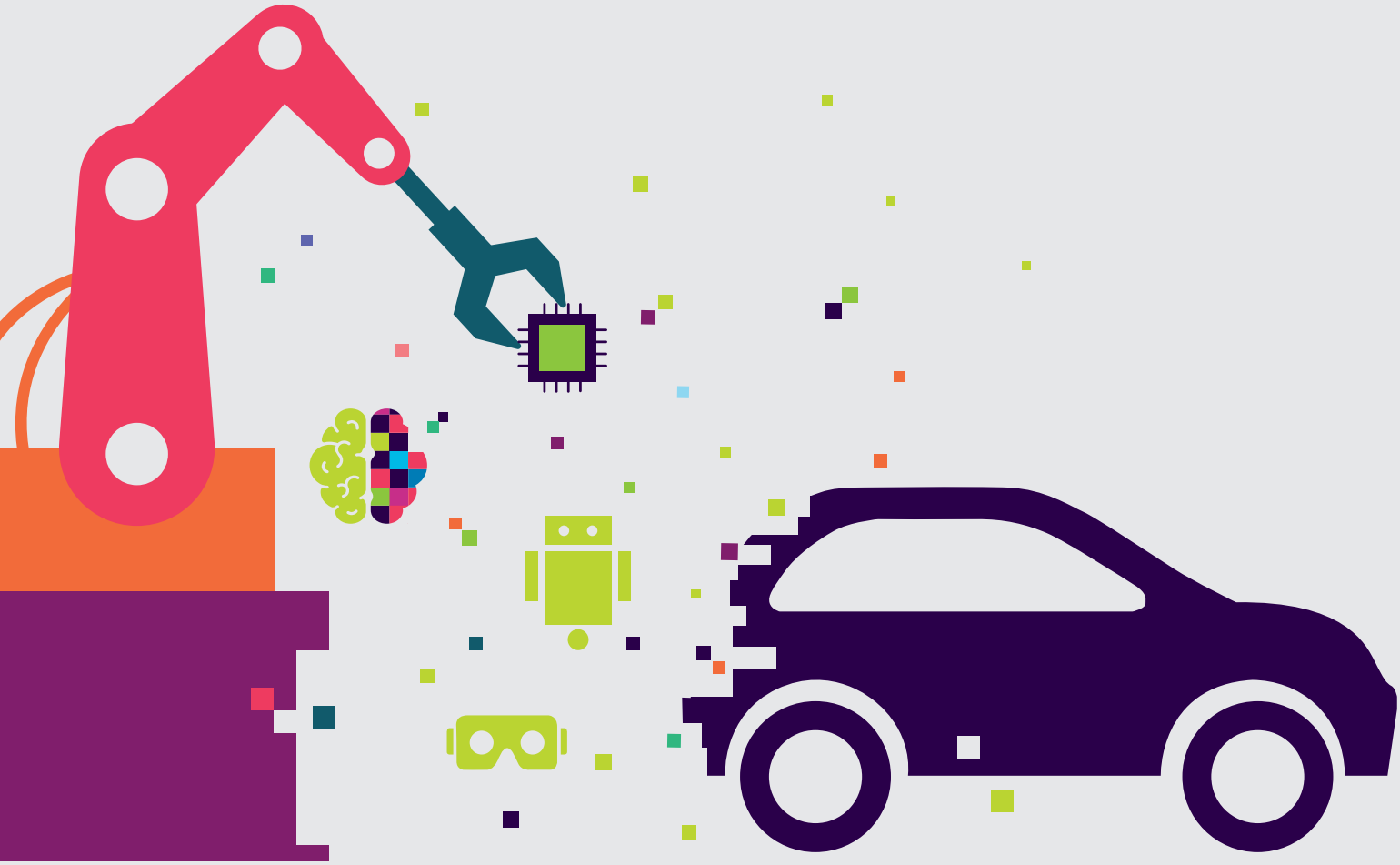
Capgemini
RESEARCH INSTITUTE

Automotive Smart Factories



Putting automotive manufacturers in the **digital industrial revolution** driving seat

Introduction

Our 2017 research[1] – *Smart Factories: How can manufacturers realize the potential of digital industrial revolution* – found that the investments that manufacturers are making in smart factories are set to deliver benefits of up to $1,500 billion over the next five years. Investment levels varied widely between industries, but it was notable that automotive was one of the most bullish sectors in this domain.

We were keen to understand whether this enthusiasm has led to tangible success. Drawing on the 220+ auto executives we surveyed last year, we surveyed a further 100 executives. Our analysis has some significant findings and implications for the automotive industry:

1. Smart factories could add up to $160 billion annually to the global auto industry as productivity gains by 2023 onwards.
2. The automotive industry is the most enthusiastic about smart factories – it is making larger investments and setting higher targets for its digital manufacturing operations than any other sector.
3. However, few automotive manufacturers have translated this enthusiasm into real progress –42% of smart factory initiatives are struggling and the digital maturity of their manufacturing operations is below par.
4. Those that are making the best progress invest 2.5 times more than the companies that are struggling. Additionally, they are involving their leadership teams, developing their talent, and investing in the right areas. By the "right areas," we mean those smart factory components that are critical for the future, such as manufacturing intelligence and predictive maintenance.
5. More manufacturers could make a success of this opportunity if they follow in the footsteps of a cohort we call the "digital masters." This is a group that, in particular, has manufacturing operations functioning at a high level of digital maturity.

The size of the smart factory prize: $160 billion by 2023 onwards

Our analysis reveals that smart factories could add an extra $160 billion of productivity gains annually to the global automotive industry by 2023 onwards (see Figure 1).

Based on our survey, automotive industry executives expect average productivity growth in smart factories to average 30% by 2023:

- The industry expects to have 24% of its factories as "smart" operations in this time period. This will lead to increased productivity to the value of $160 billion globally, which is around 7% of total annual industry value.[2]
- Capgemini believes that as many as 50% of automotive factories have the potential to be smart factories by 2023.[3] In this optimistic scenario, the annual value from smart factories to the industry reaches $344 billion (15% of industry's global annual revenues as of 2017).

Figure 1. Smart factories are expected to add up to $160 billion to the global auto industry.

Factors	Scenario based on industry estimates
A. Expected productivity gain per factory by 2023 onwards	30%
B. Expected number of factories to be smart by 2023 onwards	24%
C. Absolute gain on productivity (A x B)	7%
D. 2017 industry revenue	$2,290 billion
E. Estimated productivity gains (C x D) by 2023 onwards	**$160 billion**

Source: Capgemini Research Institute Smart Factory Survey 2017–18, Capgemini Research Institute analysis.

Smart factories can help a top-ten global automaker earn an additional $5 billion in operational profit

We took a detailed look at the impact of smart factories on the financials of large automotive manufacturers. Our analysis confirms that the auto companies stand to make substantial productivity gains by 2023. This will help them achieve break-even on smart factories within a year of those operations reaching full potential.

We have assessed the financial impact of adoption for an average automotive Original equipment manufacturer (OEM) and an average automotive supplier from the global top ten, based on annual revenue. The top-ten OEM category has an average annual revenue of $158 billion (as of 2017) and an operating margin of 6%:

- In the scenario shown in Figure 2, where the smart factory adoption rate is expected to be 24% (as per our survey), we believe that automotive OEMs would be able to increase their operating profit by up to $4.6 billion – a 50% increase from the current levels. For a top-ten supplier, this gain would stand at $1 billion. This jump would result from a 30% productivity gain and 0.5%–7% reduction in operational costs of logistics, material, and administration owing to

smart factories. Reaching this level of benefits will start reflecting by 2023 onwards.

- Our experience, coupled with estimates from the survey, suggest that in the most positive scenario the accrued benefits would more than double – a gain of $10.1 billion or 110% growth on the current level of operating profit for an average top-ten auto OEM. For an average top-ten automotive supplier, the most positive scenario can yield a gain of $2 billion or 85% growth on the current level of operating profit.

Figure 2. Smart factories will boost the operating profit of an average auto manufacturer in the top-ten category by 50%.

Factors	Scenario based on industry estimates	
	OEMs	**Suppliers**
A. Expected productivity gain per factory (by 2023 onwards)	30%	30%
B. Expected number of factories to be smart (by 2023 onwards)	24%	24%
C. Absolute gain on productivity (A x B)	7%	7%
D. Reduced operational costs in the areas such as logistics, administration, direct labor, and material as well as revenues	Between 0.5% and 7%	Between 0.5% and 7%
E. Operating profit by 2023 onwards (from the current level of $9.5 billion for OEMs and $2.6 billion for suppliers)	$14.1 billion **($4.6 billion or 50% increase from the current level)**	$3.6 billion **($1 billion or 38% increase from the current level)**
F. Operating Margin by 2023 onwards (from the current level of 6% for OEMs and 8% for suppliers)	8.3% (1.4x increase from the current level)	10.3% (1.3x increase from the current level

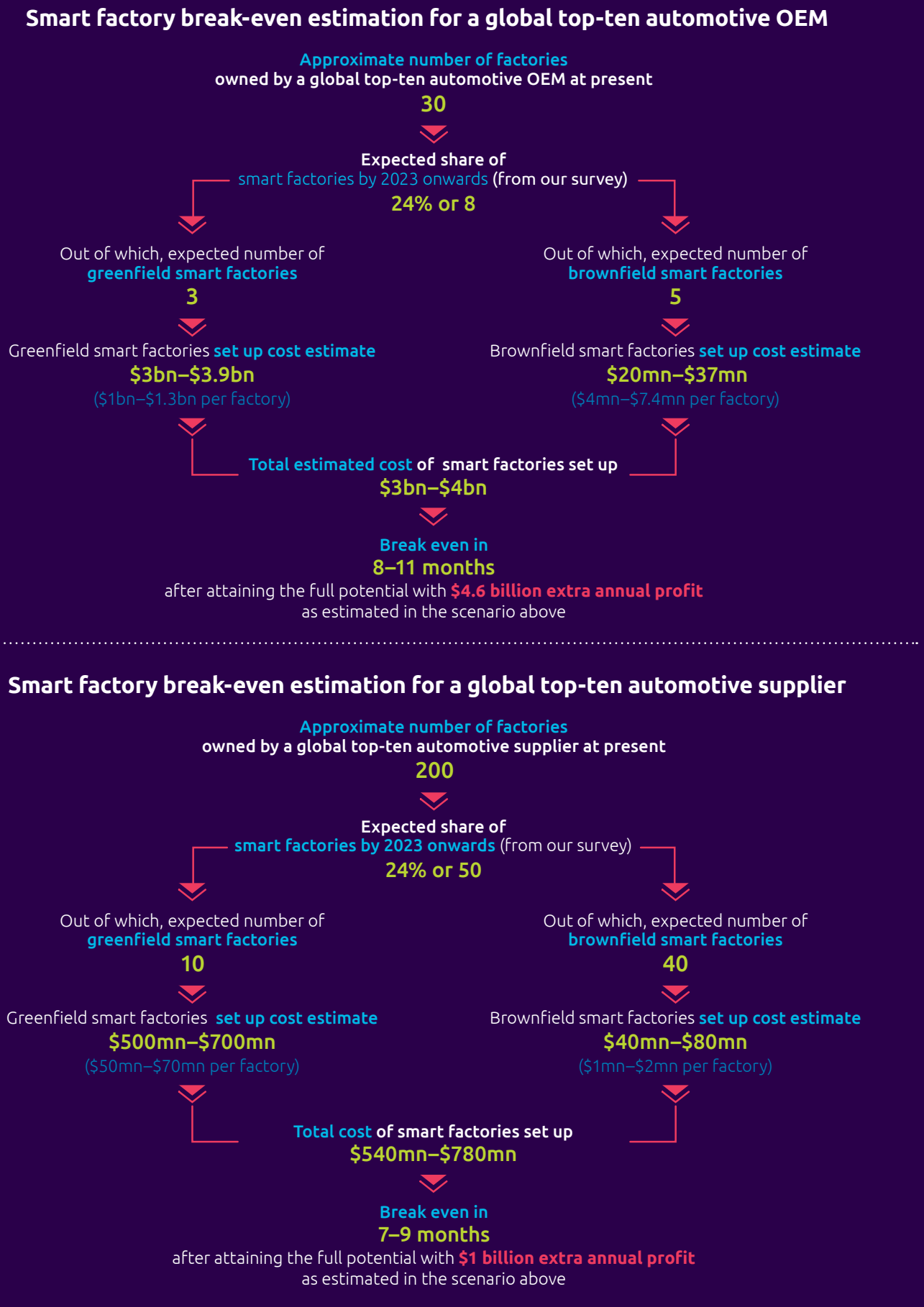
Source: Capgemini Research Institute Smart Factory Survey 2017–18, Capgemini Research Institute analysis.

A top-ten automaker can achieve break-even within a year of reaching the smart factory's full potential

Having calculated the potential upside from smart factories, we are able to estimate how long it will take for a top-ten OEM and supplier to achieve break-even on its smart factories. Our model predicts achieving break-even within a year of the smart factory attaining its full potential, for both OEMs and suppliers (see Figure 3). Refer to the Appendix A at the end of the report for more details.

> **50%**
> boost to the operating profit of an average top-ten automotive manufacturer owing to smart factories

Figure 3. A top-ten auto manufacturer will achieve break-even of its smart factories within a year of attaining its full potential



Source: Capgemini Research Institute Analysis.

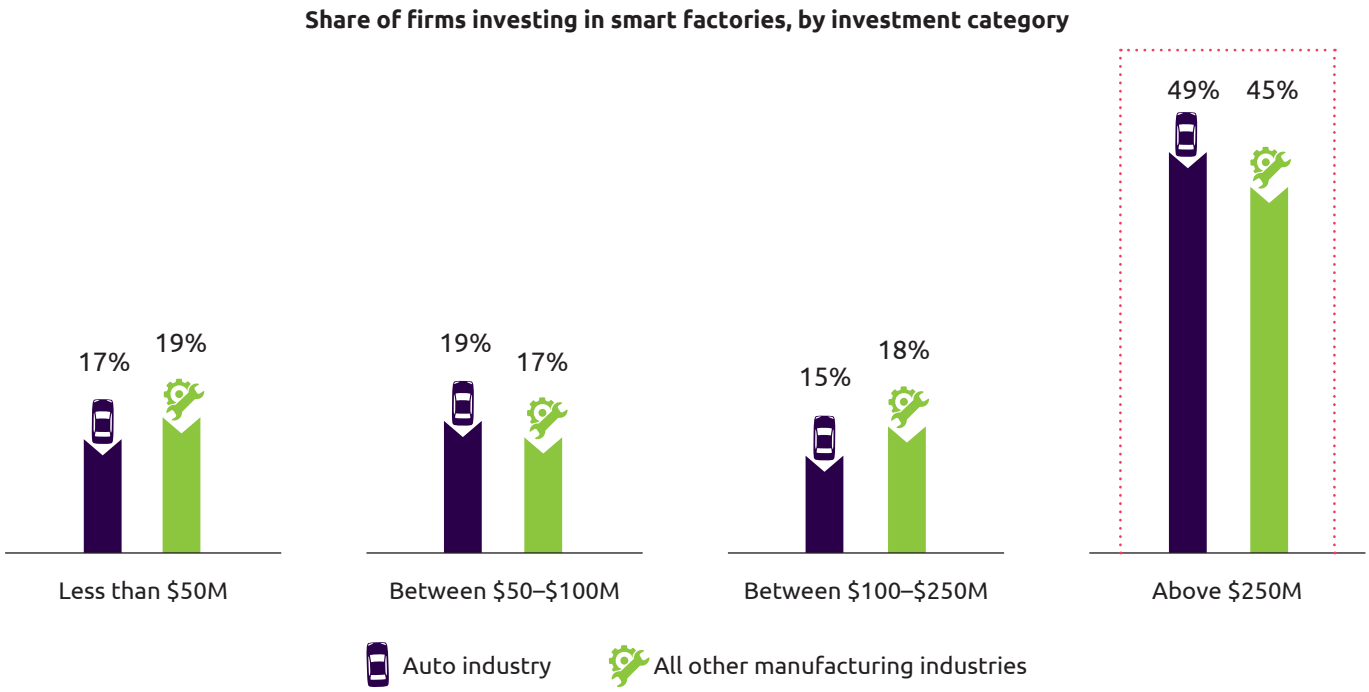
Automotive—the most bullish sector on smart factories

With its eyes on the prize, the auto industry out-invests other sectors

The auto industry has grasped the significant potential of smart factories and has a head start over other sectors in terms of adoption. Nearly half (49%) of automotive organizations have invested $250 million or more in smart factory initiatives over the last five years. As Figure 4 shows, this is more than their peers in other manufacturing industries, where 45% have made similar commitments:

- Audi invested $1.3 billion in building its smart factory in San José Chiapa, Mexico.[4] The plant is at the cutting edge of digital manufacturing capabilities – employing centralized production control, smart logistics, and an electronic quality process – leading to very high productivity and efficiency levels.
- BMW is investing $1 billion in expanding one of its most flexible and automated plants located in Spartanburg, South Carolina, USA.[5] The plant, which is also BMW's largest production facility in world, started leveraging collaborative robots as early as 2013.[6] It will further invest a $600 million at the site between 2018 and 2021.[7]
- Faurecia, one of the world's largest automotive parts manufacturers, has multiple smart factories in its stable. Faurecia recently unveiled its $64 million smart factory in Columbus South, Indiana, USA.[8] Faurecia's Caligny smart plant in France is a highly digital, state-of-the-art facility, and has been recognized as an "Industry of future showcase" from the French Industry of Future Alliance.[9]

Figure 4. The automotive industry leads all other industries in its share of firms in the highest investment category.

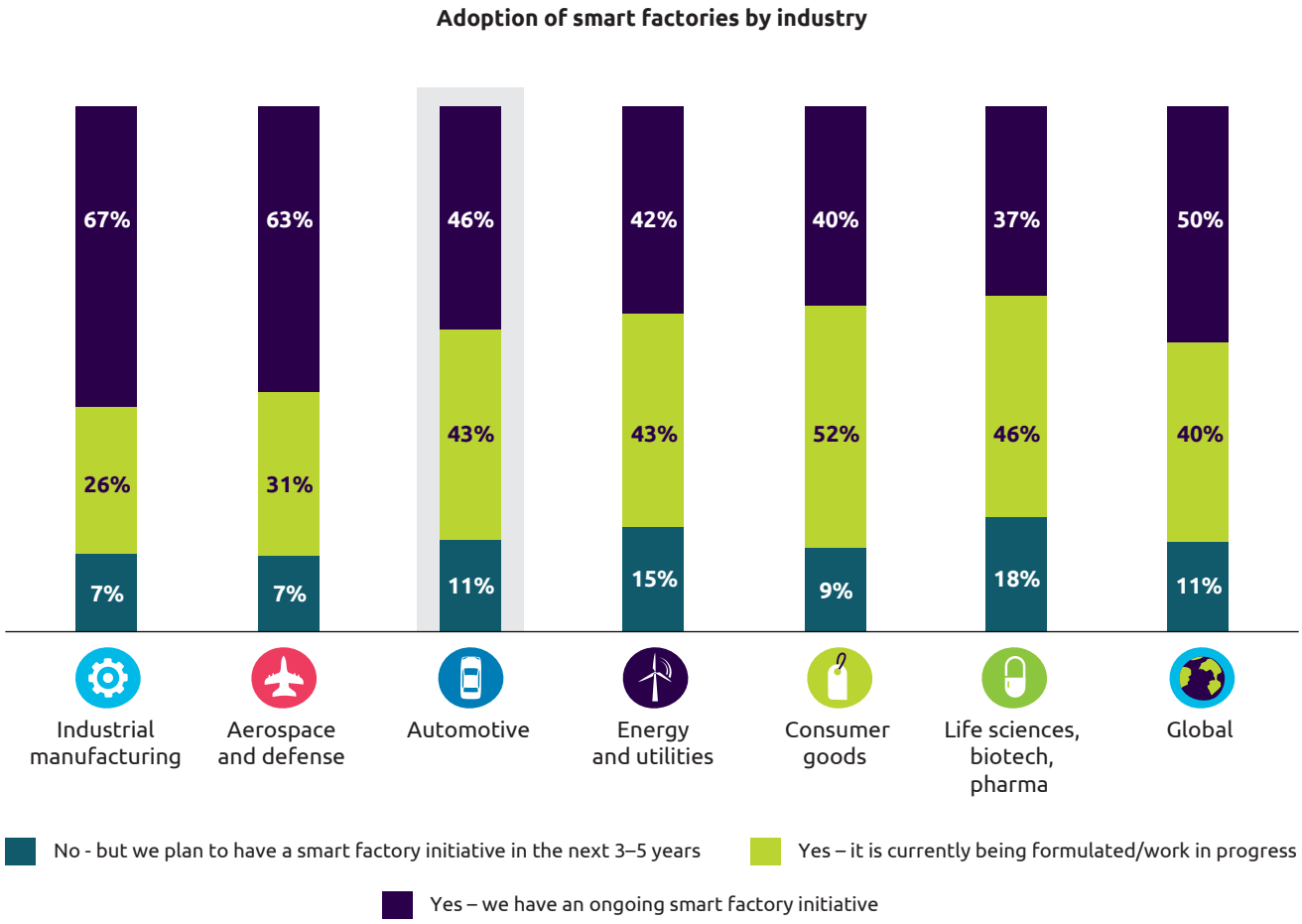


Source: Capgemini Research Institute Smart Factory Survey 2017–18.

Nearly half of auto manufacturers already have a smart factory initiative

The automotive industry is a leading adopter of smart factories – one of the top three sectors across all major manufacturing industries that we surveyed. We found that 46% of automotive companies already have a smart factory initiative. As Figure 5 shows, this puts the sector behind only industrial manufacturing (67%) and aerospace (63%).

Figure 5. The auto industry has taken big strides in kickstarting smart factory initiatives.

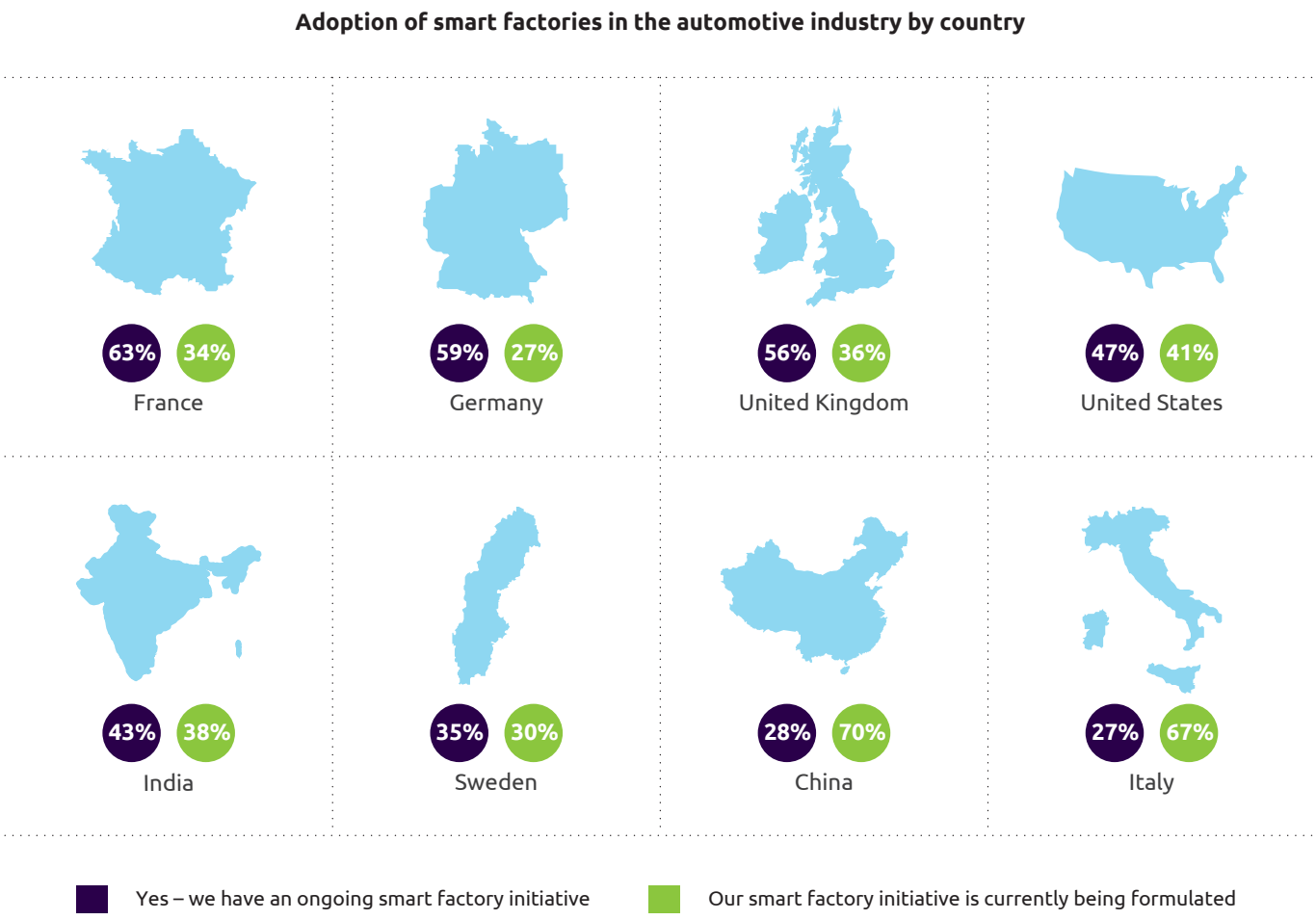


Note: Percentages may not total to 100 due to rounding

Source: Capgemini Research Institute Smart Factory Survey 2017–18.

In France, Germany and the UK, a majority of auto manufacturers (63%, 59%, and 56%) have ongoing smart factory initiatives – a considerable lead over the other countries (see Figure 6). Chinese and Italian automotive manufacturers plan to catch up with the leading countries soon, with around 70% formulating strategy for their smart factory initiatives.

Figure 6. France and Germany lead other countries in adopting smart factories.

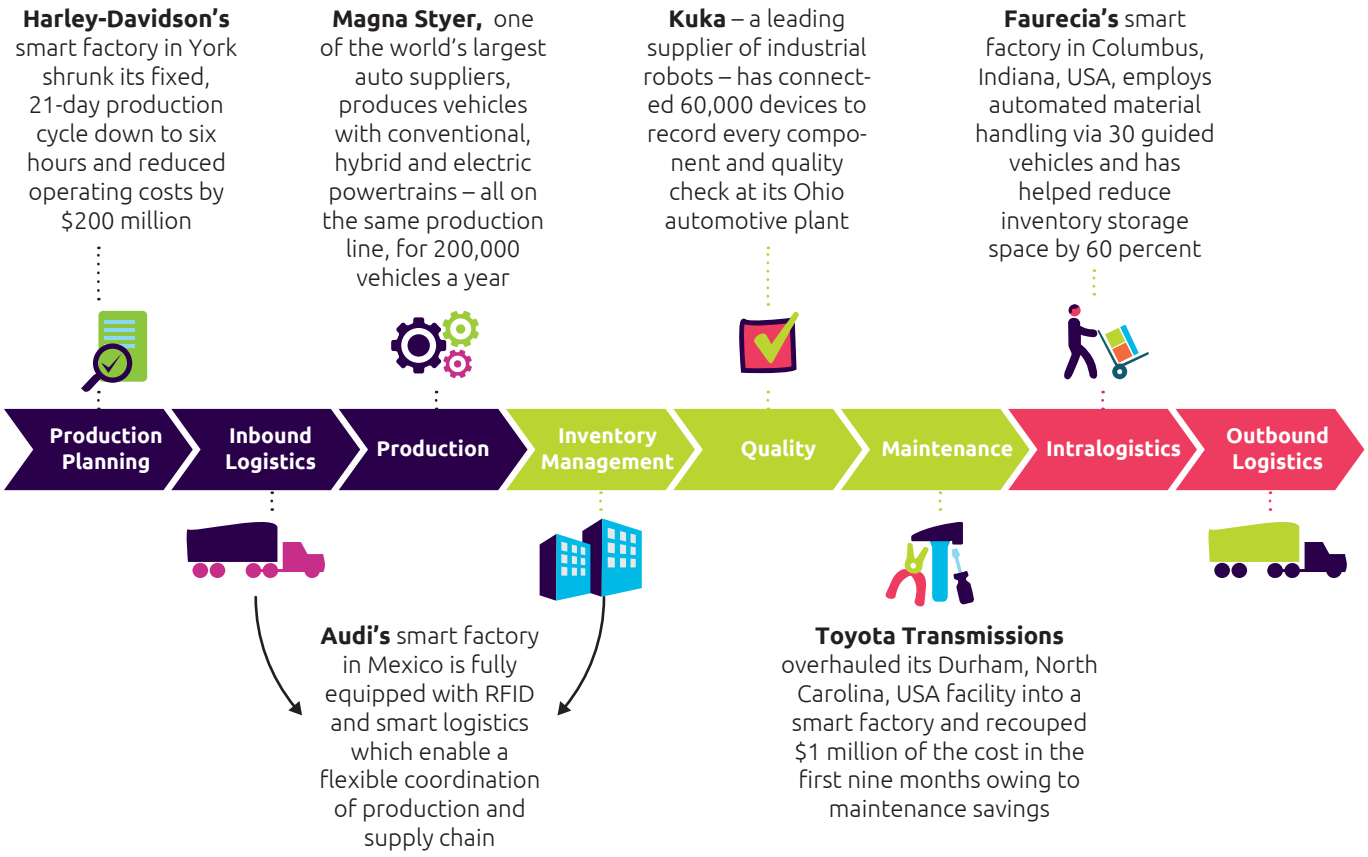


Source: Capgemini Research Institute Smart Factory Survey 2017–18.

> **63%**
> share of automotive firms in France who have a smart factory initiative—the most among all countries

Smart factories have the potential to transform the entire value chain of the automotive manufacturing, and leading auto manufacturers around the world have already benefited from transforming crucial stages of their manufacturing value chain (see Figure 7).

Figure 7. Automotive manufacturers around the world have embraced smart factories to transform every element of manufacturing value chain.

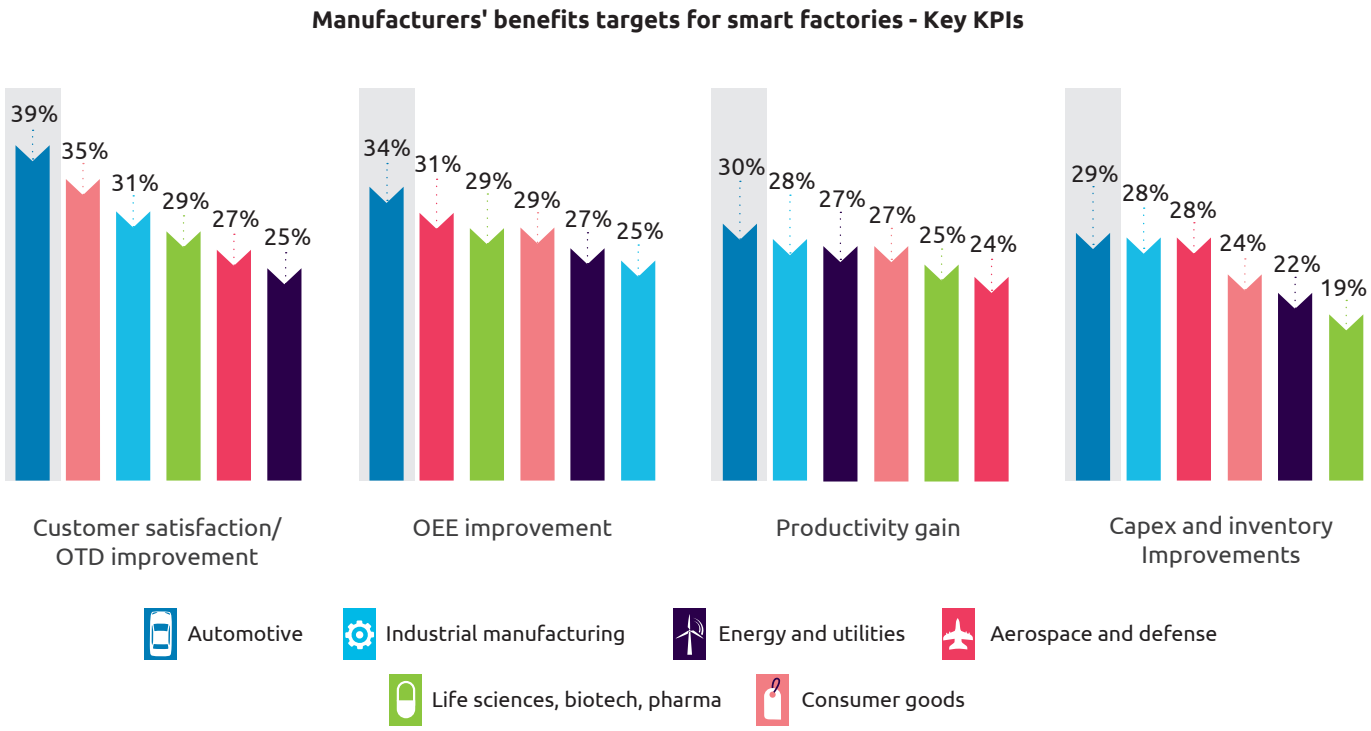


Source: Company websites and press releases.

Automotive manufacturers have set more aggressive targets for smart factories than other sectors

The auto industry sets more ambitious KPIs than all other manufacturing industries (see Figure 8). For example, Audi's smart factory in Mexico was inaugurated in 2016 with a target production capacity of 150,000 cars annually.[10] It achieved this target in 2017 – its first full year of operation.[11] Plant Head - Quality at one of the world's largest farm automobiles and equipment manufacturers outlines how ambitious targets are established from the beginning of initiatives. *"Right from the outset of our transformation, we had very high expectations and targets for our smart factories, and we're glad to have achieved them,"* he says. *"Right first time and defect reduction through digital means have helped drastically improve quality – to the extent of 50-60%. Upgrading our plants to smart factories has grown their productivity by 40% overall while inventory has reduced by up to 35%."*

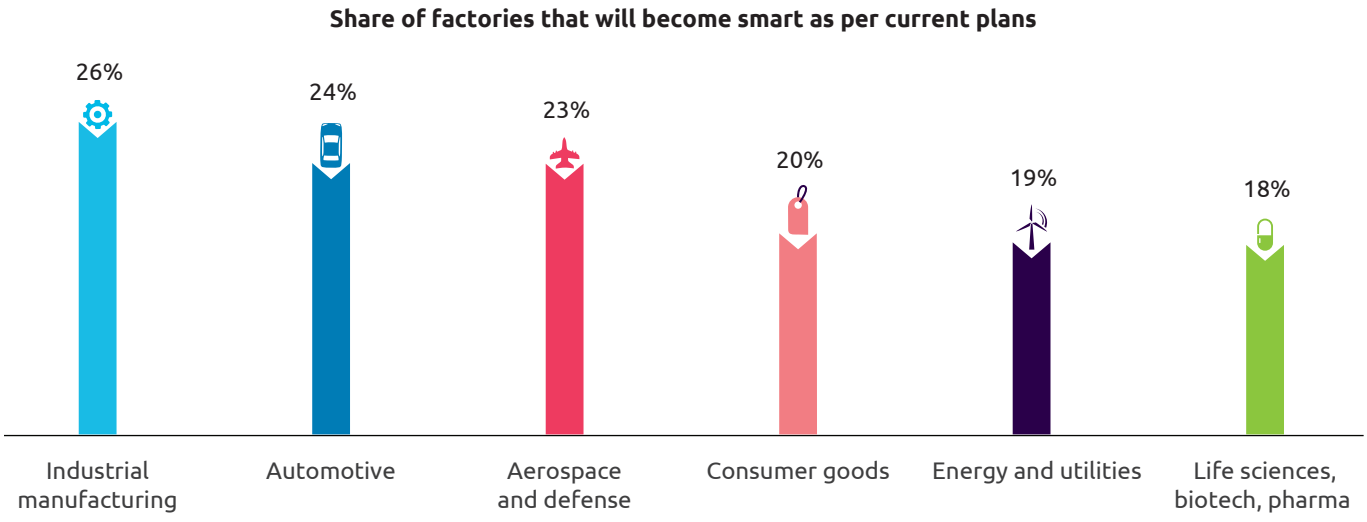
Figure 8. The auto industries' targets for smart factories are more aggressive than all other industries.



Source: Capgemini Research Institute Smart Factory Survey 2017–18.

As Figure 9 shows, the industry also plans to make about a quarter of its production facilities smart by 2023. This is more than most other manufacturing sectors.

Figure 9. The auto industry plans to make about a quarter of its production facilities smart.



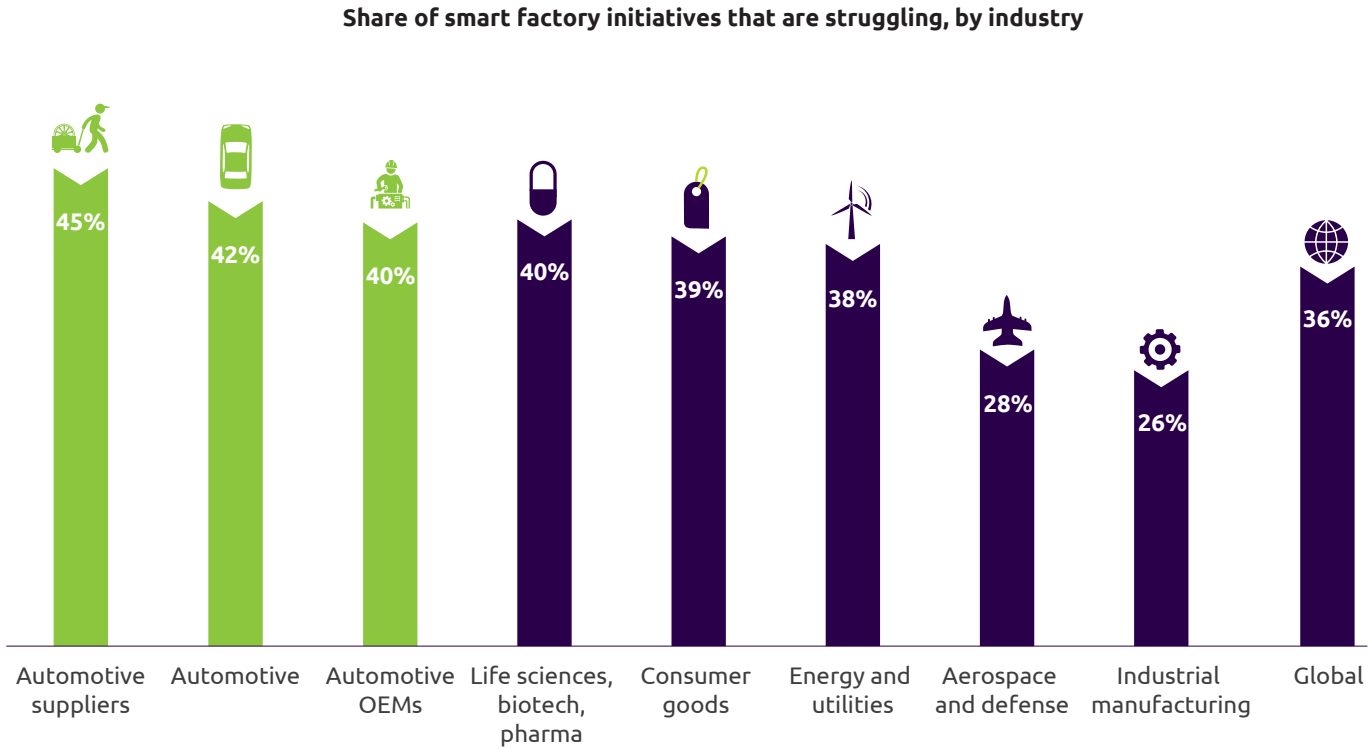
Source: Capgemini Research Institute Smart Factory Survey 2017–18.

Few auto manufacturers have translated their enthusiasm into real progress

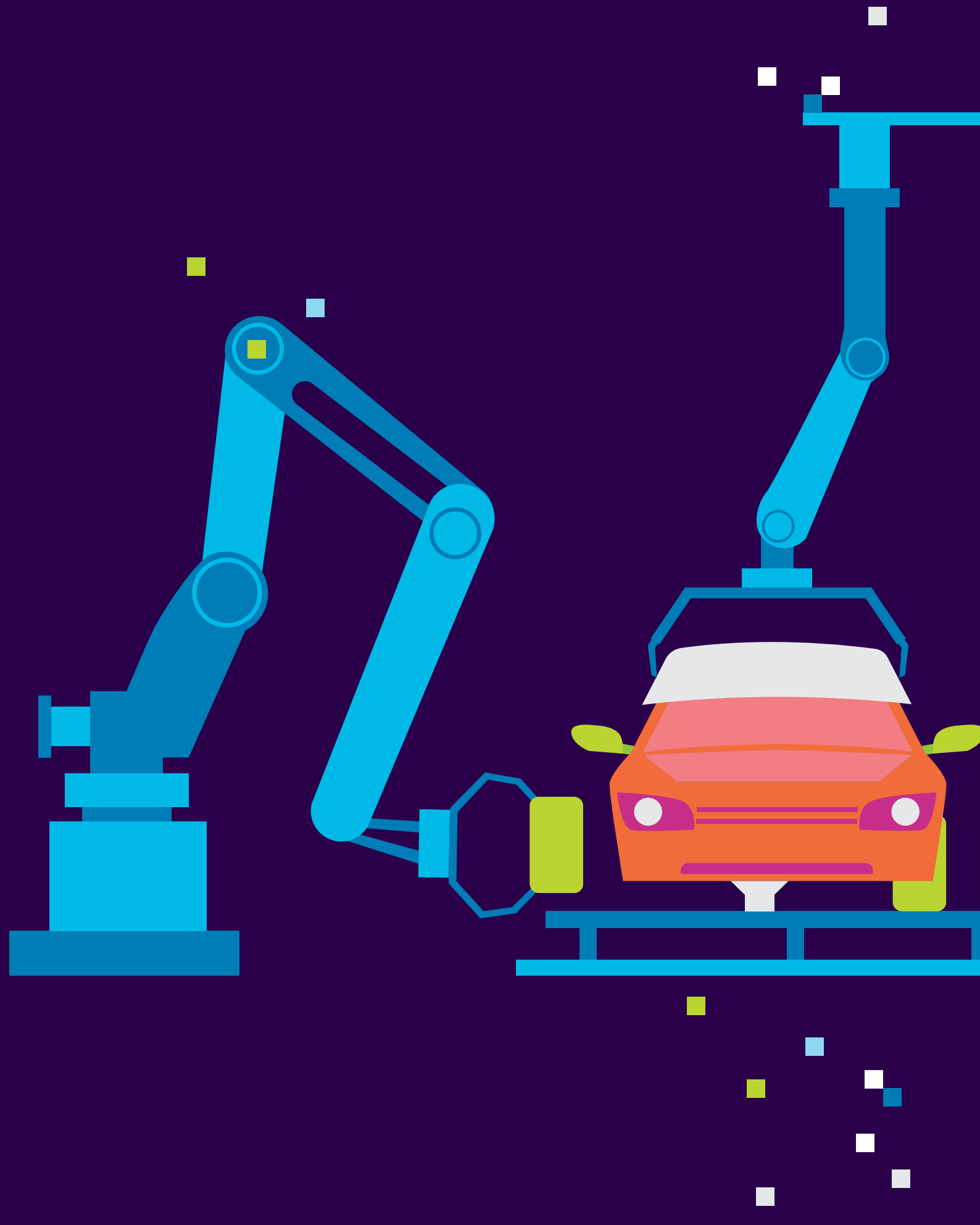
Automotive smart factory initiatives are struggling

Many automotive manufacturers accept that they are not on track to realize the full potential of smart factories. When we asked survey respondents to evaluate their smart factory initiatives, 42% said they were struggling. This is the highest across all the manufacturing sectors that we studied during our previous research last year (see Figure 10). Nearly half (45%) of suppliers' and 40% of OEMs' smart factory initiatives are struggling.

Figure 10. The automotive industry has the highest share of struggling smart factory initiatives.

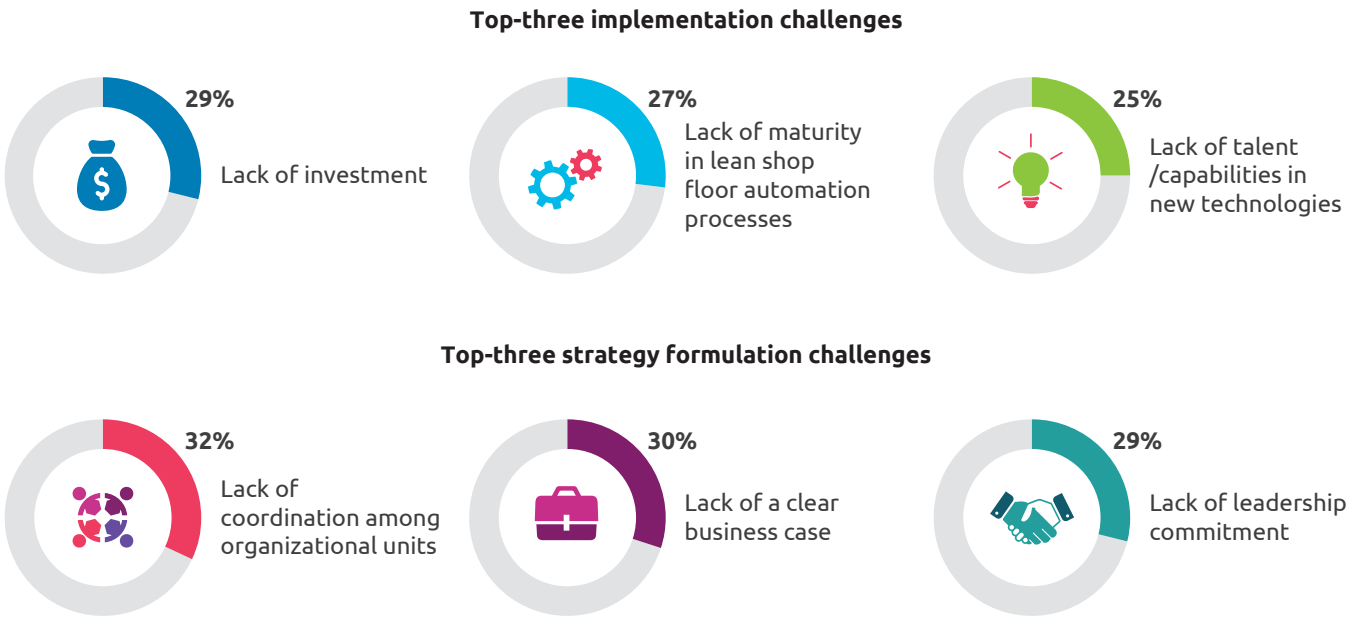


Source: Capgemini Research Institute Smart Factory Survey 2017–18.



This gap between the industry's enthusiasm and its lack of progress could reflect the industry's high expectations for its smart factory initiatives (see page 13). We also looked at some of the specific challenges they face at different stages, from strategy to implementation (see Figure 11). At the strategy stage, lack of coordination is the key barrier. At the implementation stage, it is lack of investment.

Figure 11. Lack of coordination, business case and investments are the most-cited challenges in smart factory adoption.



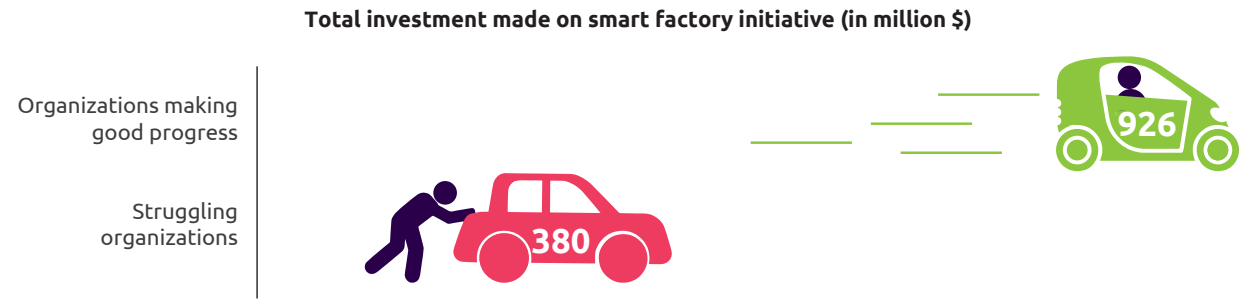
Source: Capgemini Research Institute Smart Factory Survey 2017–18.

Laggards can learn from their peers

A closer look at the initiatives of those who are making progress and those who are struggling reveals a few intriguing differences:

- Companies that are making good progress invest 2.5 times more than the companies that are struggling (see Figure 12). This could reflect the fact that struggling companies lack a compelling and strong vision. Only 34% of struggling companies agree with the disruptive power of smart factories compared to 55% of those who are making good progress. For Dr. Gunter Beitinger, vice president of manufacturing at Siemens Digital Factory, a strong vision is critical: *"One common reason why some companies struggle in their smart- factory initiative is that their vision of smart factory is more technology oriented than business oriented,"* he says. *"Those companies also often underestimate the effort and investment required to achieve their smart factory vision."*

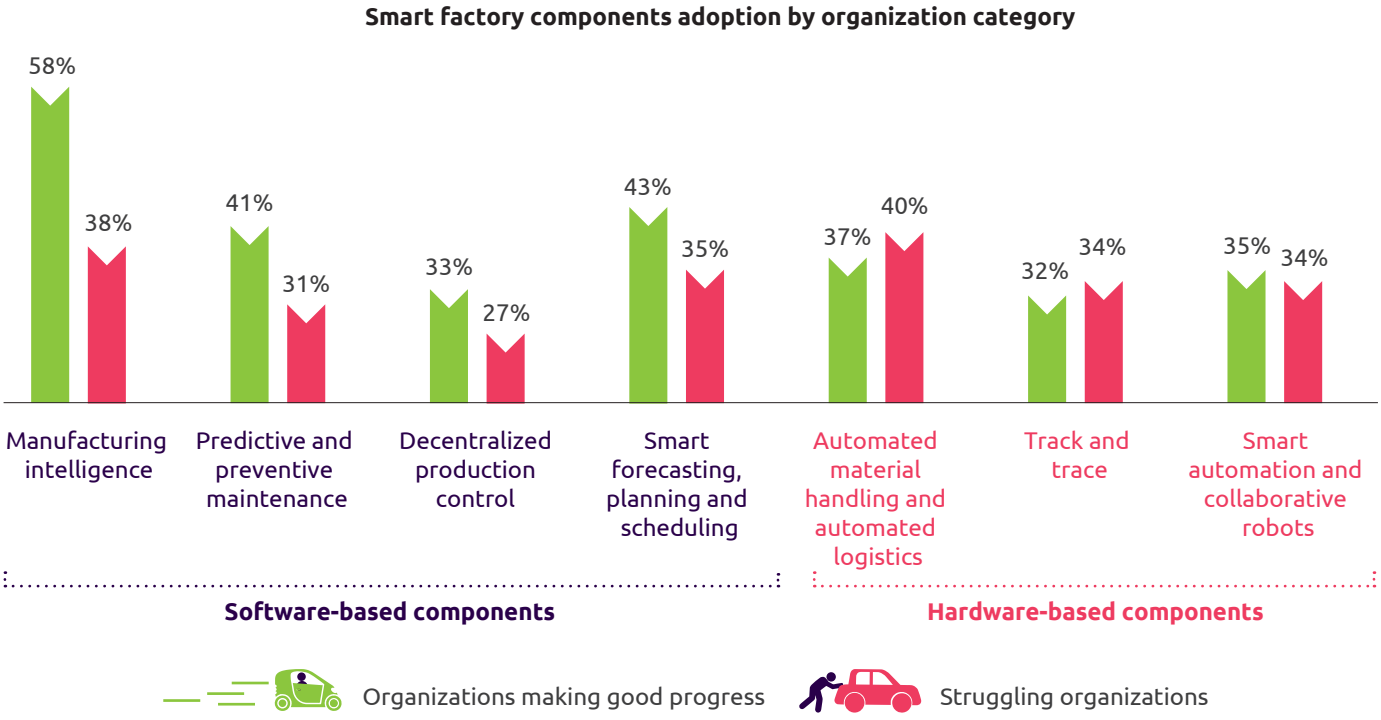
Figure 12. Auto manufacturers making good progress on smart factories invest 2.5 times more than strugglers.



Source: Capgemini Research Institute Smart Factory Survey 2017–18.

- Those making good progress are also leveraging software-driven components that better prepare the organization for the future. These include advanced analytics and AI-based components, such as predictive and preventive maintenance. As Figure 13 shows, the struggling manufacturers are putting more focus on hardware-based components and are lagging on the software-based ones.

Figure 13. Auto manufacturers making good progress on smart factories have been building up their software as well as hardware prowess.



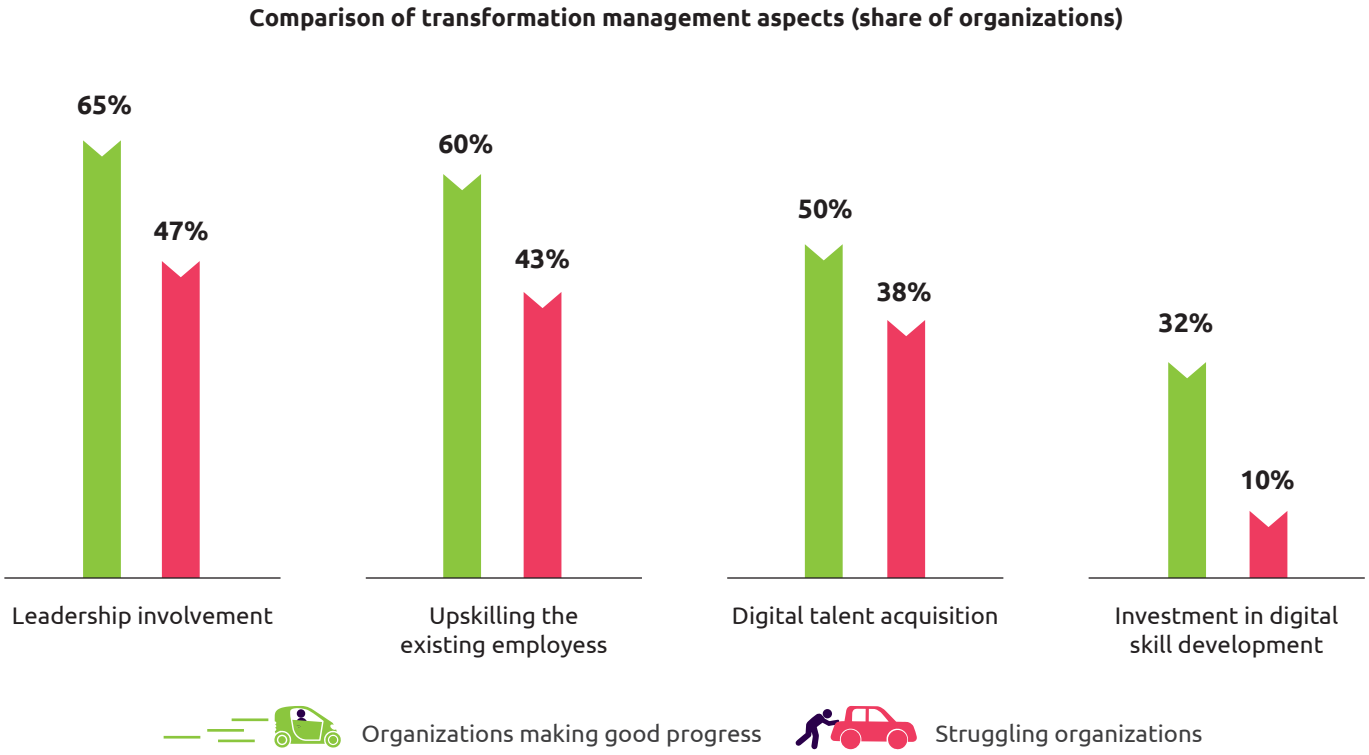
Software-based components involve extensive levels of data collection, processing, and analysis enabled by sophisticated software capabilities such as predictive analytics and artificial intelligence.

Hardware-based components involve incremental upgrades to mechanical systems or automation of manual processes using hardware technologies such as automated material handling, and track tracking and trace. Although these components require some amount of data collection, the amount of processing and analysis needed is not very sophisticated or complex.

Source: Capgemini Research Institute Smart Factory Survey 2017–18.

- Organizations making good progress are also managing their transformation better from a people and leadership standpoint. As Figure 14 shows, high-performing organizations are investing in building digital skills through acquisition and talent development while also keeping leadership involved in smart factory initiatives.

Figure 14. Organizations making good progress on smart factories are managing their transformation better from a peoples' viewpoint.



Source: Capgemini Research Institute Smart Factory Survey 2017–18.

65% vs. 47%
Share of firms with leadership involvement in smart factories among companies making good progress on smart factories vs. struggling organizations

Automotive OEMs outperform suppliers in smart factory adoption

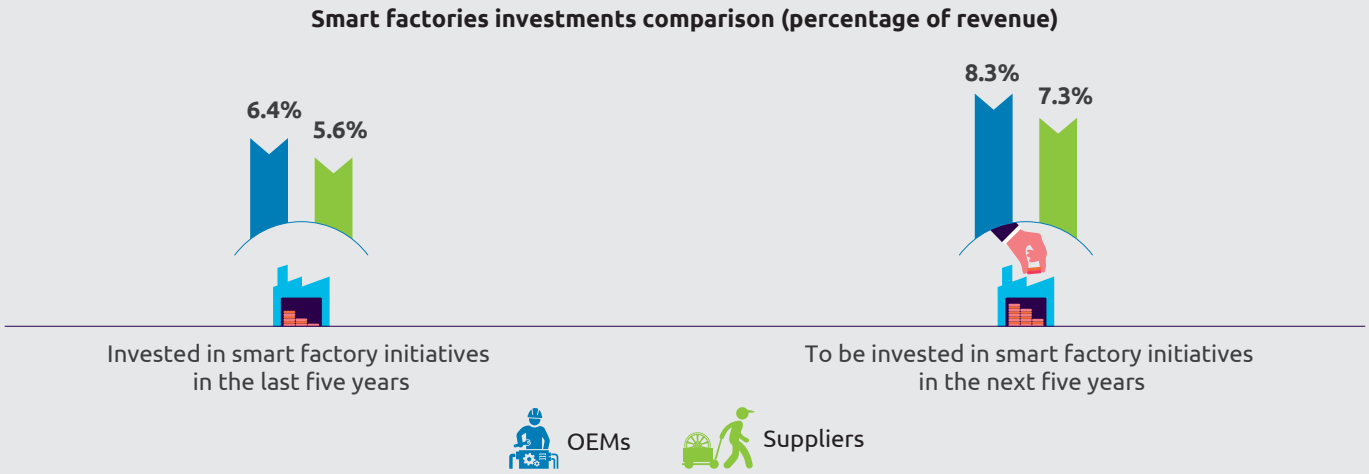
It's OEMs that are setting the pace in the auto industry when it comes to smart factory adoption. Nearly half (46%) have been successful in their smart factory initiatives, compared to less than a third of suppliers (32%). The share of suppliers that are struggling (45%) in their smart factory initiatives also exceeds that of their OEM counterparts (40%). If this trend continues for a few years, it could lead to a rift between the suppliers and OEMs, jeopardizing potential benefits to the industry as a whole.

Distribution of firms making good progress on smart factories vs. struggling ones, by sub-sector

Source: Capgemini Research Institute Smart Factory Survey 2017–18.

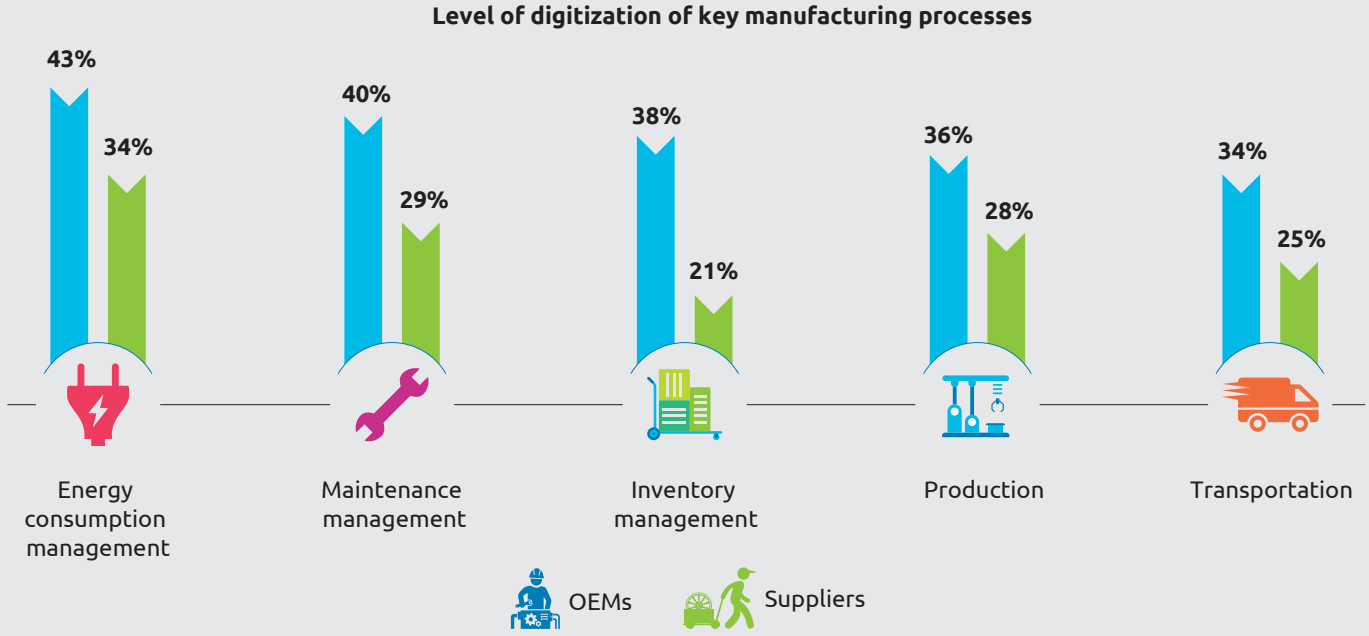
OEMs' greater success is thanks in part to large investments. OEMs have invested more in smart factory initiatives and plan to invest more over the next five years. Given that the OEMs have much larger average revenues, the quantum of investments they have been making and plan to make in smart factories far outstrips that of suppliers.

> **42% vs. 32%**
> share of OEMs who are making good progress on smart factories vs. share of their suppliers counterparts



Source: Capgemini Research Institute Smart Factory Survey 2017–18.

OEMs also outperform their suppliers in digitization of their key manufacturing processes.



Source: Capgemini Research Institute Smart Factory Survey 2017–18.

If suppliers fall behind in their smart factory projects, the entire industry will feel the shortfall. For example, if suppliers fail to use smart factories to drive quality, the OEMs will have to compensate by increasing parts' inspections. This would mean diverting resources and investment that could have been used to improve output at their own smart factory.

Leading OEMs and suppliers realize this and adopt a collaborative approach to mitigate this sort of impact. Hyundai, for instance, has helped 1,450 small and mid-sized firms turn their factories into smart factories through financial support totaling 30.4 billion Won over seven years.[12]

Volvo Group has established a pilot plant in Umeå which offers a pre-commercial production system that can produce new high-tech products in small volumes. In this pilot plant, they aim to bring together university talent and suppliers to share knowledge and address the new skills needed.[13]

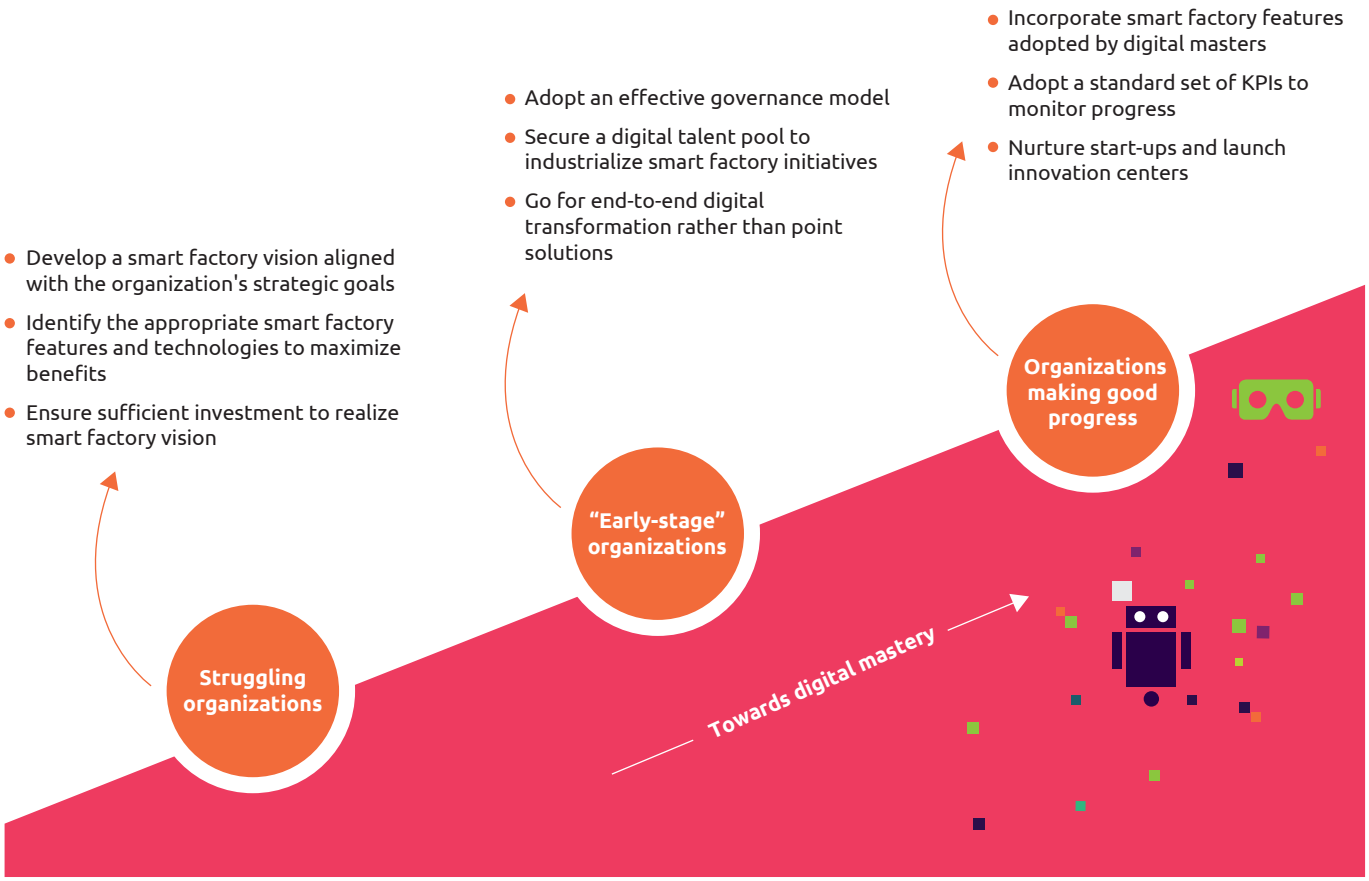
The smart factory success formula

As we saw in our previous study on smart factories,[14] it is the digital maturity[15] of manufacturers that holds the key to achieving full potential. In this study, manufacturers fell into three categories:

1. Struggling
2. Early stage
3. Making good progress.

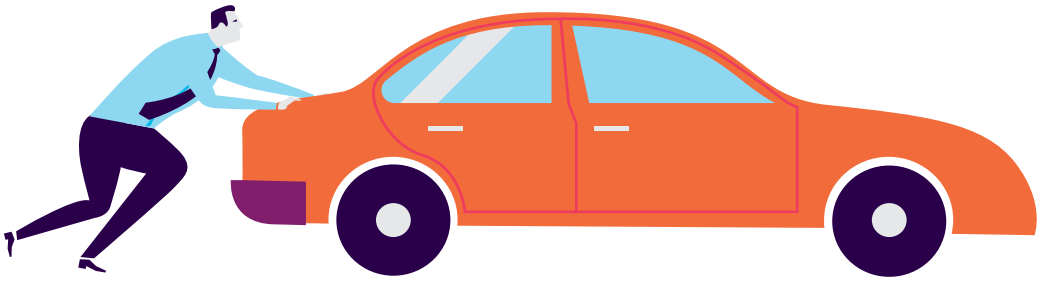
Below, we explore how each of the three categories can graduate to become "digital masters."[15] By "masters," we mean organizations that have digitally mature manufacturing operations and that consistently achieve greater operational gains and financial benefits (see Figure 15).

Figure 15. Auto manufacturers' road to digital mastery.



Source: Capgemini Research Institute Analysis.

1. Strugglers need a clear vision, strong investment, and a focus on the features utilized by digital masters



Develop a smart factory vision aligned with the organization's strategic goals

Lack of vision is significant. About two-third of "struggling" organizations admit that they do not have a clear vision for their smart factories. This means they underestimate key elements, such as the disruptive power of smart factories or the continuous investment required.

The most effective way to develop a clear vision is to tie it to the strategic goals of the organization. For instance, Faurecia, a leading global automotive supplier, has identified five strategic initiatives – paperless shop floors, machine intelligence, enhanced automation, improved traceability, and logistic optimization – to develop their vision of smart factory.[16]

Identify the appropriate smart factory features and digital technologies to maximize the smart factory benefits

In addition to lack of vision, struggling companies often fail to identify the smart factory features and technologies used by digital masters.

For example, manufacturing analytics and predictive maintenance are two of the most crucial features of smart factories, helping improve quality, cost, and productivity performance. Our survey finds that more than 80% of digital masters leverage manufacturing analytics, and about two-thirds implement predictive maintenance. However, only about 30% of the struggling companies say that they would implement predictive maintenance, and less than 40% say the same for manufacturing analytics.

Roadmap definition and business case analysis are effective means of identifying the appropriate features and technologies.

Ensure sufficient investment to realize the smart factory vision

Struggling organizations need to ensure that their smart factory initiatives are not suffering from lack of investment. Digital masters have invested more than $1 billion on average over the last five years, compared to the average $380 million investments made by struggling organizations.

As we saw earlier in this section, this investment gap between digital masters and struggling companies can be traced to the lack of clarity over a vision and a failure to find compelling business cases.

Grégoire Ferré, chief digital officer at Faurecia, outlines how using a pilot project can demonstrate potential value-add. *"Initially, we had funding from the Group to build the core elements and standards as well as to launch pilot programs to demonstrate the values of the initiatives,"* he explains. *"Once the value is demonstrated by pilot projects, then the plants, the business units, and the users pay for what they would like to implement."*[17]

2. Early stagers need to focus on governance and talent

Adopt an effective governance model by appointing a leader and forming a decision-making committee

Auto manufacturers that are at an early stage of their smart factory initiative are doing better on several fronts – such as developing a smart factory vision and identifying crucial smart factory features – than the companies that are struggling.

However, governance is one area where they need to significantly improve. Effective governance starts with appointing a leader as well as forming a committee to guide decision-making and to prioritize actions. As a senior vice president at one of the largest global automotive manufacturers told us: *"You have to nominate one person for the smart factory initiatives. He then has to coordinate with different units of the organization to figure out the next steps and what the best strategy would be."*

From our survey data, we found that almost 100% of digital masters have appointed a leader for their smart factory strategy and formed a decision-making committee. However, more than half of the automotive companies with early stage smart factory projects are yet to do the same.

Build a talent pool to industrialize smart factory initiatives

Success for early stage companies depends largely on how effectively they can scale up their initiatives from pilot runs to industrial level. Scaling up requires employees with digital skills.

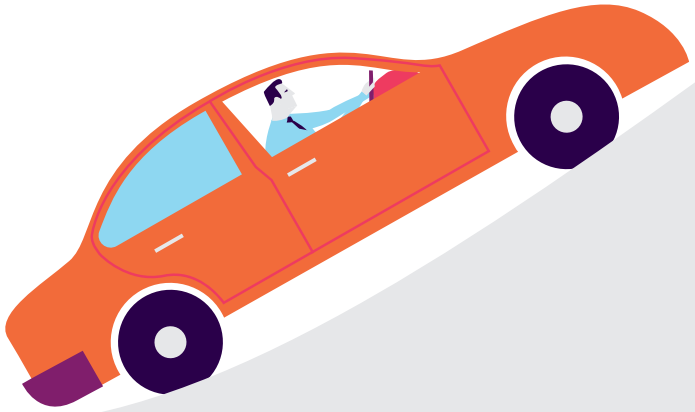
Our survey data tells us that a lack of digital skills can become a major hindrance. Fewer than 20% of early-stage companies believe that they have adequate skills in areas such as cyber-physical systems and data and analytics. But 50% of digital masters do.

Our study also reveals that the majority (about 60%) of the early stagers depend on upskilling their existing talent pool. While this is important to develop employees, fresh blood is also critical for what are very specialized areas. Our survey shows that almost every digital master uses both external hiring as well as upskilling.

Go for end-to-end digital transformation rather than point solutions

Early-stage organizations are more likely to go for point technology solutions, such as collaborative-robots and smart displays, than end-to-end transformation of manufacturing operations (see Figure 3, earlier). In our survey, 66% of early stagers said that they were implementing point technology solutions, while only 32% respondents opted for end-to-end digital transformation.

However, the full potential of smart factories can only be achieved when all the key areas of manufacturing leverage digital technologies. For instance, the improved productivity provided by cobots might get offset if quality control procedures use out-of-date mechanisms.



3. Organizations making good progress must follow the example of the digital masters

Emulate the key features of digital masters

Companies that are making good progress are more likely to have implemented major capabilities, such as manufacturing analytics and smart forecasting, than companies from the other two categories. However, our survey shows that many are not exploring some features that are commonly implemented by digital masters.

Smart energy consumption and enterprise asset management are two examples. These features, which have been implemented by more than 60% of digital masters, can be crucial to bringing down operation and maintenance costs. However, for organizations making good progress:

- Only 38% have implemented smart energy consumption
- Only 18% have implemented enterprise asset management.

Adopt a standard set of KPIs to monitor progress against business cases

Companies that are making good progress need to ensure that their progress eventually gets translated into the target return on investment (ROI) measures. Careful monitoring is essential.

However, we find that only 56% of the companies making good progress actively track benefits against business cases – a practice followed by 100% of digital masters.

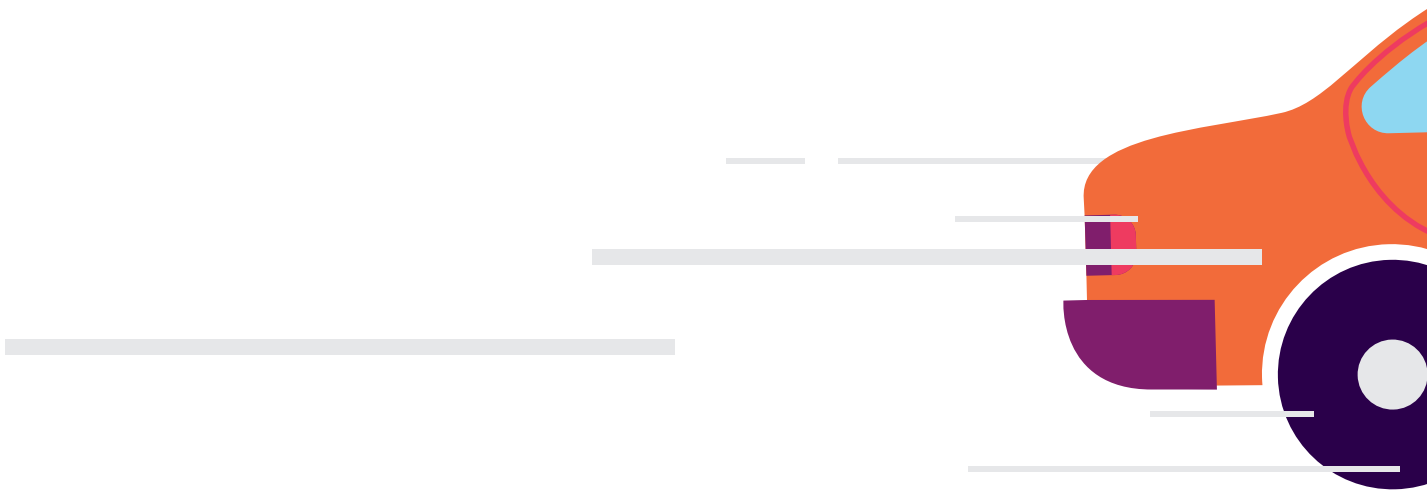
Using a standard set of KPIs is another important factor in monitoring the progress. This is because progress data needs to be interpreted correctly across different organizational units. We found that only about 50% of companies making good progress use a standard set of KPIs – a practice that all digital masters follow.

Nurture start-ups and launch innovation centers

Because of its focus on standardized work procedure, economies of scale, and capital-intensiveness, the traditional automotive manufacturing industry is not always as agile as digital technologies demand. Companies making good progress need to have a platform to pilot digital solutions without disrupting day-to-day operations.

Partnership with start-ups, or launching innovation centers, can help achieve these goals. Emerging digital solutions can be tested in the facilities of start-ups or innovation centers. At the same time, team-members from start-ups and innovation centers can introduce and encourage a more digital first-mindset.

Daimler has opened four innovation centers, called "Lab1886," in four different cities – Berlin, Stuttgart, Beijing, and Sunnyvale. Their objective is to provide employees with a platform to test their ideas and industrialize them quickly.[18]



Conclusion

The auto industry stands to massively boost its productivity through smart factories – a shot in the arm for an industry striving for growth. And the significant investment required for smart factories can be recouped in reasonable time. But even with this clear benefits case, and significant enthusiasm in the industry, success has eluded many. By emulating the habits of the digital masters, and focusing on driving digital maturity, the industry can put itself firmly in the driving seat of the digital industrial revolution.

Appendix A

Smart factory break-even estimation for automotive OEMs and suppliers

A typical automotive OEM in the top-ten category has nearly 30 manufacturing plants globally. Our research shows that nearly 24% of the plants of an auto manufacturer will be smart plants by 2023 onwards. This estimate, coupled with an estimate of the share of smart plants that will be greenfield vs. brownfield, allowed us to predict that three of the smart plants will be established as greenfield while five will be brownfield.

Further, we calculated the approximate investment that goes into setting up a smart factory considering digital components only, which came to $20–37 million. This investment, coupled with the non-digital investment that would be necessary in case of greenfield plants, led us to estimate that the total investment for an OEM in smart plants will be in the range of $3–4 billion. Given the potential upside for a top-ten OEM in operating profit from smart factories is $4.6 billion, it leads us to conclude that the investments in smart factories will be recouped in 8–11 months once the smart factories of the organization are at full potential of operation. For a top-ten supplier, a similar analysis shows that the break-even can be achieved even sooner – in a matter of 7–9 months of achieving the full potential.

Appendix B

Digital maturity matrix of manufacturing operations

We assessed the digital maturity of manufacturing operations in various sectors. We did this by using the digital maturity matrix that we introduced in our previous, cross-industry research published last year. The matrix assesses how far the digitization of manufacturing has progressed (on the digital intensity axis) vis-à-vis how well the transformation is being managed via vision, governance, and skills to drive benefits. See the table below for detailed definitions of these two dimensions.

This assessment segments organizations into four groups, ranging from "beginners" to "digital masters." Our previous research also demonstrated that greater digital maturity yields greater benefits. Those who are classified as "digital masters" outpace all other categories in terms of benefits realized from smart factories.

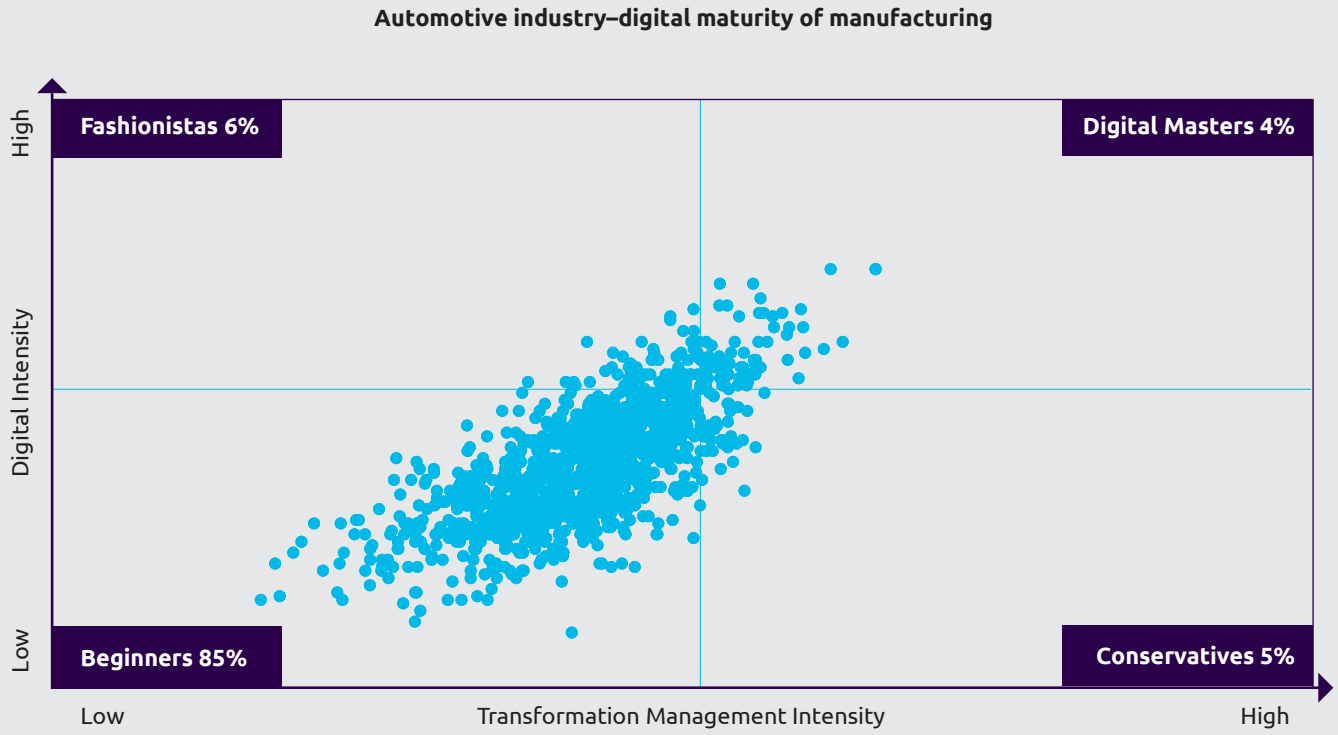
1	
Digital Intensity—the "what"	**Illustration**
How far essential processes (production, inventory, management, quality, planning and forecasting) have been digitized and how much use is made of digital technologies such as robotics, internet of things, artificial intelligence, big data analytics, etc.	Siemens' plant in Amberg, Germany is a highly automated facility, with machines and computer handling 75% of the value chain on their own*. The factory manufactures 12 million products of the Siemens' Simatic product line per year at a quality of 99.99885 percent.

2	
Transformation Management Intensity—the "how"	**Illustration**
How well the transformation is being managed to drive benefits, including key aspects such as the manufacturer's smart factory vision, governance, and the digital skills of its workforce.	Grégoire Ferré, Chief Digital Officer, Faurecia: *"Our digital transformation program runs in parallel across five streams—Operations, R&D, Sales & Programs, HR & Communications and Purchasing. This ensures that key processes supporting smart plans are developing together and benefitting from each other. In the initial phase of transformation, we identified areas that needed digitization and launched a number of pilots. In the current phase, we are digitizing and industrializing the tools developed earlier. These will become standards that will drive future stages of transformation".*

*Siemens, "Digital Factory – Defects: A Vanishing Species", October 2014

Our research shows that 85% of automotive players are digital beginners, and only 4% are digital masters (see figure below).

Figure. Large differences exist in the digital maturity of different automotive manufacturer categories.



Source: Capgemini Research Institute Smart Factory Survey 2017–18, Capgemini Research Institute Analysis.

Digital Maturity Framework adapted from: Andrew McAfee, Didier Bonnet, and George Westerman, "Leading Digital: Turning Technology into Business Transformation," 2014.

> Only **4%** of automotive manufacturers are digital masters

Digital Masters Outperform Other Categories in Reaping Financial Benefits

In our previous research on smart factories, we demonstrated that digital masters will realize greater operational benefits than beginners. In this research, we took a step further and analyzed the financial performance of automotive manufacturers belonging to different categories of the digital maturity matrix of manufacturing operations. We found that the operational profit – one of the most crucial financial key performance indicators (KPIs) for an automotive manufacturer – has been the strongest for digital masters (see figure below).

Over the past five years, the compound annual growth rate (CAGR) of operational profits of digital masters is higher than any other category and six percentage points higher than of beginners.

In addition to operational profit, we found that digital masters outperform other categories in terms of share price growth (CAGR) over the last five years.

Figure. Digital masters' financial performance has been stronger than that of their peers in the last five years.

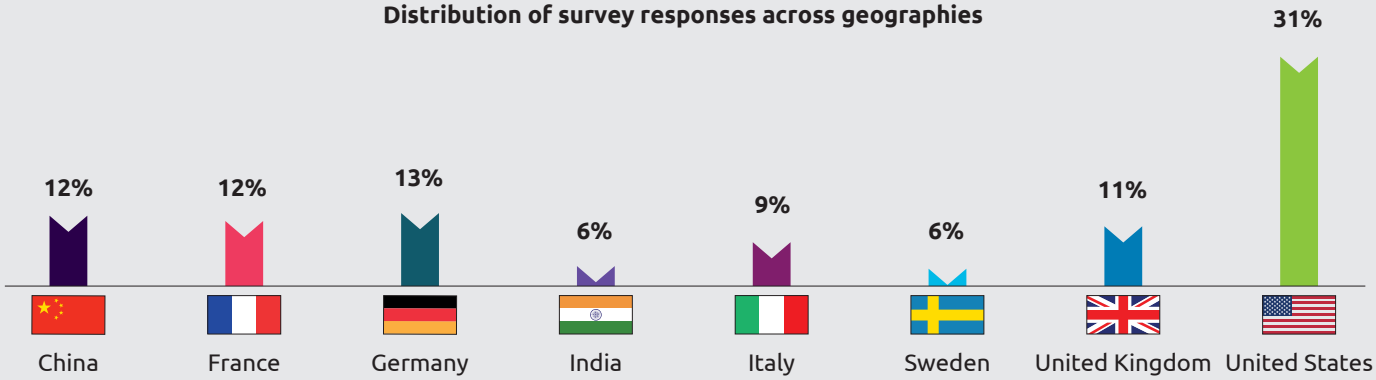
Source: Capgemini Research Institute Smart Factory Survey 2017–18, Capgemini Research Institute Analysis.

Research methodology

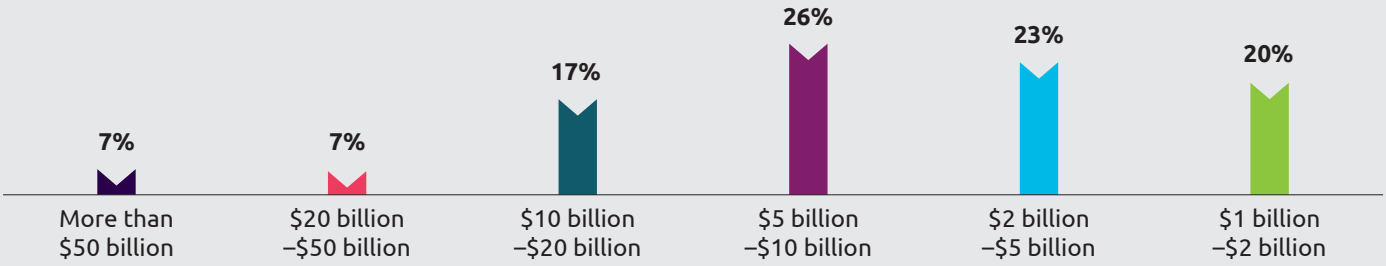
Quantitative survey:

We surveyed 223 automotive executives in 2017 as part of our "Smart Factories: How can manufacturers realize the potential of digital industrial revolution" research. This year, we have surveyed a further 103 executives from automotive industry. These executives were drawn from director-level or above, from a diverse set of functions, and were closely associated with their organizations' smart factory initiative. The survey covered executives from eight countries – China, France, Germany, India, Italy, Sweden, the United Kingdom, and the United States. The survey sample is evenly distributed between OEMs and suppliers, each having $1 billion or more in annual revenues. See the charts below for more details.

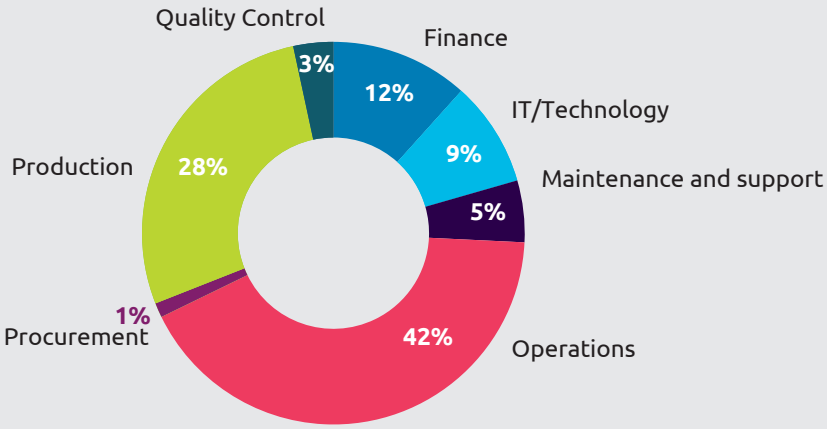
Distribution of survey responses across geographies



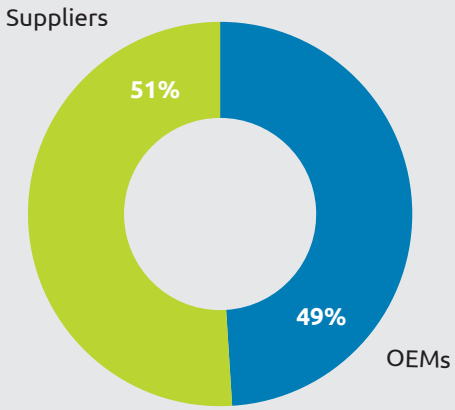
Distribution of survey responses across revenue categories



Distribution of survey responses across job functions



Distribution of survey responses across industry sub-sector



Focus interviews:

In addition to the quantitative survey, we held in-depth discussions with eight senior-level executives from leading automotive companies across the world to understand their organizations' vision, objectives, and approach of smart factory projects.

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15. We measure the digital maturity of manufacturing operations along two dimensions – “digital intensity” or the “what” and “transformation management intensity” or the “how.” The companies that have made good progress along both dimensions are digitally mature and called “digital masters.” Please refer to the Appendix B at the end of the report for more details.
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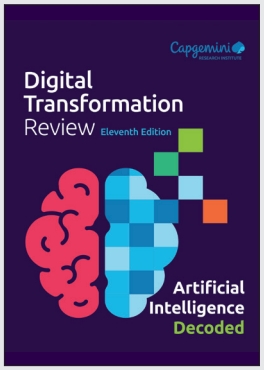

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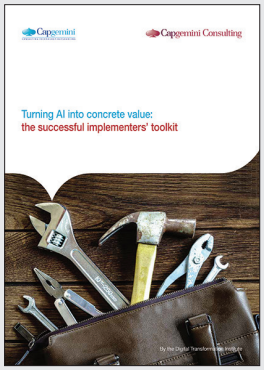

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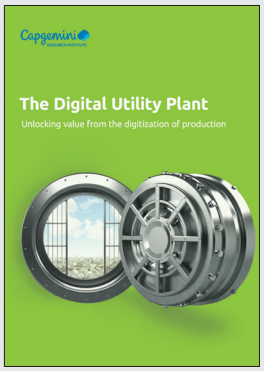

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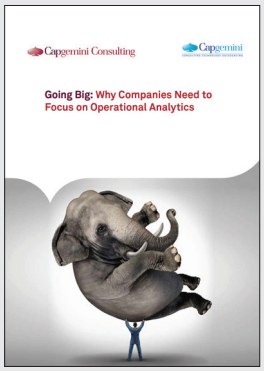

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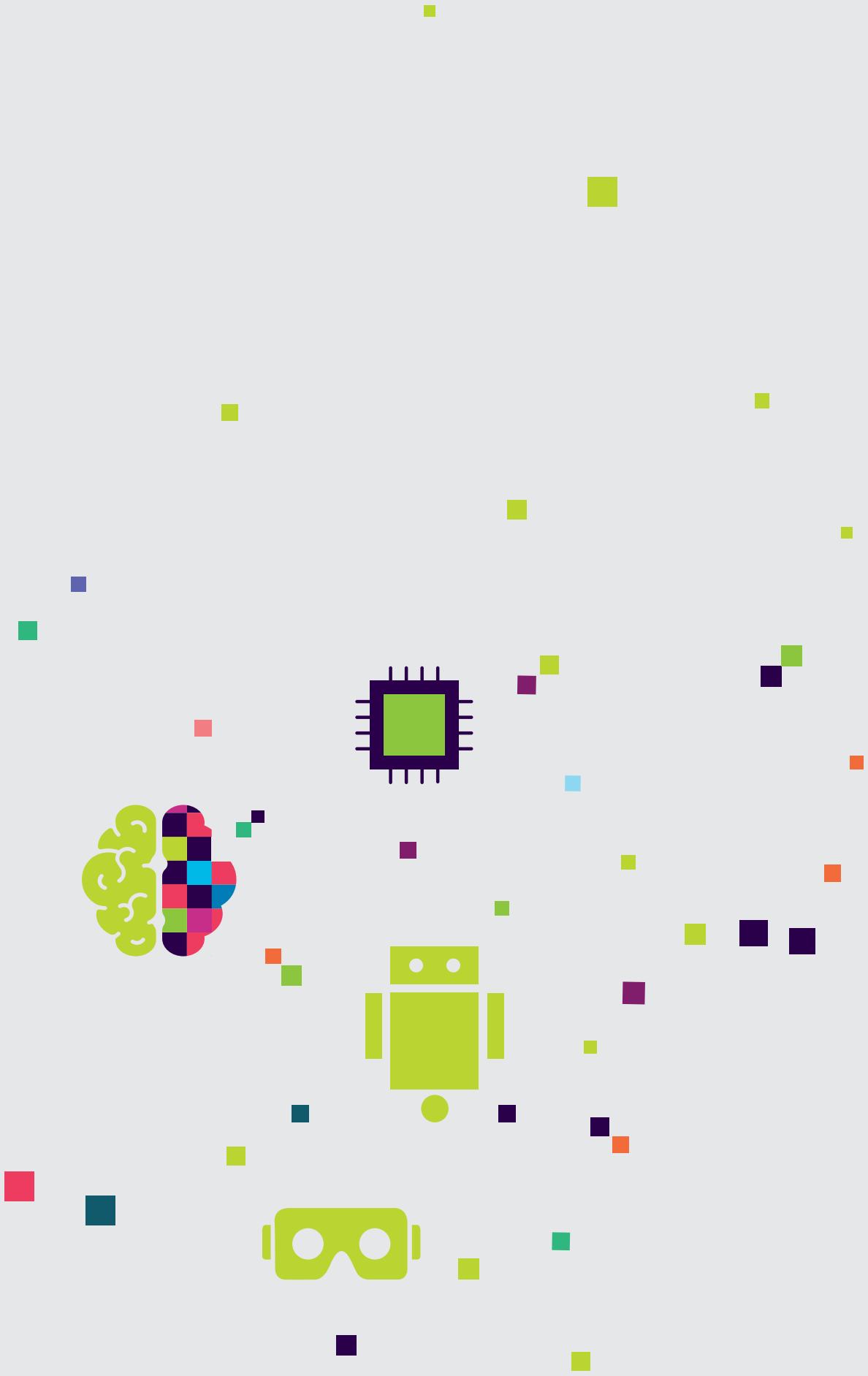

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