pace than Trailblazers.

FOLLOWERS: On the smart factory journey

Followers have an overwhelming characteristic of “waiting until technology is proven.” While caution can be a worthy attribute in some cases, in this age of digital transformation, it can be a severe impediment. Followers are behind their peers, but it is not too late to ramp up activity and catch up quickly.



INVESTMENTS

On average, Followers dedicate only 13 percent of their global factory budget for smart factory initiatives, but 59 percent hope to increase investment in the coming year by 11 percent on average.



USE CASES

Followers’ lower investment yields fewer use cases—five on average. But these cases are generally spread across all 12 categories.



ADOPTION LEVEL

Followers’ smart factory initiatives are often at the “planning to start implementing” stage.



BENEFITS OBSERVED

Followers saw modest gains in key productivity metrics, but they do expect this to increase by 3 percent in the coming three years.

Ecosystem—Followers fall behind peers in connecting their ecosystem; on average, 20 percent have connected ecosystems. Glaringly, 27 percent are connected to “nobody other than production”—this is a potential opportunity for Followers to leverage.

Source: Deloitte analysis of the 2019 Deloitte and MAPI Smart Factory Study data.

Winning approaches along the pathway to adoption

AFTER UNDERSTANDING THE “mindsets” of manufacturers riding the smart factory wave, we wanted to see how they got there, and we sifted through survey responses to understand the “ingredients” of successful smart factory initiatives (figure 6). What we discovered is a process that is linear and intuitive, but also tedious and often fraught with pitfalls. Fortunately, the process seems adaptable for manufacturers of all sizes, and the risks can be partially mitigated by planning and prioritizing investments.

concrete business outcomes. Specifically, they selected improved production capacity, increased throughput, greater visibility into asset performance, and improved product/part quality as the key reasons to start or expand an initiative. So, a business case with pointed outcomes is often a must-have. Expectedly, this is a defining trait of Trailblazers who often consider multiple outcomes as “must-haves” in building the business case.

In other words, *building the right business case and taking small steps to big wins* appear to be the defining traits of successful smart factory initiatives.

Be open to new approaches

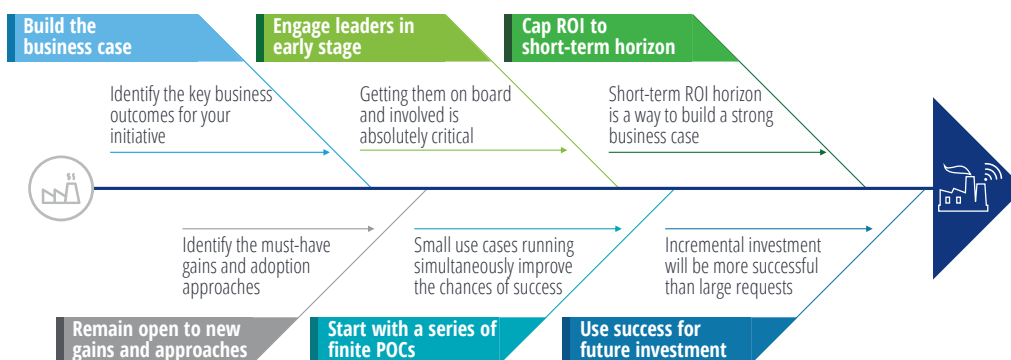
While it is tempting—and common—to go down the tried-and-true path, having multiple approaches can help with faster results simply because if one approach flops, an organization can test a different approach and quickly course-correct when needed. For example, Trailblazers are not fixated on just one implementation approach for their smart factory initiatives and, in fact, show a higher propensity for multiple adoption

Build a business case

When probed about the business reasons influencing smart factory initiatives, respondents identified

FIGURE 6

Building the right business case helps in the success of a smart factory initiative



Source: Deloitte analysis of the 2019 Deloitte and MAPI Smart Factory Study data.

approaches. They are two times more likely than Explorers and Followers to adopt a dual approach—a combination of retrofitting and building new assets. This may be partly why they are leading in the race to smart factories.

Engage the leadership early

Getting buy-ins from the leaders, especially those in the C-suite, early on can help ease the pressure for support in the boardroom and for further investment. As one executive noted, *“Getting them on board, involved and excited is absolutely critical. You’ll need significant support financially, emotionally, and in time invested by upper management to ensure the [smart factory initiative] will be successful.”* Followers report less success engaging leadership to move smart factory initiatives forward.

Launch finite proofs of concept (POC) with a short-term horizon

Starting small with POCs and scaling them can work in the smart factory domain. Survey responses reveal that Trailblazers had 50 to 70 small use cases running across different plants at

the same time. Successful initiatives often had the backing of a formal business case with provision for additional budget to roll out more broadly. As for the return on investment, these broader projects had a short-term horizon of two to three years, another way to build a strong business case and succeed. *“Don’t be afraid to state a number and show how you can get close to it [with your proposed project]”* is one leader’s advice.

Use success of an initiative to seek incremental investment

A common route to the smart factory is to start multiple small projects that have lower individual investment and to tie them to measurable business metrics to prove success and garner additional funds. In fact, one of the leaders of a global industrial products company we interviewed shared the example of starting with a single use case of reducing the forced outage rate resulting in 1–2 percent productivity improvement. Based on the success of that project, the company was able to build another business case for wider rollout for overall factory productivity improvement of 2–3 percent. The larger project received funding and went on to deliver additional tangible returns. This is one of the approaches that Explorers are using to advance their smart factory progress.

People first: It is the people that make (or break) an initiative

THE ULTIMATE SUCCESS of a smart factory initiative often lies in the hands of the people involved, from the stakeholders to the initiative leaders and, importantly, those at the grassroots who work with the new technology and processes every day. How one engages with each group potentially goes a long way in determining the ultimate outcome of an initiative. So, how are companies organizing themselves and their people around smart factory initiatives?

Get the right talent: It holds the key to success

In our interviews and focus-group discussions with leaders, they alluded to the nuanced reality of how smart factory initiatives tend to differ by company. More than once, leaders underscored the importance of having the right people as part of the initiatives and a visionary leader within the group to “keep the spark alive,” as one executive noted. Another executive stated, *“Ninety percent of the solution is getting the right leader with the right experience and passion. If you don’t, you’ll muddle around for years.”* Often, this person is inside the company and can come from a variety of roles. But, if a comprehensive leader with passion, experience, and expertise is not identified, manufacturers would do well to search outside because this pivotal role cannot be compromised.

Leverage diverse stakeholders to make well-rounded decisions

Key stakeholders in smart factory initiatives span production, technology, finance, and business. As such, they are well represented in strategy, implementation, and operation of initiatives, which can help in well-rounded decision-making. As one leader explained, *“It’s important to get a broad spectrum of people with diverse skills and perspectives. And, the team leader should allow for dissent and productive disagreements.”*



Given the transformative potential of the smart factory for every department/area of the factory, it is important that all factory departments are adequately represented on the team. While the CEO sets the business mandate, it is the diverse

perspectives from the other C-suite executives and stakeholders that help unlock true smart factory benefits. Interestingly, team composition and leadership choices among Trailblazers, Explorers, and Followers are dissimilar, giving an insight into why their outcomes for each group are different from the others (figure 7).

Manage the change well

Half the respondents—50 percent—reported managing the change by developing central teams or working groups tasked with researching, developing, and deploying smart factory initiatives (figure

8). Essentially, it is important to change how people approach their work rather than dictating new requirements. Doing things the same way on new technology won't likely produce the desired results. Interestingly, even on this measure, Trailblazers typically do things differently from the others—they apply multiple approaches to manage change. In addition to central teams, they develop centers of excellence to coordinate and connect smart factory initiatives and they develop value targets and measurement plans to assess their progress. This could well be part of the reason Trailblazers move faster on the adoption curve and realize greater benefits.

FIGURE 7

Manufacturers implement multiple solutions to manage the change introduced through smart factory initiatives

	TOTAL	TRAILBLAZERS	EXPLORERS	FOLLOWERS
A central team researches, develops, and deploys initiatives	50%	✓	✓	✓
A measurement plan to assess progress against objectives	34%	✓	✓	
A center of excellence coordinates and connects initiatives in the business units	33%	✓	✓	
A defined communication process to explain the implications to all stakeholders	33%	✓	✓	
Engage external third parties to help manage initiatives	30%	✓		

Note: Percentages denote the share of manufacturing executives implementing the respective solution.

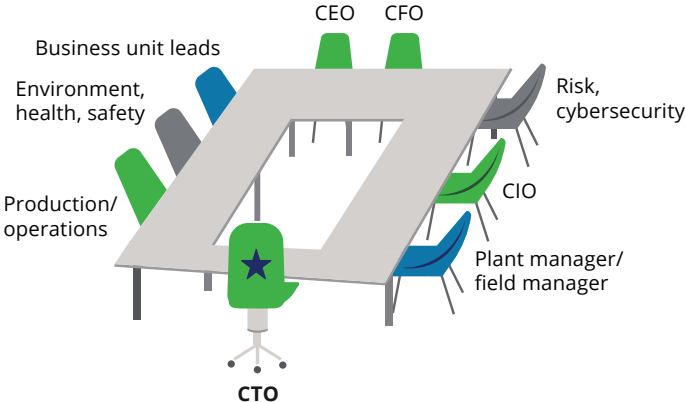
Source: Deloitte analysis of the 2019 Deloitte and MAPI Smart Factory Study data.

FIGURE 8

The smart factory boardroom: Different roles, different voices

★ Primary smart factory leader ■ Top five active stakeholders ■ Moderately active stakeholders
 ■ Least active stakeholders

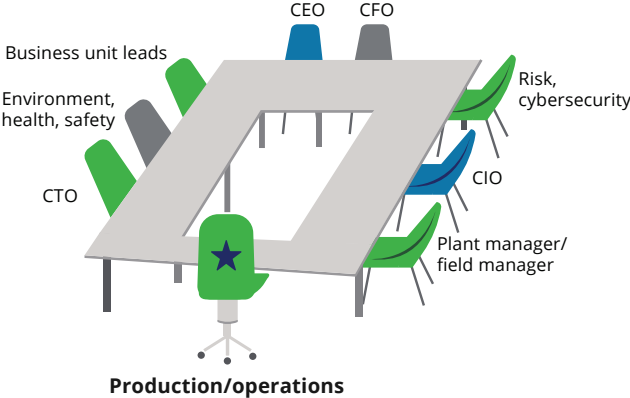
TRAILBLAZER'S BOARDROOM



The primary leader of Trailblazer's smart factory initiatives is the CTO and team.
 The CTO as the primary leader of smart factory initiatives likely explains the **fast pace of technology implementation** by Trailblazers.

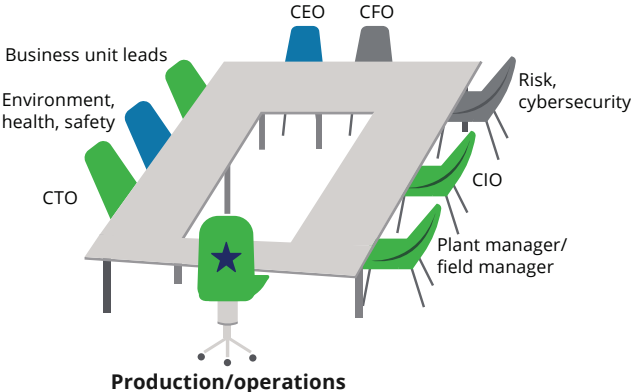
EXPLORER'S BOARDROOM

Explorers have production/operations professionals as the primary smart factory leaders.
 The average representation from all business areas at Explorers is 1.5 times higher than at Trailblazers, likely explaining a **more consensus-driven implementation approach**.



Similar to Explorers, Followers' smart factory initiatives are led by professionals from production and operations.
 Followers report a lower share of C-suite executives as the primary stakeholder than Trailblazers and Explorers, implying that **Followers have less leadership support to implement smart factory initiatives**.

FOLLOWER'S BOARDROOM



Source: Deloitte analysis of the 2019 Deloitte and MAPI Smart Factory Study data.

Obstacles along the way: Challenges and risks

WITH REWARDS COME risks. One of the biggest challenges of smart factory adoption is that many organizations simply *do not take any action* on smart factory investment and initiatives. Nineteen percent of respondents “have not thought about [smart factory transformation]” and 30 percent are “thinking about it, but currently not planning any initiatives” (figure 9).

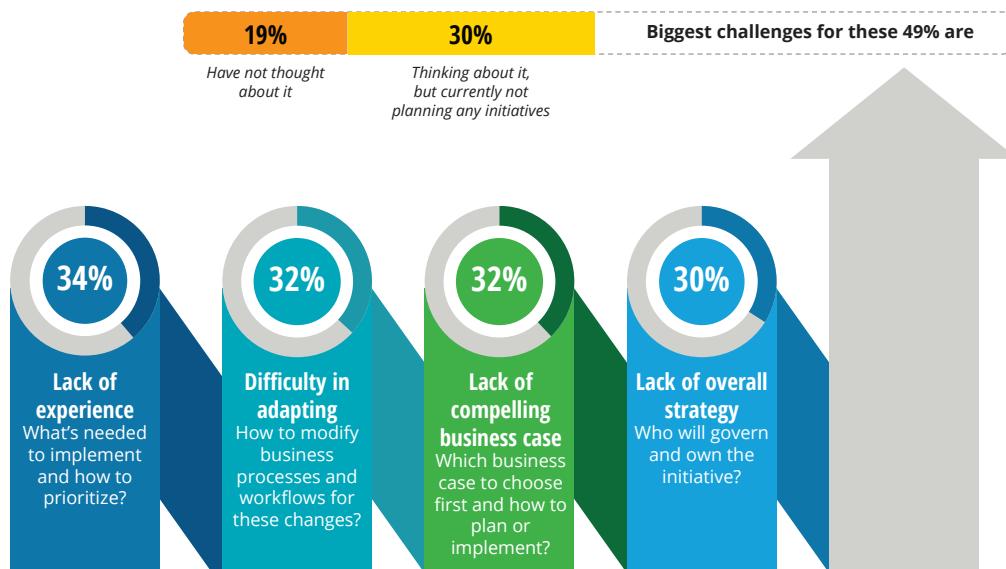
There is a possible explanation for the lack of interest—identifying the initiative, finding the initiative champions/advocates, building the business case, gaining the funding, and launching the initiative reflect the complexity of smart factory adoption. These are all *high-stake decisions* and not everyone

is ready to run the risk of failure. As one executive noted, *“In a production environment, making a mistake can bring a production line down or harm a human worker, so the stakes are very high.”* This, again, brings to the fore Trailblazers’ nimble approach to decision-making and implementation.

Respondents identified other risks too—operational risks rank number one across cohorts. Followers put it at the top because of concerns including disruption to the day-to-day business and the prospect of loss resulting from inadequate or failed experiments or change. Additionally, all

FIGURE 9

Lack of experience is preventing manufacturers from launching smart factory initiatives



Source: Deloitte analysis of the 2019 Deloitte and MAPI Smart Factory Study data.

enterprises are exposed to the cyber risk regardless of their digital maturity.

Cyber risk can upset the best laid initiatives

A particularly daunting operational risk for even the most confident manufacturing leader is the cyber risk. Cyber threats are pervasive and can have disastrous effects if smart factory initiatives are implemented without taking precautions, such as creating a cyber risk strategy. Industrial companies are becoming a popular target. Unfortunately, many seem unprepared. The 2019 Deloitte and MAPI Smart Factory Study results indicate that a significant number of companies (24 percent) do not perform annual cyber risk assessments. Even among those that do, such evaluation is often in the form of a vulnerability assessment, which is often inadequate for the complexities of the production environment. Because of the unique mix of information technology (IT) and operations technology (OT) in factories, most require a different approach than IT-only environments.

Assessing risk in the OT environment requires knowledge of devices and business processes, so alignment with business leaders can be crucial. People, processes, and technology will overlap, and companies should look beyond traditional IT tools to assess and address risk in the OT manufacturing environment. Building a mitigation and prevention strategy that centers on security, vigilance, and resilience can be key toward managing risk in the smart factory.⁷

In an environment with such high stakes, the capabilities of smart factory technologies can help to mitigate many risks. Examples include vision systems that preemptively identify issues, real-time monitoring to prevent worker injury, and autonomous technologies that can take over dangerous tasks. While the volume of risks increases in a smart factory environment, the value that smart factory initiatives can deliver is generally worth the potential risks. What is needed from company executives is awareness of these potential risks and comprehensive mitigation planning. There are some underlying approaches to managing risks in smart factory adoption that typically hold true for all cohorts.

1. Consider human safety foremost and evaluate all new technologies through this lens.
2. As you connect the factory to your broader communications and computing networks, have a nimble risk mitigation plan that evolves as smart factory initiatives mature.
3. Avoid a single point of failure by taking actions proactively. Segmenting the production line and having more than one network channel are some ways such failures can be avoided.
4. Standardize policies on risk, disaster recovery, etc. across vendors providing connected equipment.
5. Consider a layered or “stacked” security approach to strengthen overall resilience.

The playbook: Pathways to value realization

MANUFACTURERS—WHETHER ALREADY “running smart” or yet to invest in smart factory technologies—can harvest business value by managing production with digital technologies. But what should they do exactly? In the playbook below, we recommend 10 common approaches that can be used to identify and initiate

smart factory initiatives that will likely yield results (figure 10). These actions are not in a particular order and will likely appeal to companies based on the adoption pattern (Trailblazer, Explorer, Follower) that most closely resembles their current approach to smart factory initiatives.

FIGURE 10

Pathways to value realization

Learn from EXPERIENCE



Embrace experimentation

A global aerospace and defense manufacturer designed a solution driven by a combination of robotics and software to increase the speed and efficiency of inspecting components on the factory floor. Through two industrial robots equipped with sensors and machine learning algorithms, the company designed an automated system capable of inspecting parts as large as 200 feet. This solution reduced the inspection time by 40 percent. The company is now expanding this technology beyond its headquarters in the United States to Europe, and to other applications.

Best applies to: **Trailblazers** and **Explorers**



Replicate early leaders' successes

A global auto parts manufacturer implemented IoT solutions to reduce unplanned factory downtime and ensure operations continuity. Through a series of three programs, the company first enabled machinery and assets using IoT solutions and then deployed smart factory use cases (such as inspection robots, force sensors, and measurement devices). Using the data captured from assets, the company analyzed asset performance and tracked the assets remotely. The pilot program was then expanded to an entire production line in a US plant. Through this approach, the company was able to predict and prevent system failures, leading to a 100 percent reduction in manual inspection time.

Best applies to: **Followers**

FIGURE 10 *continues*

Set FOUNDATIONS



Assemble a cross-functional team

A global industrial goods conglomerate created a new role of chief digital officer (CDO) to drive adoption of digital technologies such as Artificial Intelligence (AI). The CDO formed a new team of existing and new employees and worked with the company's leadership to identify digital opportunities across all business areas. The team then launched a pilot digital transformation initiative to improve operational efficiency at one of the facilities. Following the success of the initiative, the company invested in an AI company to advance its own AI capabilities.

Best applies to: **Explorers** and **Followers**



Keep employees at the center

A leading US manufacturer of tools and equipment started a technology platform transformation program using the human resources and finance functions. The intention was to drive a digital culture and enhance employee productivity. The company rolled out employee and manager self-service digital programs as well as mobile capabilities for employees on the go. Through the new platform, it was able to support and engage a diverse workforce using persona-based engagement and adapt to the future of work imperative.

Best applies to: **Trailblazers** and **Explorers**



Perform regular factory walks to identify potential use cases

A US industrial products manufacturer hit a productivity plateau. Performance data for its equipment was not captured, which was a barrier to productivity planning. After a ground-level review of one struggling production line, the company piloted a customized internet-of-things (IoT) solution on a given production line. The IoT-enabled solution could extract data from all equipment on that line, giving data-driven insights to the leadership. Based on these insights, the board approved a business case; financial benefits included more than US\$70 million savings in the form of incremental revenue and capex avoidance. The company's leadership expanded the pilot to a full-factory asset intelligence program.

Best applies to: **Explorers** and **Followers**

Focus EFFORTS



Make targeted investments

A global automotive supplier has earmarked more than US\$40 million to digitize and implement smart elements across its factories in Europe over a period of four years. The company has identified five areas for these investments, including smart energy management, to potentially reduce energy consumption by 10 percent. The company also intends to gather performance data from their manufactured products and use the insights for creating digital product designs, reducing production time by half. Through all the initiatives, the automotive supplier expects an overall 15 percent improvement in quality.

Best applies to: **Trailblazers**, **Explorers**, and **Followers**

FIGURE 10 *continues*



Focus on pain points

A US tools manufacturer implemented an array of smart solutions to increase asset visibility at a factory in North America. The company enhanced the visibility on asset availability using IoT-enabled sensors and enterprise visibility solutions. Based on asset and production data, floor managers performed a labor remapping exercise, allocating more resources to labor-critical processes. The solutions yielded 10 percent labor efficiency gains, increasing the utilization rate from 80 percent to 90 percent. The company also observed an incremental improvement in production quality, with defects per million reducing by 16 percent.

Best applies to: **Explorers** and **Followers**



See more through virtual factory

A global consumer products manufacturer deployed digital twins of more than 100 factories to track assets and operational data. This approach lets the company make real-time changes to optimize production output and reduce inventory costs.

Best applies to: **Trailblazers** and **Explorers**

Scale INITIATIVES



Apply AI to the factory dataset

A technology equipment manufacturer deployed a mobile IoT system to collect data and information from disparate technologies, systems, and assets in a factory onto a single platform. The IoT platform, connected by a cloud management system, aggregated data and generated insights on all connected assets. Using this system, the company could better track its assets, and schedule maintenance and repair, minimizing the downtime. The system led to one-time savings of more than US\$200 every time a traditional cable-based connection was replaced by a wireless sensor. Additionally, the manufacturer could leverage advanced analytics to improve decision-making.

Best applies to: **Trailblazers** and **Explorers**



Connect better with the external ecosystem

A global manufacturing company has more than 1,500 raw material suppliers. To get better insights on inventory and additional stock for replenishment, the company intends to get all the suppliers on a centralized digital platform.

Additionally, just 150 suppliers account for 80 percent of the company's spend. Management intends to first bring 75 percent of these major 150 partners on a single digital platform. This approach could help increase inventory visibility by 65–75 percent.

Best applies to: **Trailblazers** and **Explorers**

Source: Deloitte analysis.

Final thoughts

AS THE 2019 Deloitte and MAPI Smart Factory Study results reveal, the promise of the Fourth Industrial Revolution can be delivered through smart factory initiatives, and smart factories are beginning to pay off for early adopters. The results also appear to reinforce the potential upside of factory transformation by using digital technologies and changing the very way work is done. Complexity is added not just from

technology but also from nontechnology challenges, such as managing the multifaceted risks and the **human aspect** of introducing, sponsoring, and launching initiatives. Manufacturers can extrapolate study results to identify their own adoption approach to smart factory initiatives and consider the pathways suggested in the playbook to further advance their efforts and build for success.



Endnotes

1. History.com, "Ford's assembly line starts rolling," November 13, 2009.
2. Bureau of Labor Statistics, "Manufacturing, durable manufacturing and nondurable manufacturing," US Department of Labor, August 15, 2019.
3. Neil Irwin, "Why is productivity so weak? Three theories," *New York Times*, April 28, 2016.
4. MAPI Foundation, *How important is US manufacturing today?*, September 13, 2016.
5. Germany Trade and Invest (GTAI), "Smart factory," accessed August 18, 2017; Rick Burke et al., *The smart factory: Responsive, adaptive, connected manufacturing*, Deloitte Insights, August 31, 2017.
6. MAPI Foundation, *How important is US manufacturing today?*, September 13, 2016.
7. Trina Huelsman et al., *Cyber risk in advanced manufacturing: Getting ahead of cyber risk*, Deloitte, accessed August 21, 2019.

About the authors

Paul Wellener | pwellener@deloitte.com

Paul Wellener is a vice chairman, Deloitte LLP, and the leader of the US Industrial Products & Construction practice with Deloitte Consulting LLP. He has more than three decades of experience in the industrial products and automotive sectors and has focused on helping organizations address major transformations. Wellener drives key sector industry initiatives to help companies adapt to an environment of rapid change and uncertainty—globalization, exponential technologies, the skills gap, and the evolution of Industry 4.0. Based in Cleveland, Wellener also serves as the managing principal of Northeast Ohio. Connect with him on LinkedIn at <https://linkedin.com/in/pwellener/>.

Steve Shepley | shepley@deloitte.com

Steve Shepley is a principal at Deloitte Consulting LLP's Aerospace & Defense (A&D) industry practice with more than 15 years of experience helping highly engineered product manufacturing companies drive performance improvements through the use of advanced techniques and technologies. He specializes in the development of transformational solutions that enable clients to reduce operational costs, improve productivity, and drive growth. From an industry perspective, he primarily focuses on the Aerospace & Defense, Automotive, and Industrial Products sectors. Connect with him on LinkedIn at <https://www.linkedin.com/in/steve-shepley-8b8b715a/>.

Ben Dollar | bdollar@deloitte.com

Ben Dollar is principal in the Global Supply Chain practice of Deloitte Consulting LLP. He specializes in large scale transformation enabled by digital technologies and focuses on driving adoption for sustainable benefits. He has helped some of Deloitte's largest clients reduce costs and improve workforce productivity through advanced technologies. His industry focus is primarily on global industrial manufacturers. Connect with him on LinkedIn at <https://www.linkedin.com/in/ben-dollar-1018aa/>.

Stephen Laaper | slaaper@deloitte.com

Stephen Laaper is a Digital Supply Networks leader in Deloitte Consulting LLP's Strategy & Operations practice. Laaper brings a unique mix of industry, consulting, and technology experience with a broad range of clients across the life sciences, automotive, and consumer products industries. Connect with him on LinkedIn at <https://www.linkedin.com/in/stephen-laaper-3615334/>.

Heather Ashton Manolian | hashtonmanolian@deloitte.com

Heather Ashton Manolian is the industrial manufacturing research leader in the Deloitte Research Center for Energy & Industrials and has delivered compelling insight on major enterprise business and technology trends for more than 20 years. Her expertise includes developing thought leadership at the intersection of business and technology, covering emerging technologies from cloud to blockchain and augmented reality. Connect with her on LinkedIn at <https://www.linkedin.com/in/heather-ashton-manolian-6241b78> and on Twitter at @hashtonmanolian.

David Beckoff | dbeckoff@mapi.net

David Beckoff is VP, Product Development and Insights at MAPI, where he is responsible for research, benchmarking programs, and special events for the manufacturing community. Recently, he served as Research Director at Gartner and led cross-industry studies on topics including data analytics, digital transformation, customer experience, and talent development. He is based out of Arlington, VA. Connect with him on LinkedIn at <https://www.linkedin.com/in/david-beckoff/>.

Acknowledgments

The 2019 Deloitte and MAPI Smart Factory Study was made possible through the efforts of many contributors. We would like to recognize the following individuals for their role in producing this study and all its related pieces:

Deloitte Smart Factory Advisory Board

Paul Wellener, Ben Dollar, Sean Peasley, Stephen Laaper, Adam Mussomeli, Peter Heron, Louis Librandi, Leigh Weber, Steven Shepley, Tom Walsh, Thomas McGinnis, John Johnson, Brian Umbenhauer, Brenna Sniderman, Lindsey Berckman, Kenneth Norton, Michael Schlotterbeck, Kelly Marchese, Aijaz Hussain, Mary Everette Cann, Lancy Jiang, and Ricca Racadio

MAPI Advisory Board

Stephen Gold, David Beckoff, Kristin Graybill, Kristy Kelly, Leslie Spotswood, Erika Ruiz, John Miller, and Maria Negrón Kneib

We would also like to thank **Ankit Mittal** and **Kruttika Dwivedi**, who led the survey and data analysis as well as overall report workstreams; **Danny Bachman** and **Aijaz Hussain**, who provided input and review for the economic calculations and forecast models; **Mary Everette Cann**, who drove the marketing strategy and related assets to bring the story to life; **Anisha Sharma** and **Abe Silva** for their leadership in public relations; and **Kavita Saini**, **Joanie Pearson**, **Emily Moreano**, **Amy Bergstrom**, **Junko Kaji**, and **Mike Boone** from the Deloitte Insights team who supported the report's publication, including the interactive portion.

Contact us

Our insights can help you take advantage of change. If you're looking for fresh ideas to address your challenges, we should talk.

Practice contacts

Brian Umbenhauer

Principal | Deloitte Consulting LLP

+1 312 486 43010020 | bumbenhauer@deloitte.com

Brian Umbenhauer is the leader of Deloitte's US Consulting Industrial Products & Construction Sector as well as the leader of the Global Sourcing and Procurement practice. He is based in Chicago.

Steve Shepley

Principal | Manufacturing | Deloitte Consulting LLP

+1 310 467 5887 | sshepley@deloitte.com

Steve Shepley is a principal at Deloitte Consulting LLP's Aerospace & Defense (A&D) industry practice. Shepley is based in Los Angeles.

Stephen Laaper

Principal | SC&MO | Life Sciences & Health Care | Deloitte Consulting LLP

+1 312 513 7900 | slaaper@deloitte.com

Stephen Laaper is a Digital Supply Networks leader in Deloitte Consulting LLP's Strategy & Operations practice. He is based in Boston.

Adam Mussomeli

Principal | SC&MO | Consumer & Industrial Products | Deloitte Consulting LLP

+1 203 905 2646 | amussomeli@deloitte.com

Adam Mussomeli is a co-founder of Deloitte Consulting LLP's Digital Supply Networks Practice. He is based in Stamford.

Ben Dollar

Principal | Deloitte Consulting LLP
+1 617 437 3264 | bdollar@deloitte.com

Ben Dollar is a principal in the Global Supply Chain practice of Deloitte Consulting LLP. He is based in Boston.

Industry Center contact

Andrew Slaughter

Executive director | Center for Energy Solutions | Deloitte Services LP
+ 1 713 982 3526 | anslaughter@deloitte.com

Andrew Slaughter is an executive director for the Deloitte Research Center for Energy & Industrials, Deloitte Services LP. Slaughter is based in Houston.

About Deloitte Research Center for Energy & Industrials

Deloitte’s Research Center for Energy & Industrials combines rigorous research with industry-specific knowledge and practice-led experience to deliver compelling insights that can drive business impact. The Energy, Resources, and Industrials industry is the nexus for building, powering, and securing the smart, connected world of tomorrow. To excel, leaders need actionable insights on the latest technologies and trends shaping the future. Through curated research delivered through a variety of mediums, we uncover the opportunities that can help businesses move ahead of their peers.

About MAPI

Founded in 1933, the Manufacturers Alliance for Productivity and Innovation is a nonprofit organization that connects manufacturing leaders with the ideas they need to make smarter decisions. As the manufacturing leadership network, its mission is to build strong leadership within manufacturing to drive the growth, profitability, and stature of global manufacturers. For more information, visit mapi.net.

Deloitte.

Insights

Sign up for Deloitte Insights updates at www.deloitte.com/insights.



Follow @DeloitteInsight

Deloitte Insights contributors

Editorial: Kavita Saini, Rupesh Bhat, Nairita Gangopadhyay, and Preetha Devan

Creative: Anoop K R and Rajesh Venkataraju

Promotion: Nikita Garia

Cover artwork: Kevin Weier

About Deloitte Insights

Deloitte Insights publishes original articles, reports and periodicals that provide insights for businesses, the public sector and NGOs. Our goal is to draw upon research and experience from throughout our professional services organization, and that of coauthors in academia and business, to advance the conversation on a broad spectrum of topics of interest to executives and government leaders.

Deloitte Insights is an imprint of Deloitte Development LLC.

About this publication

This publication contains general information only, and none of Deloitte Touche Tohmatsu Limited, its member firms, or its and their affiliates are, by means of this publication, rendering accounting, business, financial, investment, legal, tax, or other professional advice or services. This publication is not a substitute for such professional advice or services, nor should it be used as a basis for any decision or action that may affect your finances or your business. Before making any decision or taking any action that may affect your finances or your business, you should consult a qualified professional adviser.

None of Deloitte Touche Tohmatsu Limited, its member firms, or its and their respective affiliates shall be responsible for any loss whatsoever sustained by any person who relies on this publication.

About Deloitte

Deloitte refers to one or more of Deloitte Touche Tohmatsu Limited, a UK private company limited by guarantee ("DTTL"), its network of member firms, and their related entities. DTTL and each of its member firms are legally separate and independent entities. DTTL (also referred to as "Deloitte Global") does not provide services to clients. In the United States, Deloitte refers to one or more of the US member firms of DTTL, their related entities that operate using the "Deloitte" name in the United States and their respective affiliates. Certain services may not be available to attest clients under the rules and regulations of public accounting. Please see www.deloitte.com/about to learn more about our global network of member firms.