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GenAI in Industrial Manufacturing

Turning promise into profitability

VDMA
Software and Digitalization

Co-operation study

Software and Digitalization

The VDMA Software and Digitalization represents the interests of over 500 software manufacturers and reflects digital technologies in Industrial Manufacturing. The Informatics Department and VDMA Software and Digitalization work closely together and are managed as a single unit within the VDMA. The goal of both groups is to promote collaboration between the software industry and mechanical engineering, thereby driving digital transformation forward.

vdma.org/software-digitalisierung
vdma.org/digitalisierung-industrie-40

Additional information

AI landing page
https://www.vdma.org/kuenstliche-intelligenz

Generative AI checklist
https://www.vdma.org/viewer/-/v2article/render/87563195

Online survey “Generative AI”
https://www.vdma.org/viewer/-/v2article/render/89006171

Industry podcast – Risk of knowledge loss (German)
https://www.vdma.org/viewer/-/v2article/render/133665750

AI regulation
https://www.vdma.org/viewer/-/v2article/render/133034968

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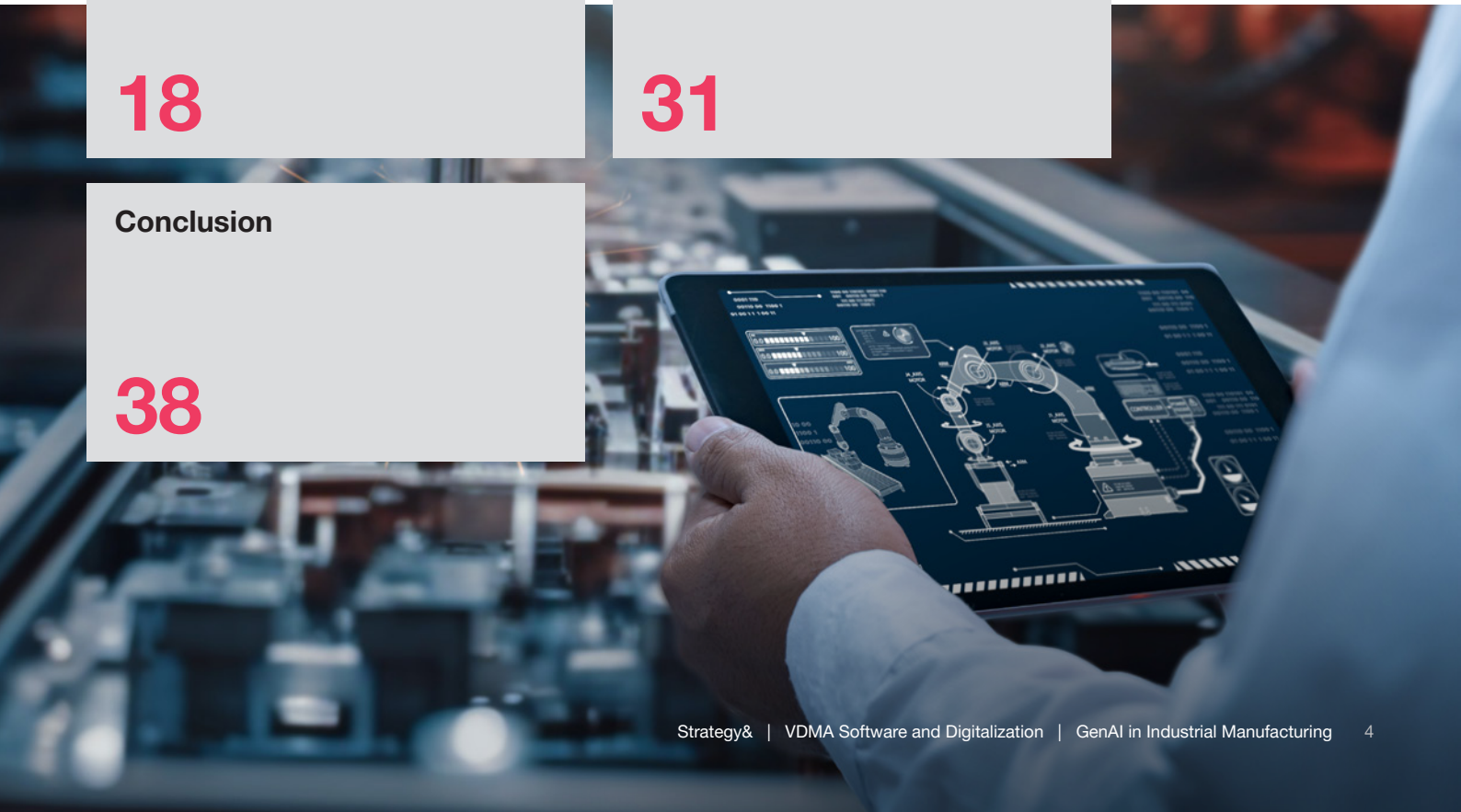


FOREWORD

Generative Artificial Intelligence (GenAI) has established itself as a key catalyst for digital transformation and is increasingly shaping many aspects of our economy. The impact spans across all business functions, fundamentally changing the way we communicate, interact, analyze, and innovate.

In the industrial manufacturing industry, GenAI demonstrates significant potential as a driver of innovation and competitiveness. The range of applications is remarkably broad, from optimizing development processes and recommending actions for predictive maintenance to conducting complex data analyses for strategic decision-making.

The continuous evolution of GenAI-based solutions enables industrial manufacturers to respond more flexibly to market dynamics and strengthen their market position. GenAI is no longer seen merely as a supporting tool but as a critical competitive advantage in an increasingly dynamic industry landscape.

To explore the diverse opportunities GenAI offers for enhancing profitability, VDMA Software and Digitalization and Strategy&, PwC's global strategy consulting business, have combined their expertise. The result is an in-depth study based on the analysis of 45 potential GenAI use cases and insights from a survey of 247 industrial manufacturing companies in Germany, Austrian and Switzerland.

This study examines:

- The transformative potential of GenAI on profitability of companies
- The most promising application scenarios with the greatest impact
- Strategic approaches for successfully integrating GenAI into business processes

The analysis covers key aspects such as the current significance and future development paths of innovative GenAI applications, the evolution of required skill sets, the transformation of the workplace, and the potential for forward-looking business models in the context of a value-driven manufacturing industry.

We hope this study provides you with valuable insights. Leverage these findings to drive the future-oriented integration of GenAI in your company and sustainably enhance your competitiveness and profitability.

VDMA Software and Digitalization and Strategy&

Can GenAI bring IM back on the growth track?

Industrial Manufacturers face the urgent task of increasing their profitability. While costs have risen over the past two decades, opportunities now arise to revive productivity growth and strengthen competitiveness.

- Up to 2010, new technologies and lean manufacturing innovations had delivered two decades of more than 30% productivity growth.
- Since 2010, technologies such as Smart Manufacturing and Industry 4.0 have emerged but have not yet fully realized their impact in the industry. Productivity per employee has barely changed since 2015 and has only risen around 5% since 2010; however, the foundation for further development opportunities in the sector has been laid.
- Despite the productivity stagnation, factor cost has increased by 27%, further challenging the overall margin situation
- The PwC Maschinenbau-Barometer survey from December 2024 shows that 65% of executives are now pessimistic about the development of the German economy in the upcoming months and only 10% optimistic. Generative Artificial Intelligence (GenAI) is seen by 52% as a potential game-changer for the industry to drive this development forward.[1]

1 https://www.pwc.de/de/industrielle-produktion/maschinenbau-barometer.html

- Strategy& has evaluated 45 real-world GenAI use cases in industrial manufacturing, finding that use cases are most potentially valuable in the core processes of the organization (E.g. showing an operating margin uplift potential of 1.7 percentage points in Research & Development and 2.4 percentage points in Sales) – not in the support functions, where they have most commonly been introduced to date.

- All 45 use cases show an operating margin uplift potential of a total of 10.7 percentage points if these GenAI use cases are successfully implemented. This would result in an increase of €28bn in total profit for the manufacturing industry in Germany according to current status.

- To identify the level of implementation, 247 manufacturers from Germany, Austrian and Switzerland have been questioned together with the VDMA Software and Digitalization.

- The results show, that for most manufacturers, the current focus lies on opportunistic use cases in support functions that will not yet deliver the full potential evaluated. These opportunistic use cases will be standard industry-wide and therefore do not have the potential put industrials in a differentiating market position and competitive advantage.

- Companies should assess/categorize whether use cases are ‘game changers’, which have the highest impact because they address a large share of the profit and loss (P&L), ‘must haves’, which have the potential to improve profitability in several areas across the value chain, or ‘hyped’, because the support processes they address account for such a limited share of the P&L.

- Manufacturers should make a strategic choice on the depth of GenAI integration in their own future operating model (incremental business process enhancement vs. business model reinvention).

- Leveraging the collaboration with external partners (e.g. from the VDMA Software and Digitalization member network) and deploying existing language models is the way to reach quick wins, however differentiating GenAI capabilities (e.g. with the proven Strategy& Incubator approach) need to be built to make profitability impact sustainable.

SECTION 1

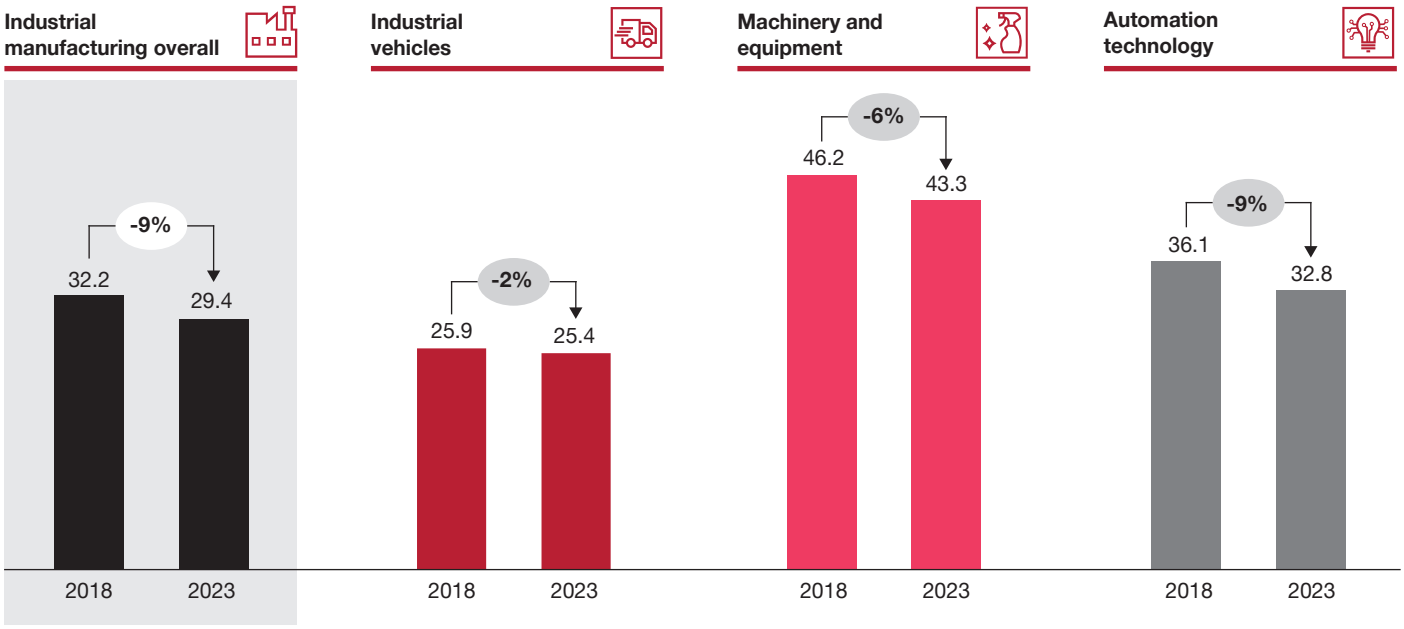
Why is profitability falling?

Over the last five years, gross profit in industrial manucaturing in Germany, Austrian and Switzerland has been falling. At the same time costs have been rising while productivity growth has slowed. This is a malaise that has affected a broad spectrum of industrial manufacturing companies, from Industrial vehicles to machinery and equipment to automation technology (*see Exhibit 1 and 2, next page*).

EXHIBIT 1

Profitability is falling in European industrial manufacturing

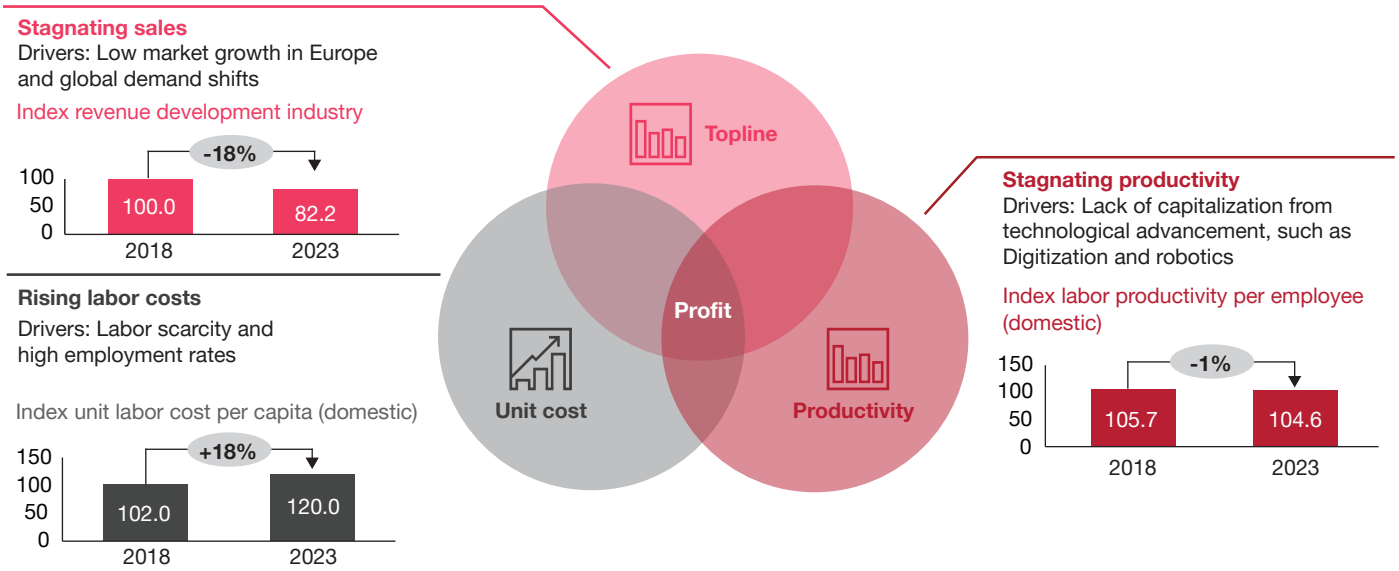
Gross profit development (in % of revenue)



Source: Strategy& analysis of representative industrial manufacturing companies with headquarters in Germany, Austria and Switzerland (n=117, period 2018–2023)

EXHIBIT 2

Main reasons for profit decline



Source: Strategy& analysis of representative industrial manufacturing companies with headquarters in Germany, Austria and Switzerland (n=117, period 2018 -2023), Federal Statistical Office of Germany (Destatis), as of: 13.08.2024 (Index: 2018 = 100)

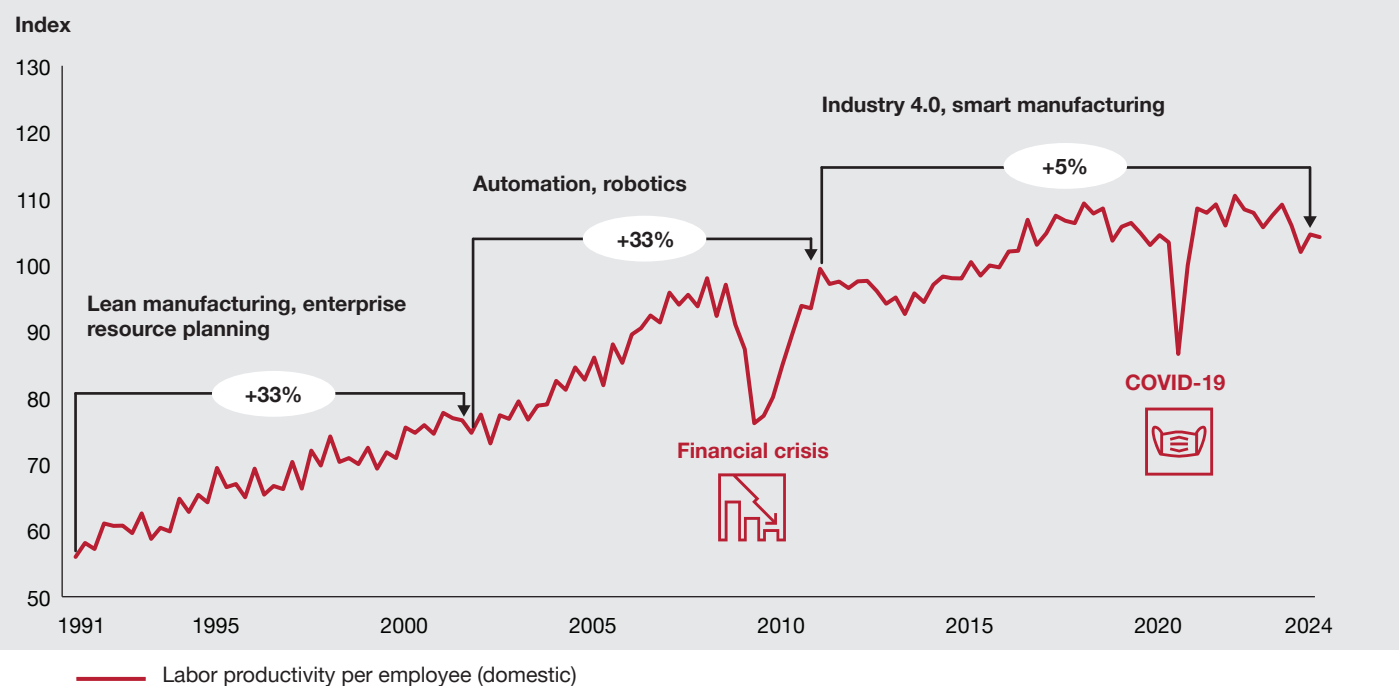
In the last decades industrial manufacturers have been able to increase productivity and profitability through innovations in organization and technology – first by e.g. implementing lean manufacturing and enterprise-wide resource planning, and then by the introduction of automation and robotics.

These innovations have been productivity game changers, with the lean manufacturing era delivering productivity growth of over 30% during 1990-2002, followed by another decade of over 30% productivity growth thanks to the applications of automation solutions and robotics.

The implementation of Smart Manufacturing and Industry 4.0 has proven to be challenging in practice. Many companies have worked on finding the optimal balance between investments and measurable benefits for revenue and profitability, with results varying. Productivity per employee has barely changed since 2015 and has only risen around 5% since 2010 (*see Exhibit 3, next page*).

EXHIBIT 3

Productivity gains in industrial manufacturing



Note: Labor productivity: Gross domestic product resp. gross value added (price adjusted, chain-linked index 2020 = 100) per hour worked by persons in employment
Source: Federal Statistical Office of Germany (Destatis), as of: 13.08.2024 (Index: 2015 = 100)

The productivity-cost equation

Productivity growth rates is only one driver of profitability rates. Costs, and particularly labor costs, are equally significant. And while productivity growth has been falling in recent years, labor costs have been rising.

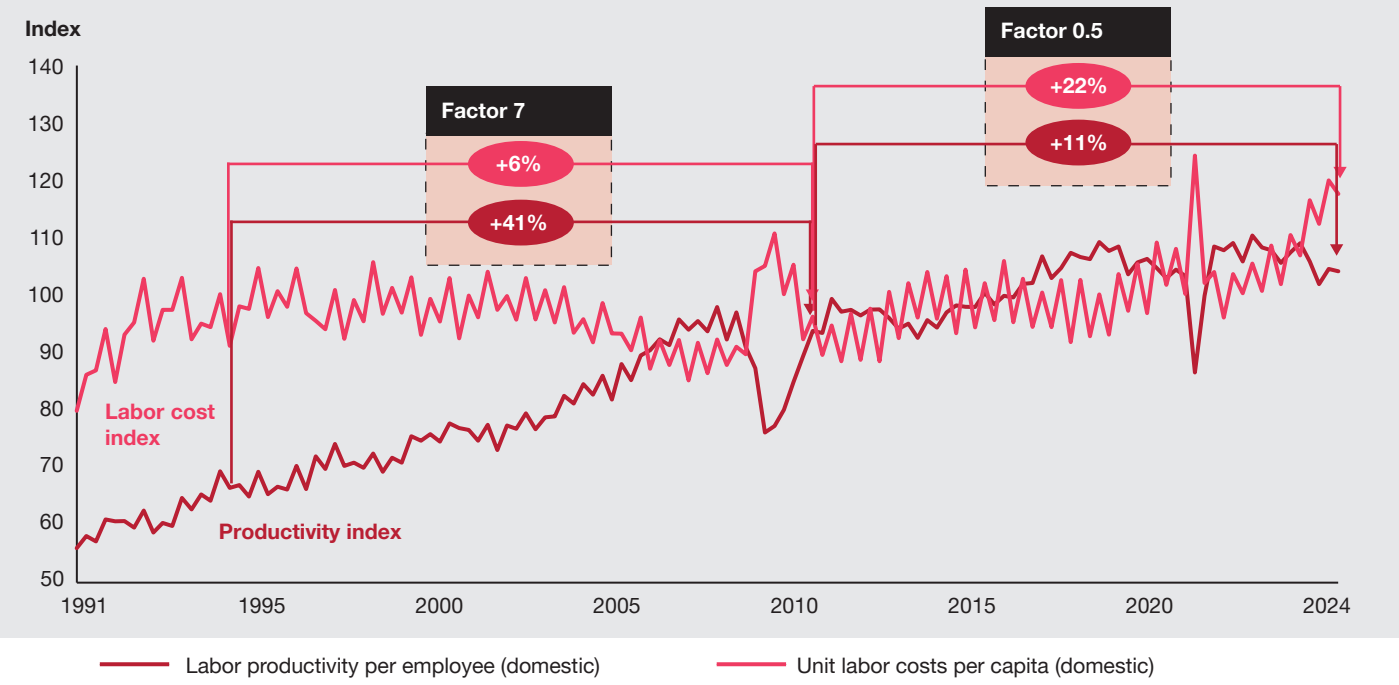
In the period 1995-2010, productivity grew at 41% while labor costs only grew at 6%, producing consistent improvements in profitability for many industrial manufacturers. However, since 2010 that situation has reversed, with productivity growing at 11% while labor cost increases have outstripped productivity gains, growing at 22%, double the rate of productivity improvement (*see Exhibit 4, next page*).

As a result, the rate at which industrial manufacturers create wealth has fallen precipitously. This amounts to a profitability problem in the heartland of European manufacturing.

EXHIBIT 4

Productivity development in manufacturing

Productivity versus cost



Source: Federal Statistical Office of Germany (Destatis), as of: 13.08.2024 (Index: 2015 = 100)

> Generative AI is far more than just a technological trend for the manufacturing industry – it is becoming a strategic tool to thrive in a global market facing increasing pressure on margins and supply chains."

Bernd Jung, Senior Partner and Industrial Products Practice Lead Europa, Strategy& Germany

A path to productivity recovery?

Unsurprisingly, manufacturing companies are extensively looking for ways to change the productivity trend and return to profitability growth. For many, the emergence of GenAI with applications throughout the manufacturing process seems to offer just such a turnaround opportunity.

Whether these expectations are realistic and how industrial manufacturers can avoid profitless investment in GenAI applications, is the subject of this report.

Smart Manufacturing and Industry 4.0 have led to valuable insights in many companies. These experiences form a solid foundation for further development. The next promising step is to translate the insights gained into comprehensive process optimizations. This will unlock the full potential of these forward-looking concepts in widespread applications. So, companies should strategically plan how to use GenAI to drive profitability. It is a general-purpose innovation with potential applications right across the industrial process spectrum – but only some are also likely to produce returns on investment.

Companies should therefore break down the broad GenAI opportunity into a top-down business strategy as well as bottom-up specific use cases and evaluate those use cases on an individual profitability-focused basis. And before they can do that, it is necessary to establish which broad industry trends are producing negative effects on both productivity and profitability, so that the GenAI strategy can be refined and targeted on the areas that matter most.

Key survey insight

89%

of companies surveyed say GenAI is either important or very important for their future profitability

SECTION 2

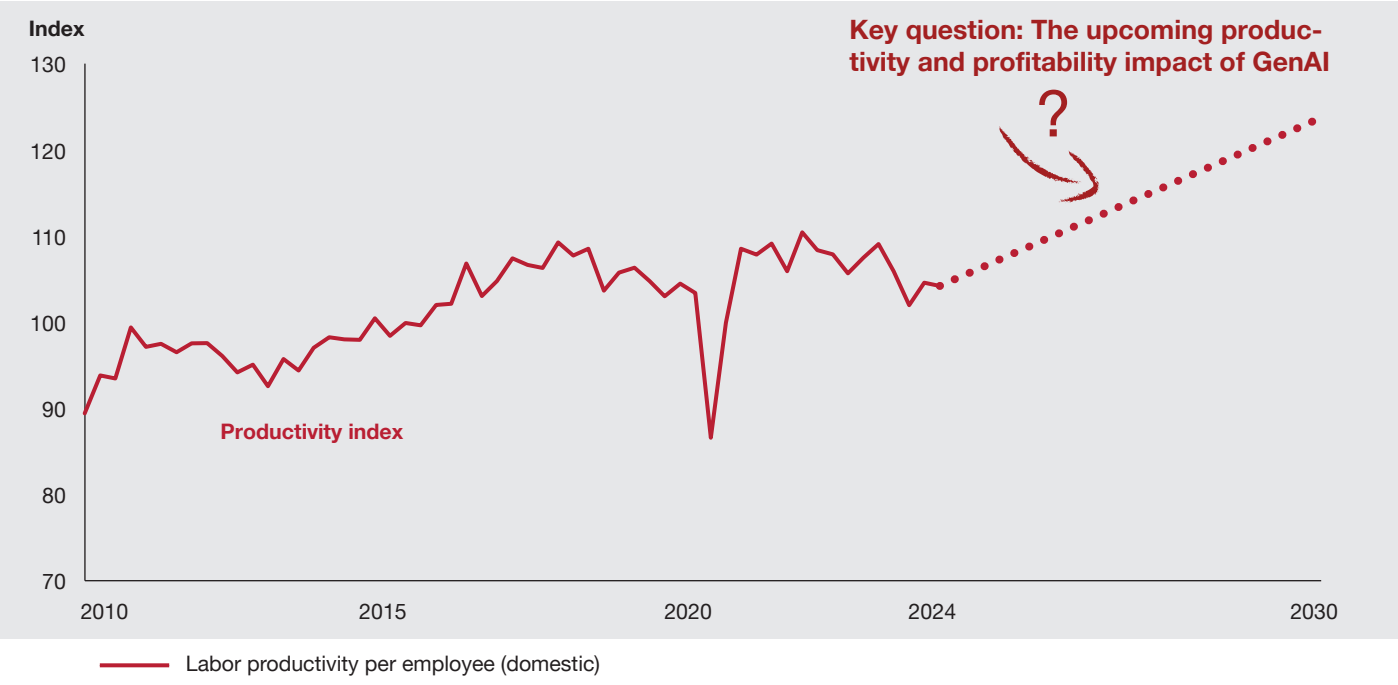
Behind the industry trends: Pessimism and hope

More than half of the companies surveyed in December 2024 as part of the PwC Mechanical Engineering Barometer are becoming increasingly pessimistic about prospects for growth and profitability – but they also think that GenAI has potential to change the game.

According to data from the German Statistical Office, the average expectation on GenAI impact of manufacturing executives is to add a significant productivity growth on an annual basis between now and 2030, effectively returning the industry to the productivity growth rate enjoyed during the first decade of the millennium (*see Exhibit 5*).

EXHIBIT 5

The impact of GenAI on profitability



Source: Federal Statistical Office of Germany (Destatis), as of: 13.08.2024 (Index: 2015 = 100)

This level of GenAI optimism amid pessimism about the future of industrial manufacturing in the upcoming months is confirmed by results from the PwC Maschinenbau-Barometer, a quarterly survey of 150 German industrial manufacturing executives. Over the last six quarters expectations of manufacturing have tended to decline, with 65% of executives now being pessimistic about the economic future in 2025 and only 10% optimistic. Growth expectations have been negative and declining over the last two years, and executives[2] also report a consistent decline in capacity utilization.

Against this outlook, the gradual rise in expectations of the change potential of AI in industry is understandable: 52% of executives now see AI as a potential industry game changer, the highest level in the last six years.[3]

Global trends spell challenges – and GenAI opportunities

Industrial Manufacturing is influenced by a variety of global trends, including the complexity of international supply chains, changing customer requirements in different markets, technological innovations, and geopolitical developments. To understand the ways in which new technologies like GenAI may prove effective at meeting these challenges, it is important to understand the trends that are shaping the manufacturing environment.

Industrial manufacturing is by nature partially more exposed to global factors than national or regional ones. Industrial manufacturing has a global supply chain and customer base. It operates in markets that are fragmented but very competitive, making it difficult to counter cost increases through the classic strategy of consolidated buying power. And industrial manufacturing is heavily dependent on industries that are currently experiencing technology-driven upheaval, such as the automotive industry.

Against this background, we see ten global trends that all industrial manufacturers should confront; trends that define both the depth of the challenge but also the operational areas where new opportunities may emerge (*see Exhibit 6, next page*).

Key survey insight

79%

of companies are using or planning to use GenAI

2 https://www.pwc.de/de/industrielle-produktion/pwc-maschinenbau-barometer-q4-2024.pdf
3 https://www.pwc.de/de/industrielle-produktion/pwc-maschinenbau-barometer-q2-2024.pdf

> Industrial Manufacturing thrives on precision, efficiency, and profitability. Generative AI opens up new ways to accelerate processes, reduce costs, and increase value creation. Those who use it secure their future. Those who wait lose touch.“
>
> **Florian Klein, Referent of VDMA Software and Digitalization**

EXHIBIT 6

Ten trends and implications for the industrial manufacturing industry

Source: Strategy& analysis

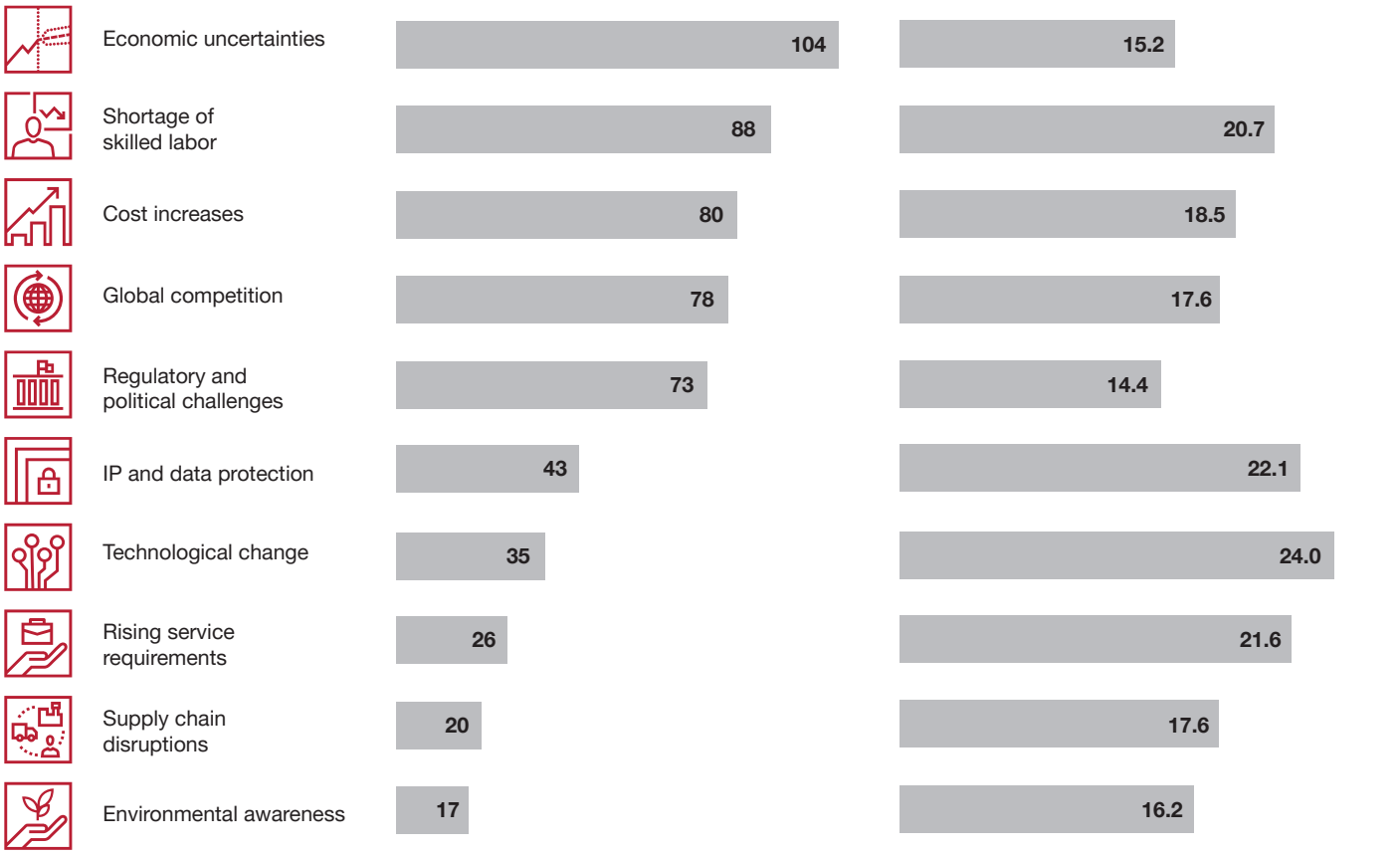
Economic uncertainties	Weakened global demand, driven by economic slowdowns, is restraining industrial growth. Capex limitations in customer industries are slowing market expansion.
Cost increases	Labor costs are rising, even in former low-cost regions, while energy and input prices continue to climb. The growing demand for green energy adds further financial pressures, prompting companies to seek cost-efficient as well as sustainable solutions
Labor shortages	A lack of talent especially in IT and engineering is hampering innovation and operational efficiency. Aging workforces in developed economies intensify the challenge.
Rising service requirements	Customer expectations for faster service lead times and higher parts availability are growing. Market-specific demands and new data-driven services are increasing service complexity.
Environmental awareness	A rising awareness of environmental impact demands sustainable products and circular value chains. As customer requirements grow, industrial manufacturers have an opportunity to differentiate themselves in terms of environmental performance.
Supply chain disruptions	Supply chain instability, caused by crises and natural disasters, has become commonplace. Shortages and volatility require companies to strengthen resilience through multi-sourcing and local-for-local manufacturing approaches.
Global competition	Low-cost competitors are expanding globally, increasing pressure on European incumbents while trade barriers demand effective risk management and regional market adaptations to remain competitive.
Technological change	R&D and advanced manufacturing are essential for maintaining competitiveness. Companies must embrace technology as a differentiating capability to meet market demands and stay ahead of global rivals.
IP and data protection	Rising cyber threats and data theft are heightening the need for robust cybersecurity systems. Protecting internal and external data is critical to ensuring operational continuity and customer trust.
Regulatory and political challenges	Increasing conflicts with both regional and global dimensions are developing against a background of deglobalization. New opportunities in military projects offer some relief amidst the regulatory complexities.

In our survey in collaboration with VDMA Software und Digitalisierung, underlying this report, we asked industrial manufacturing companies how they are affected by these trends, and to what extent they believe GenAI can help them overcome the challenges that change presents (*see Exhibit 7, next page*):

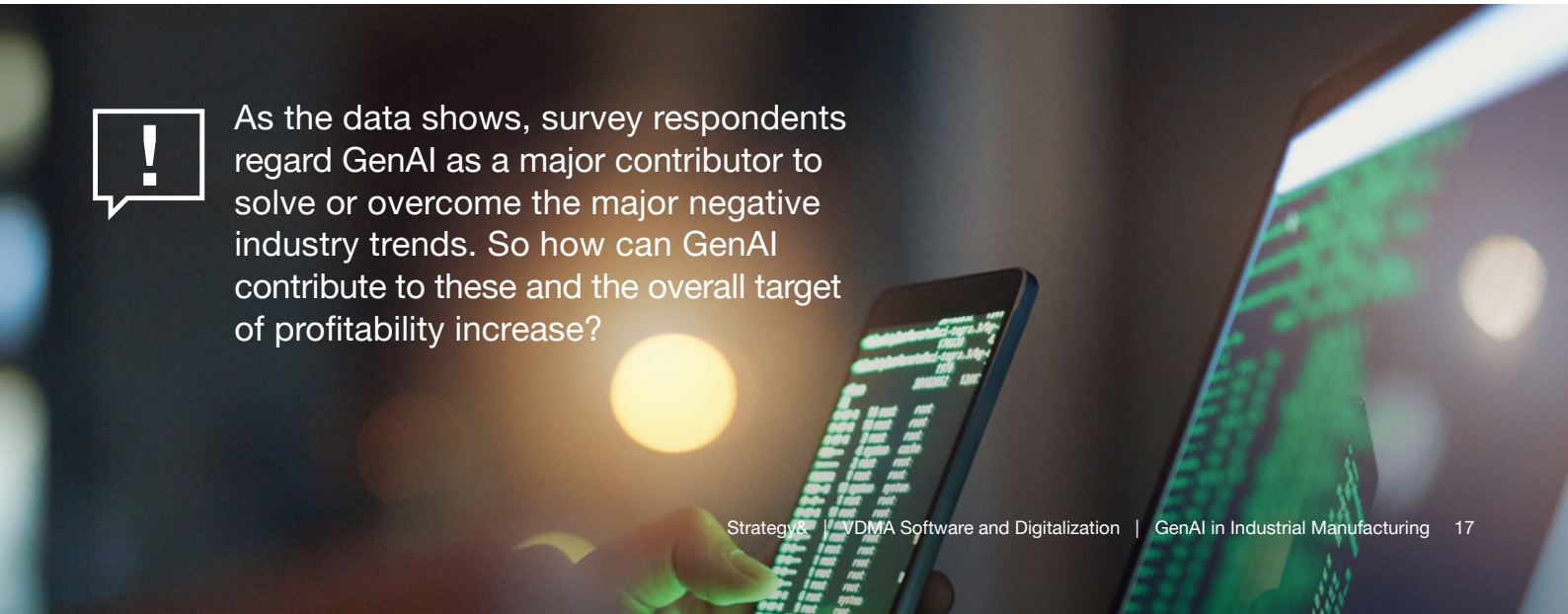
The survey results show that many respondents see GenAI as a promising tool to effectively address some of the current challenges in the industry. So how can GenAI contribute to these and the overall target of profitability increase?

EXHIBIT 7

Trend impact



Source: Strategy& and VDMA Industrial Manufacturing Survey; n=247 industrial manufacturing executives



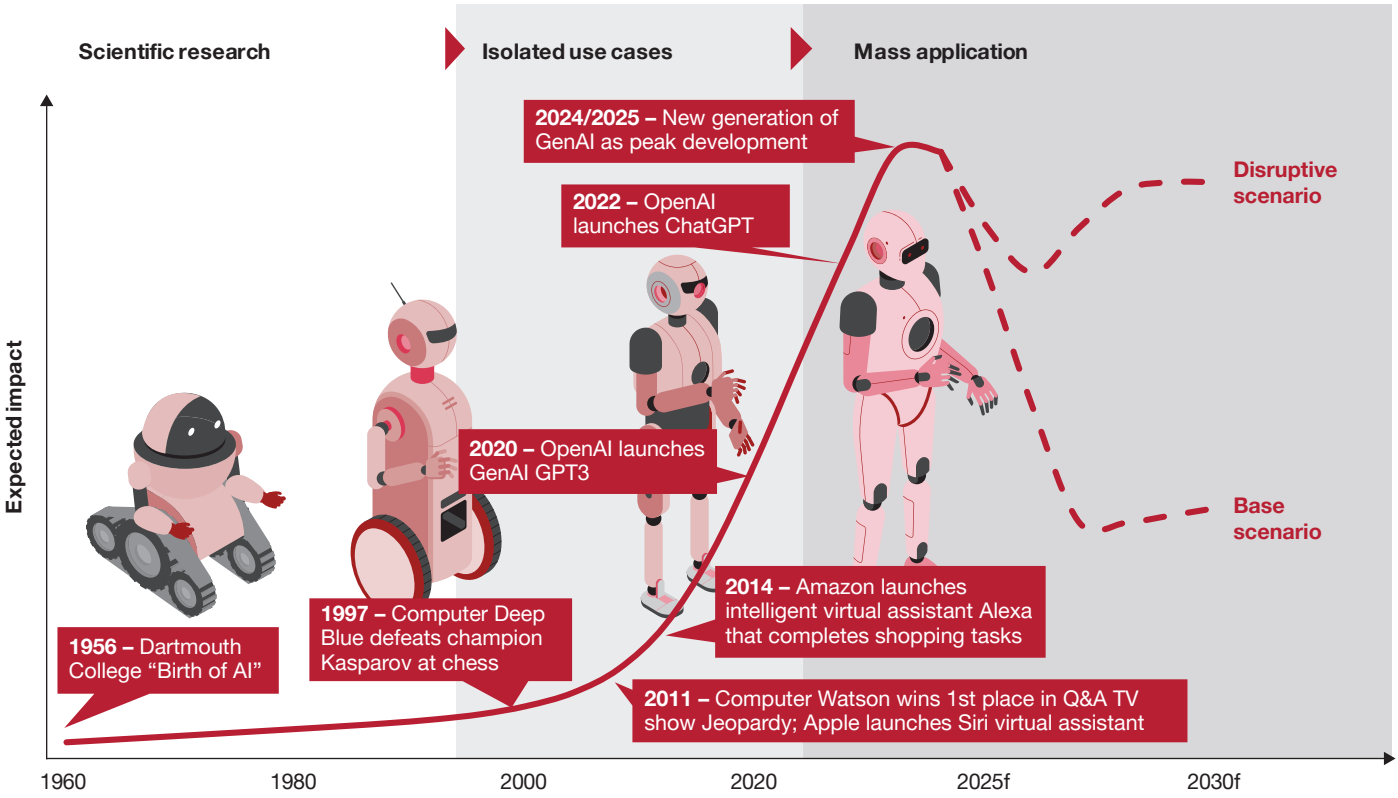
As the data shows, survey respondents regard GenAI as a major contributor to solve or overcome the major negative industry trends. So how can GenAI contribute to these and the overall target of profitability increase?

SECTION 3

The real-world potential of GenAI

Neither Artificial Intelligence nor GenAI is new. The development of the fundamentals of what we know today as GenAI began in the 1970s; between then and 2010 the development of neural networks gradually increased the number of GenAI applications. Over the last fifteen years, the development of generative adversarial networks reached a turning point with the release of GPT2 by OpenAI in 2018, opening the floodgates to mass development and gradual adoption of GenAI applications for business (*see Exhibit 8*).

EXHIBIT 8
Evolution of (Gen-)AI technologies



Sources: Strategy& analysis (2023)

As the chart above (*see Exhibit 8*) shows, expectations around the transformative potential of GenAI are at their peak, and even the most disruptive future scenario is likely to fall slightly short of the sky-high potential identified today. Might GenAI instead follow the path of the base scenario, and play a much more minor role among the technology tools used by industrial manufacturers?

Usable real world business applications of GenAI have now been available for almost five years, creating a record of experience of implementations and outcomes that any business can access.

Key survey insight

91%

of companies plan to invest in GenAI in 2025

> GenAI success isn't about doing everything – it's about doing the right things fast. AI incubators drive profitability by scaling the most impactful use cases, turning potential into results."
>
> **Florian Stürmer, Partner Digital and Technology Strategy, Strategy& Germany**

Is the industrial manufacturing sector ready?

Our survey of 247 industrial manufacturers in Germany, Austria and Switzerland suggests that while companies in Europe's manufacturing heartland have become increasingly interested in GenAI, this interest largely remains at the experimental or proof-of-concept stage. Information gathering and pilot projects are common – but adoption and implementation of an overall strategic approach to GenAI are (so far) still rare (*see Exhibit 9*).

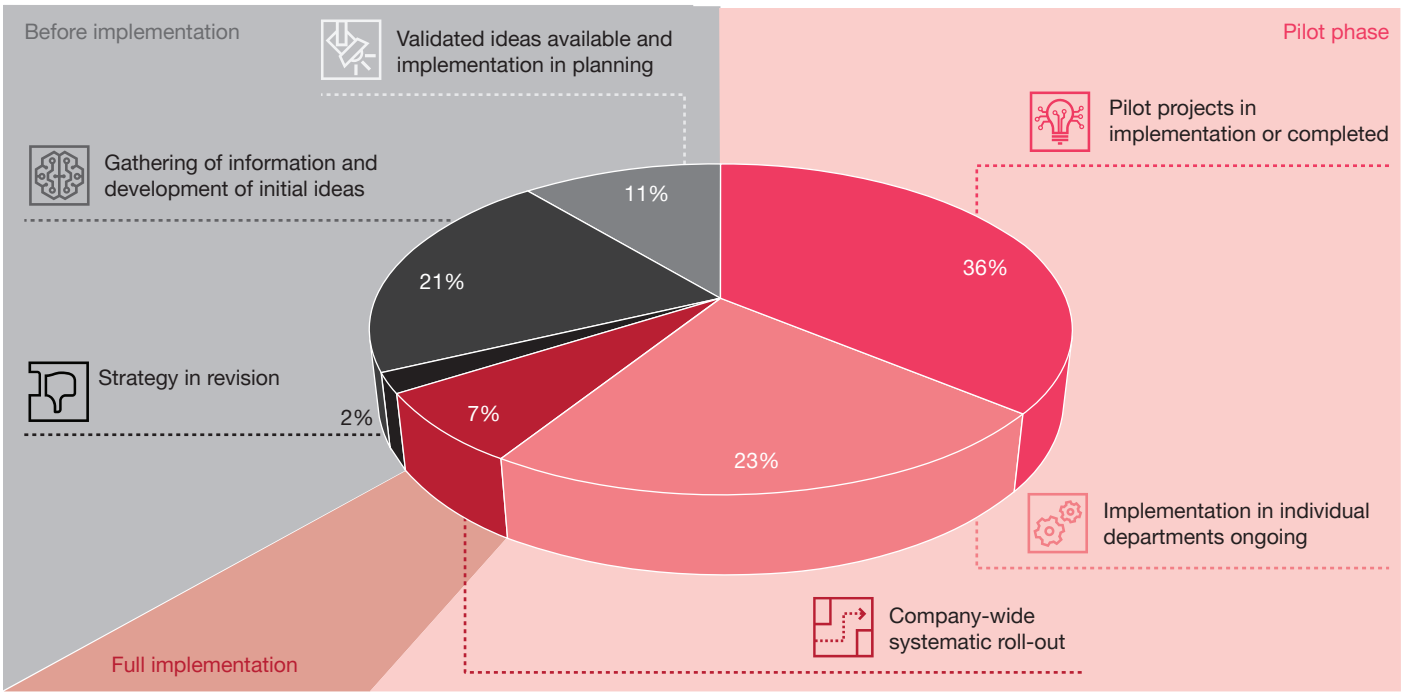
Key survey insight

only 7%

of companies have systematically rolled out GenAI

EXHIBIT 9

Current adoption of GenAI in the industrial manufacturing industry



Source: Strategy& and VDMA Industrial Manufacturing Survey; n=247 industrial manufacturing executives

The use cases assessed in this study

Looking again at the gap between the most disruptive scenario and the base scenario identified in the chart above, which use cases would allow industrial manufacturers to make the leap and achieve the maximum improvement to profitability by using GenAI? The values we have assigned to real-world implementations of GenAI in industrial manufacturing are based on an extensive evaluation of 45 use cases relevant to manufacturers, broken down into core function and support function use cases along an entire value chain (*see Exhibit 10*).

EXHIBIT 10

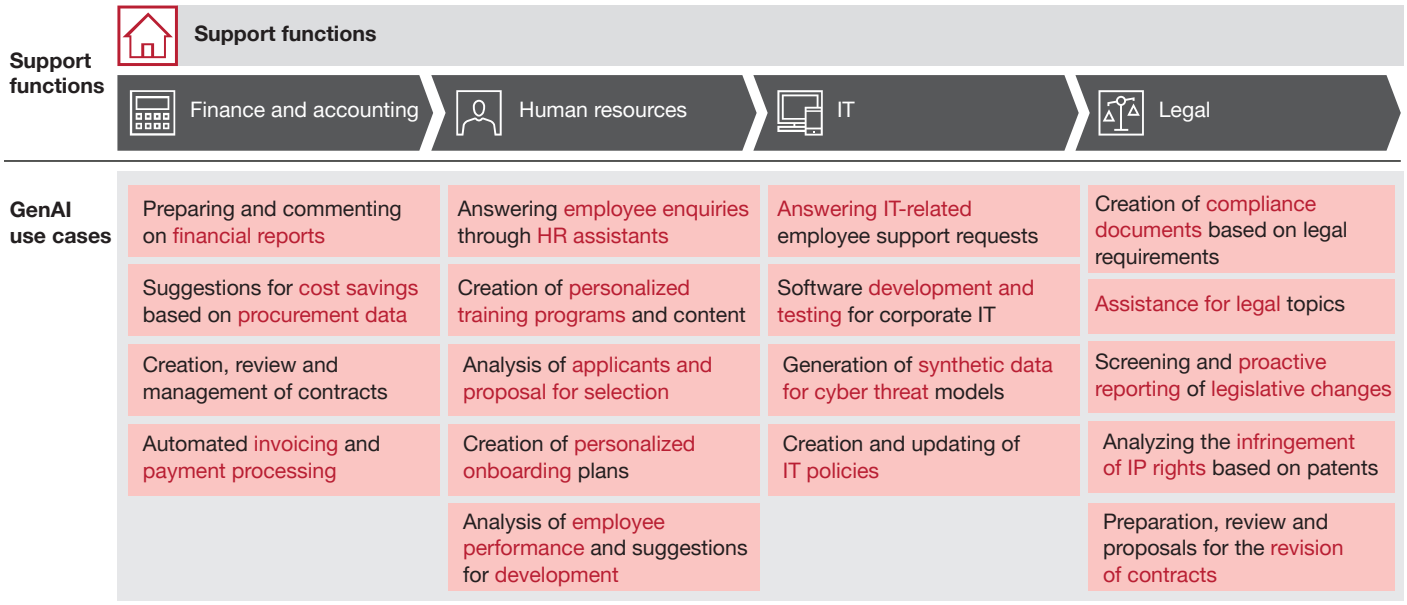
Use cases along the IM value chain (core functions)

Core functions	R&D	Sales	Planning	Procure-ment	Logistics	Pro-duction	After sales
GenAI use cases	Input-based development of product design/ construction proposals	Answering customer enquiries through virtual assistants	Recommen-dations for planning adjustments based on demand trends	Recommen-dations for material selection through product specs	Identification of stock discrepancies	Identification of security risks and suggestions for prevention	Personalized processing of customer enquiries
	Interaction with digital prototypes and models	Personalized product recom-mendations for customers	Notification of changes in the supply chain	Reporting on geopolitical developments	Suggestions for route optimization	Recommen-dations for predictive maintenance	Information on predicted demand peaks for spare parts
	Personalization according to data-based customer preferences	Market analysis and recommen-dation of price adjustments	Recommen-dations for production planning of resources	Analyzing offers and negotiating with suppliers		Analysis of energy consumption and recom. for energy optimization	Creation of technical documentation based on product specification
	Ideation of new business models and product innovations	Identification of new market areas incl. competitor analysis		Automated response to claims		Robot communication for interaction with humans	
	Software development and testing for product development	Creation of hyper-personal-ized marketing campaigns				Automation of process analyses including recommendations	

Source: Strategy& analysis

EXHIBIT 11

Use cases along the IM value chain (support functions)



Source: Strategy& analysis

The 45 GenAI use cases assessed for their impact on profitability have been evaluated for their relevance to optimization, creativity and social interaction. Optimization and automation implementations include predictive maintenance and event forecasting, process optimization through fine tuning of parameters, and automation of repeatable work packages. Creative real-time customizations, and recommendations for optimal materials. Conducting social interaction implementations through language/speech capabilities include generation of personalized solutions, automated handling of customer enquiries and customer need predictions (*see Exhibit 11*).

When we map the 45 GenAI use cases against the main P&L drivers of revenue, cost of goods sold and operating expenses, it is very noteworthy that although the use cases cover all dimensions of the industrial manufacturing chain, most address the optimization and automation of processes. Operating expenses in particular are most affected by GenAI implementations in process optimization, and the impact of GenAI implementations in the support functions category also tends to flow mostly to reduction of operating expenses.

Additional use cases by product functionality might come up in the near future, however this report focuses on the use cases within the value chain shown.

Overall, our financial modeling proves that GenAI use cases are most potentially valuable in the core processes of the organization, whether in service enhancement, product creation or automation of design, marketing and customer response functions. These core functions are where impacts will be felt in terms of revenue improvements, efficiencies in cost of goods sold, and operating expenses. And as these are the most expensive or the most cost intensive parts of the business model, making them more efficient naturally results in greater percentage gains in profitability. In contrast, support function implementations are only likely to impact operating expenses.

GenAI use cases are most valuable for the company's core processes.

Use case implementation: Potential versus reality

Our survey with the VDMA Software und Digitalisierung of industrial manufacturers in Germany, Austria and Switzerland shows that so far, only a small proportion of industrial manufacturers have achieved fully rolled-out implementations of Gen AI use cases (*see Exhibit 9, page 19*). For example, in the case of core function implementations, the vast majority of companies do not have a fully rolled-out implementation in any of the use cases identified, and even in the most-used example of GenAI (answering customer enquiries through virtual assistants) only 6% of companies have achieved full implementation.

In the case of support functions, the reported rate of full implementation is higher, with 14% of companies having fully implemented GenAI in e.g. software development and testing for corporate IT, and 10% of companies having done so in creation and updating of IT policies.

This current rate of uptake and implementation of GenAI in industrial manufacturing appears to significantly under-exploit the profitability potential of the technology. To calculate the true potential of our identified use cases we have analyzed the P&Ls of over 200 industrial manufacturers to compare actual operating margin with potential operating margin with full implementation of our 45 GenAI use cases. Each use case has been analyzed in terms of its impact on specific P&L contributors, and the impacts are combined for each case (*see Exhibit 12*).

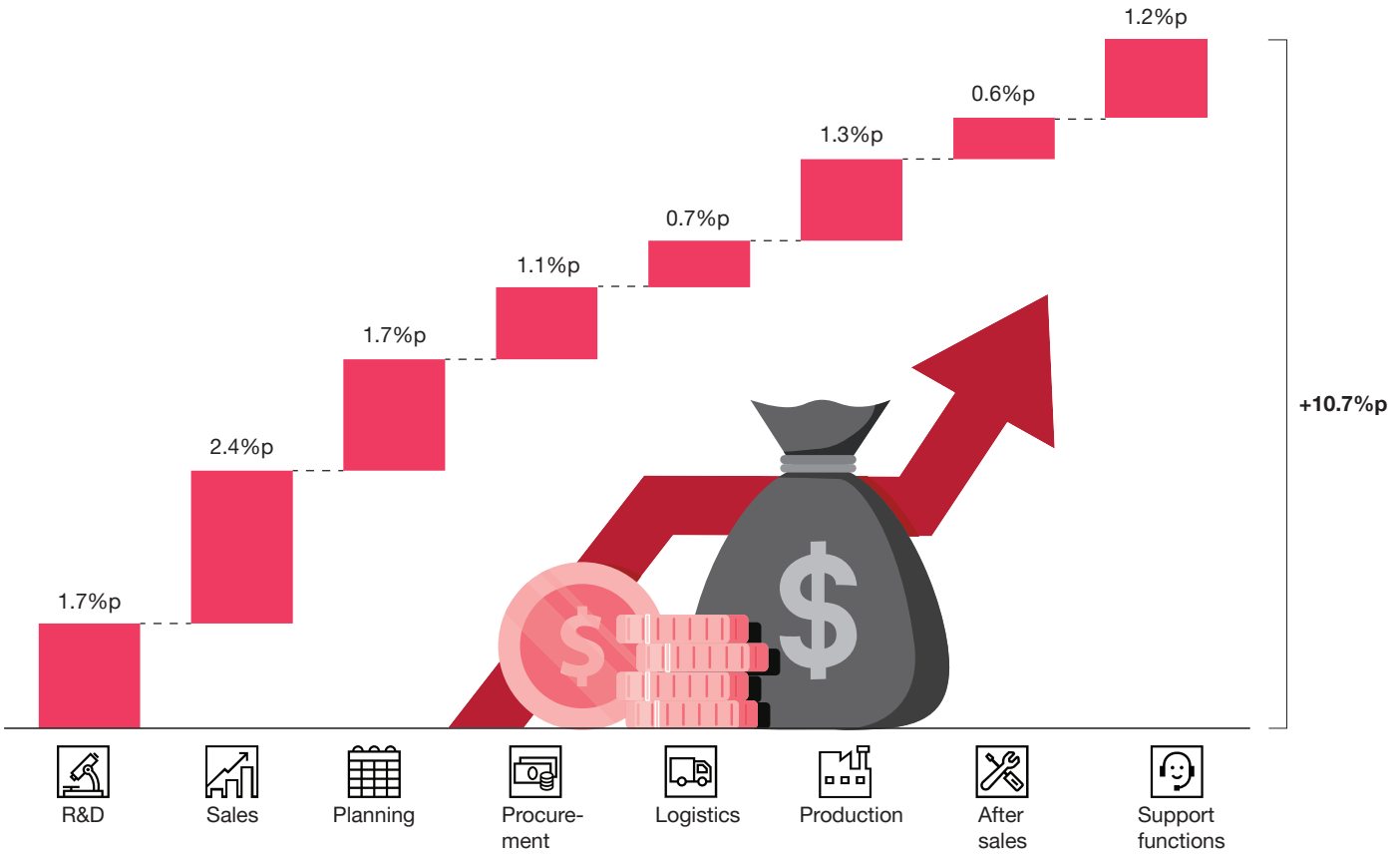
Key survey insight

29%

of companies have rolled out at least one GenAI use case.

EXHIBIT 12

Expected profit potentials by implementation



Source: Strategy& and VDMA Industrial Manufacturing Survey; n=247 industrial manufacturing executives

The profitability-potential analysis shows an operating margin uplift of 10.7 percentage points. Based on a total industrial manufacturing market size of €263.7bn[4] in 2023 this would result in an increase of €28bn in total profit for the industry in Germany. And action is required – of the potential 10.7 percentage-point increase, only 0.74 percentage points would be captured if the current rate of use case implementation is maintained. The potential margin improvements could also be far higher in future as new GenAI use cases evolve.

Estimated P&L improvement from GenAI implementation derives from three main operational sources. Sales growth is driven by generating additional revenue through customizing and personalizing customer interactions, together with AI-assisted strategic pricing or general product functionality enhancement by GenAI. R&D efficiency is driven by reducing the time and resources required for specific steps in the development process (e.g. coding), but also by optimizing and facilitating selection of individual development projects and associated materials. Enhanced planning has a significant impact on production costs, supply chains and distribution by enhancing synchronization, reducing waste between the different elements of the supply chain and optimizing production processes in manufacturing companies.

According to companies in our survey, the greatest impacts are expected in sales and marketing (by 53% of respondents) and in R&D (by 43% of respondents). This result is in line with our assessment of the P&L impact of GenAI use cases. However, survey participants expect higher potential in area of production and after sales than in planning compared to our P&L assessment (*see Exhibit 13, next page*).

Just ten of our use cases account for 58% of the total margin improvement potential, and all ten focus on core functions (the ranges of profit margin improvement are due to different cost structures of sub-industries). This is a strong contrast to the current focus of companies which usually focus on use cases in support functions with low P&L impact.

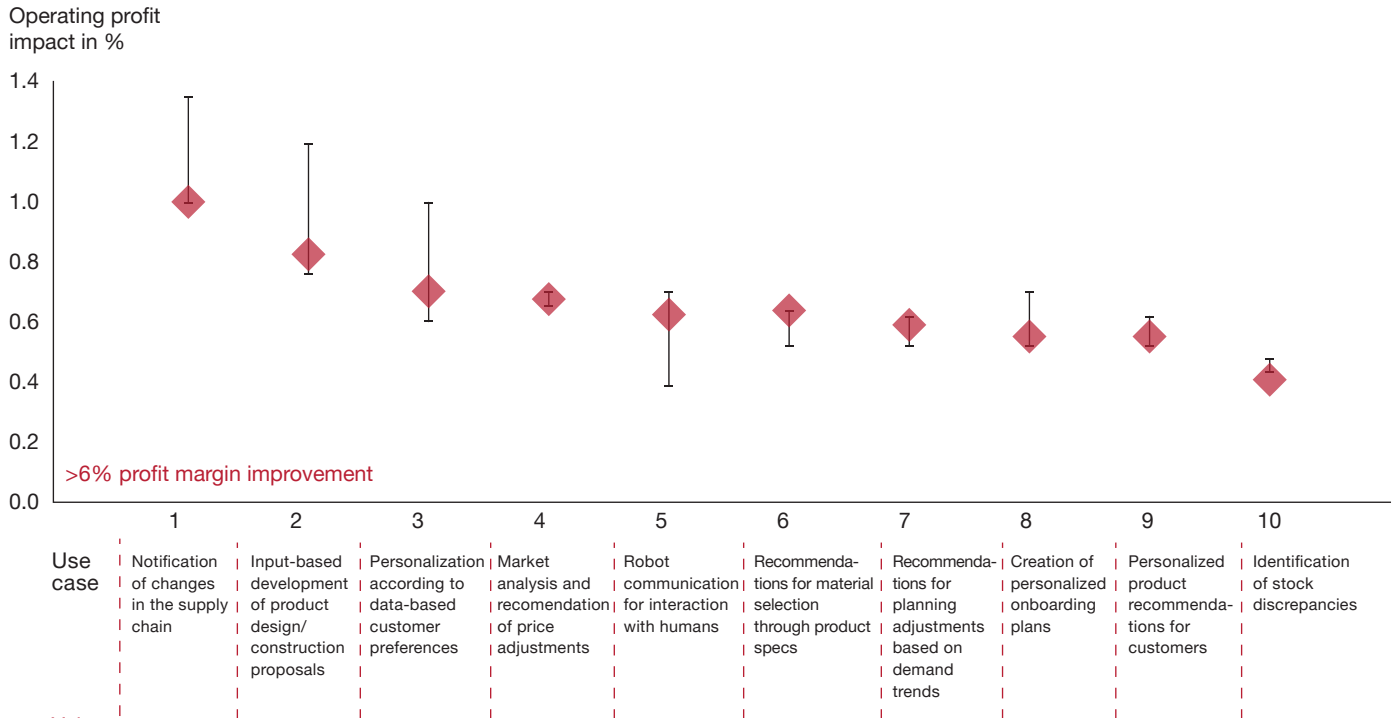
Two use cases are calculated to offer more than 1% profit margin improvement each. They are ‘notification of changes in supply chain’ and ‘input-based development of product design’, due to the wide range of impact and the extensive share of the P&L they address.

The use case with the highest impact is ‘notification of changes in the supply chain’, which addresses the inefficiencies in the collaboration between different functions such as procurement, manufacturing and planning, and the fact that the use case addresses large cost blocks such as material costs, production costs, and supply chain and distribution costs.

4 VDMA, Konjunktur 2024. Lage und Ausblick im Maschinen- und Anlagenabau https://vdma.org/documents/34570/4802648/Charts_D_Jahres-PK+Konjunktur+2024-2025.pdf/529ec0ec-2ecb-1f12-125d-5a4c9830d9c6?t=1733818629385?filename=Charts_D_Jahres-PK+Konjunktur+2024-2025.pdf

EXHIBIT 13

GenAI use case operating margin improvement



Source: Strategy& and VDMA Industrial Manufacturing Survey; n=247 industrial manufacturing executives

"With GenAI we have the ambition to significantly reduce our administrative efforts to gain more space for strategic work. We expect GenAI enabled new business models and an increased competitive advantage by taking a leading role in the use of GenAI technology."

Manfred Mießl, Head of Data Driven Applications and AI, Heidelberger Druckmaschinen AG

The top ten use cases

1. Notification of changes in the supply chain	By automatically identifying changes in demand, transport, and supply chain disruptions, GenAI can suggest actions based on capacities and inventory data. It enhances demand forecasting accuracy by analyzing unstructured data to spot trends, sentiments, and events that influence demand.
2. Input-based development of product design/construction proposals	GenAI enables the development of product designs, allowing for rapid iterations and visualization of prototypes. This process includes data generation, simulation, and automated test case generation.
3. Personalization according to data-based customer preferences	GenAI translates individualization requirements into changes of product designs, tailoring products to meet specific customer preferences.
4. Market analysis and recommendation of price adjustments	By processing large pools of historical and competitor benchmarking data, GenAI considers demand, capacity, and forecasting trends to suggest and optimize pricing. It also profiles customers to enhance engagement and conversion rates.
5. Robot communication for interaction with humans	Facilitating robots' recognition and interpretation of human gestures and movements, GenAI enables more intuitive collaboration. Robots can perform tasks requiring strength or precision, working alongside humans.
6. Recommendations for material selection through product specs	GenAI rapidly analyses material parameters and requirements, providing suggestions based on historical data and current specifications.
7. Recommendations for planning adjustments based on demand trends	Improving demand forecasting accuracy, GenAI analyzes unstructured data from social media, customer reviews, and news articles to identify trends, sentiments, and events that influence demand.
8. Creation of personalized onboarding plans	By generating tailored onboarding plans, GenAI analyzes performance data and interprets employee needs, ensuring a customized onboarding experience.
9. Personalized product recommendations for customers	Delivering personalized product recommendations, GenAI creates profiles and provides real-time information and price predictions through rapid data analysis.
10. Identification of stock discrepancies	Assisting in inventory planning and procurement decisions, GenAI trains models on purchase history, order lead times, site locations, logistics, and transportation data.

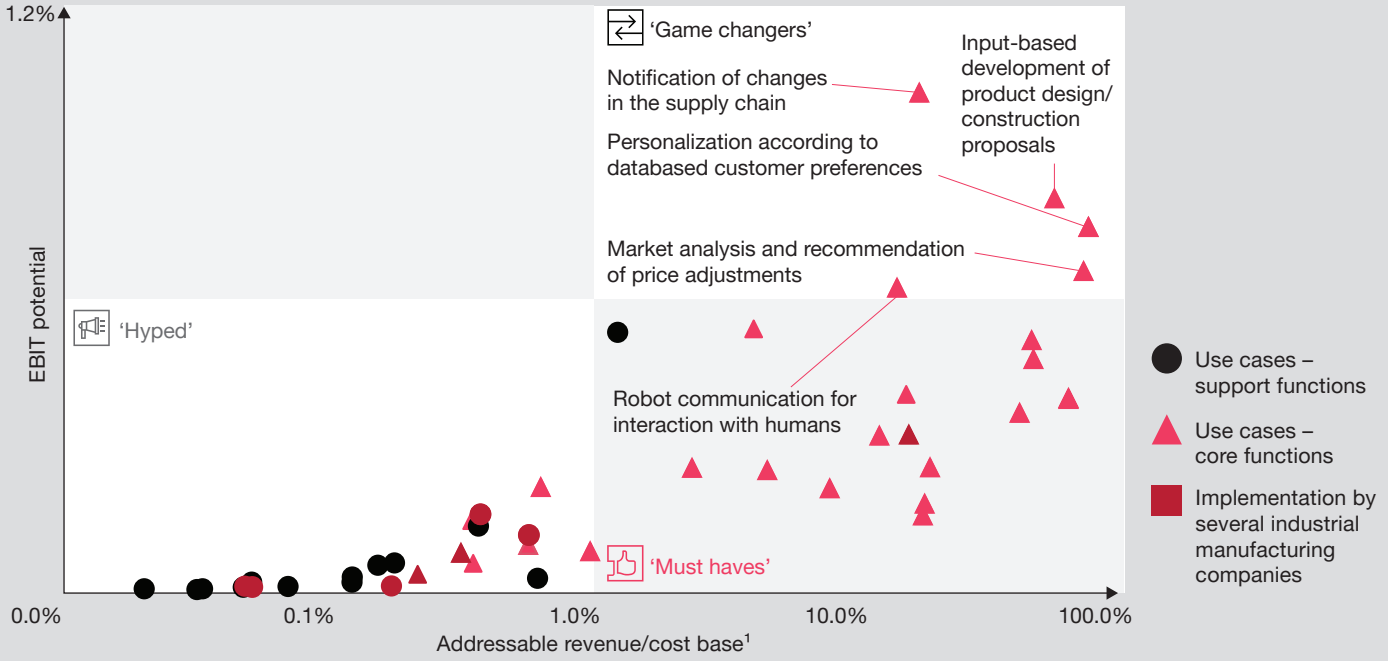
Game changers, must haves … and hype

We have categorized use cases according to whether they are high P&L impact 'game changers', widely applicable 'must haves', or limited impact 'hype' use cases that have received more attention than their P&L impact deserves.

‘Game changers’ address a large share of the P&L and have high efficiency gain potential: They include notification of changes in the supply chain, input-based development of product design and construction proposals, and personalization according to data-based customer preferences. These are relatively high-effort, high-complexity implementations because they address core elements of the business operations. ‘Must have’ use case impacts are spread more widely across the value chain but have medium efficiency gain potential. They include recommendations for planning adjustments based on demand trends, and personalized product recommendations for customers. ‘Hyped’ use cases are of value but mostly support processes with a limited share of the P&L, meaning that even though significant efficiency gains (of up to 50%) are expected, the overall profit margin impact is limited.

As discussed above, so far more of the use cases being implemented are in support functions such as IT. However, they are only addressing a small share of the addressable revenue/cost base. Our quantitative analysis proves that the real game changing use cases happen in the core functions, where 86% of the potential operating profit impact is expected.

EXHIBIT 14
Margin improvement and addressable cost base



1 Percentage of top line addressable or percentage of total cost addressable
Source: Strategy& analysis

The majority of use cases in the support functions only address a small share of the cost base, and inevitably have much lower margin improvement potential. This is the group we define as hyped. We can see from the survey results that companies started to implement them, but they are not bringing any major competitive advantage. To gain that, manufacturers need to go for the game-changing use cases which address a far greater share of the P&L and as a result, produce greater returns when it comes to profitability. In the middle are the 'must have' use cases, which we expect will be widely implemented in the next few years. They certainly offer profitability improvements but will not make your company a market leader. However not to fall behind, these use case need to be implemented anyhow (*see Exhibit 14, previous page*).

'Game changer' and 'must have' use cases:

Game changer	Notification of changes in the supply chain
	Input-based development of product design/construction proposals
	Personalization according to data-based customer preferences
	Market analysis and recommendation of price adjustments
	Robot communication for interaction with humans
Must have	Recommendations for material selection through product specs
	Recommendations for planning adjustments based on demand trends
	Creation of personalized onboarding plans
	Personalized product recommendations for customers
	Identification of stock discrepancies
	Ideation of new business models and product innovations
	Identification of new market areas incl. competitor analysis
	Analyzing offers and negotiating with suppliers
	Answering customer enquiries through virtual assistants
	Suggestions for route optimization
	Personalized processing of customer enquiries
	Recommendations for predictive maintenance
	Analysis of energy consumption and recom. for energy optimization
	Recommendations for production planning of resources
	Information on predicted demand peaks for spare parts
	Creation of hyper-personalized marketing campaigns
	Automated response to claims

In this context, it is important to note that the positive impact of GenAI use cases on the P&L is expected to erode as market adoption increases. This means that the competitive advantage or efficiency gains that companies can achieve through early adoption of use cases will diminish over time as adoption progresses. Due to this erosion effect, the total expected potential is projected to decrease from 10.7 percentage points to 4.1 percentage points.

> Wide-ranging training measures are essential to ensure that all employees in a company can familiarize themselves with GenAI and build up knowledge on how this technology can be quickly integrated into everyday working life to increase efficiency.“
>
> **Guido Reimann, Deputy Managing Director, VDMA Software and Digitalization**

SECTION 4

Forming a GenAI strategy

The first chapter of this report outlined how the eras of Industry 4.0 and smart manufacturing have proved disappointing in terms of cost reduction and productivity improvement, with productivity largely stagnant since 2010 and profitability falling over the last five years. We therefore need to ask: What solutions does the era of GenAI offer, and how can the industry become more successful?

In retrospect, various technological innovations have been tested in recent years. This phase of exploration provided valuable insights into the potential of new technologies. Now, there is an opportunity to consolidate these experiences and develop a targeted top-down-driven strategy for GenAI implementations, considering the following aspects:

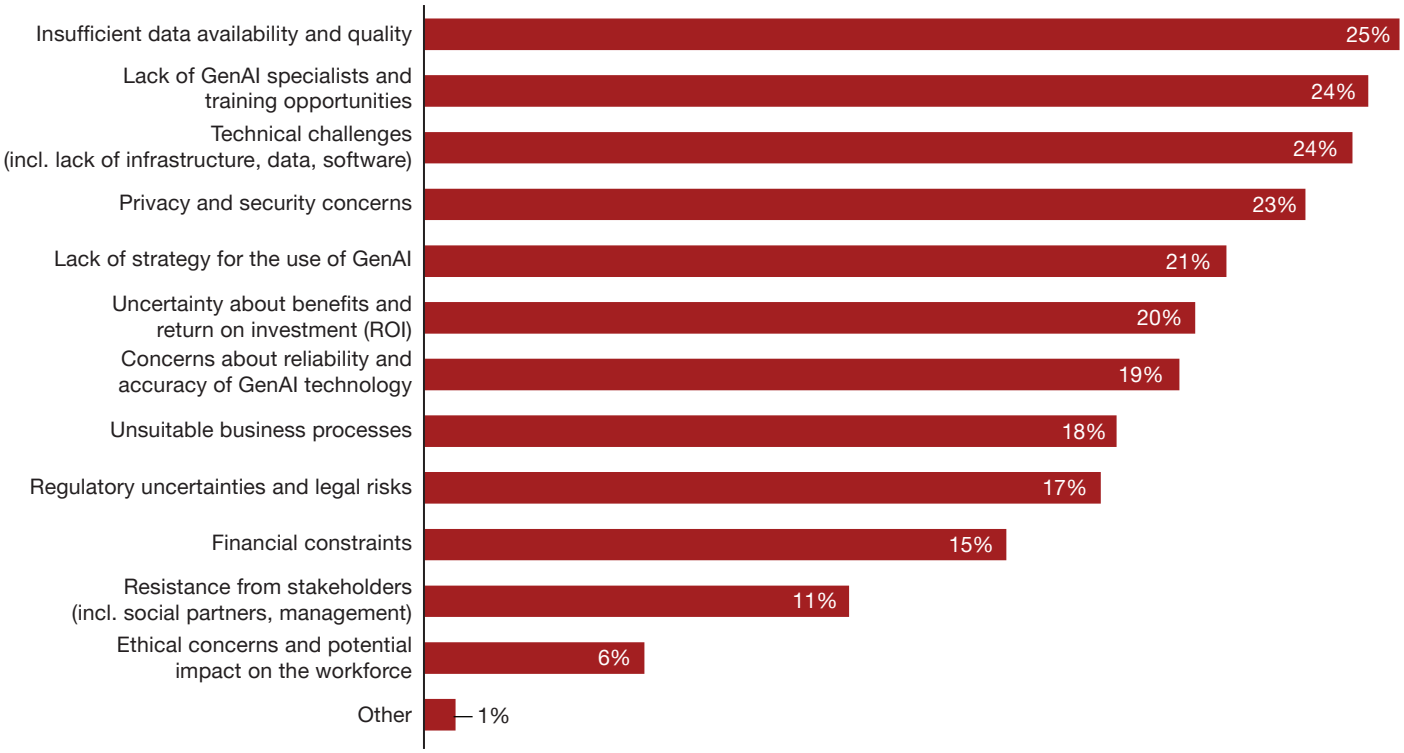
Key survey insight

13%

of companies report GenAI pilots are used for the ideation of new business models or products.

EXHIBIT 15

Survey insights: Current hurdles for GenAI investments



Source: Strategy& and VDMA Industrial Manufacturing Survey; n=247 industrial manufacturing executives

- The linking of individual projects, clear success metrics, and structured value management can increase efficiency.

- Strengthened cross-departmental coordination and solid data foundations offer opportunities to maximize the benefits of technological investments and further strengthen innovation power.

Similar to the trends and hypes of the past decades, GenAI also experiences various hurdles and investment barriers on the way to successful adoption and implementation.[5] According to our survey, the top three hurdles currently are (1) lack of data and data quality, (2) lack of specialist skills and training opportunities, and (3) deficits in IT infrastructure and software sophistication (*see Exhibit 15, previous page*).

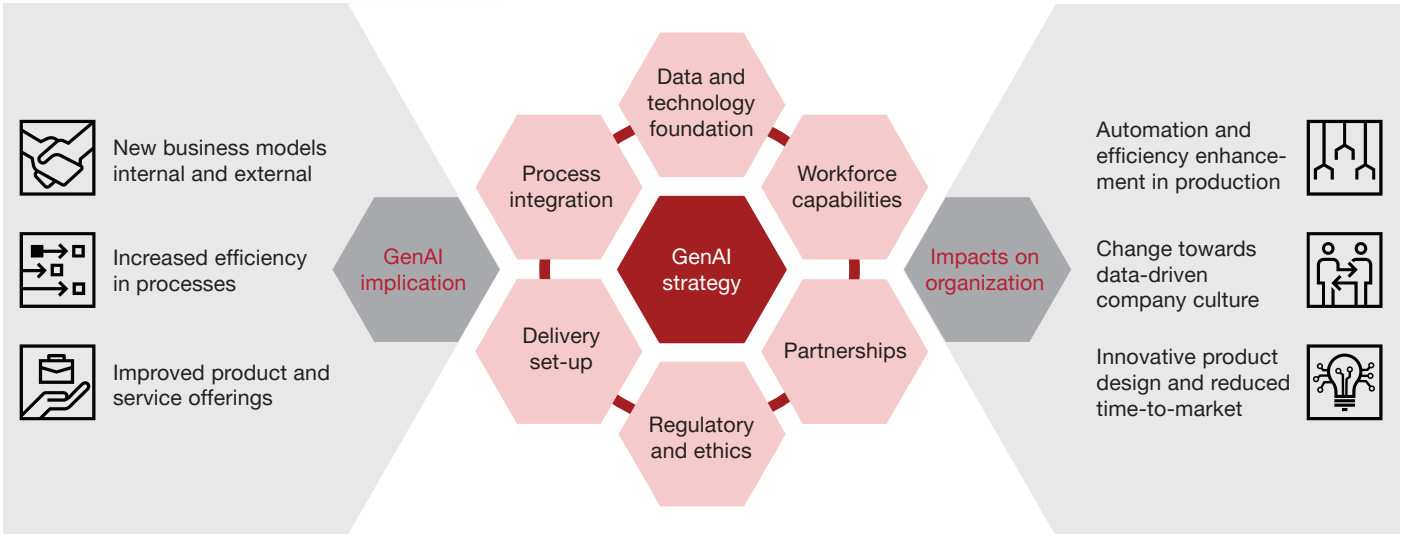
To overcome hurdles and investment obstacles, it is crucial to first understand and then overcome these roadblocks. A top-down GenAI strategy with clear strategic imperatives is therefore needed.

A strong data foundation is the crucial base for all GenAI applications, containing a clear data governance and data quality as well as an overarching data management.

The strategy must define a target picture how GenAI will shape the future operating model on a range from incremental to disruptive. To avoid regulatory challenges a governance framework helps ensure compliance with regulations and GenAI ethics. Additionally, an incubator as an engine can provide guidance and the power for an effective and efficient use case delivery process. Trustful partnerships can form a strong lever to build the necessary workforce capabilities fast (*see Exhibit 16*).

5 Cf. for examples of successful AI adoption: https://www.pwc.com/gx/en/industrial-manufacturing/pdf/intro-implementing-ai-manufacturing.pdf

EXHIBIT 16
GenAI strategy framework



Source: Strategy& analysis

To leverage these winning characteristics, companies have to define a GenAI strategy, requiring awareness of GenAI implications for the company and potential impacts on the organization. The GenAI implications can span across all parts of the company, ranging from new business models to process efficiency increases. The organizational impacts can also extend over development and production as well as company culture. Deriving from this, a target picture must be set for the key factors: Data and technology foundation, workforce capabilities, partnerships, regulatory and ethics, delivery set-up and process integration (*see Exhibit 16*).

This work will make clear how to set the target picture and what companies need to change to enable GenAI applications to reach their full potential. Companies are capable of setting clear business objectives with value-focused use cases, acting dynamically to achieve fast implementations, and creating the necessary data and infrastructure foundations for GenAI-enabled change.

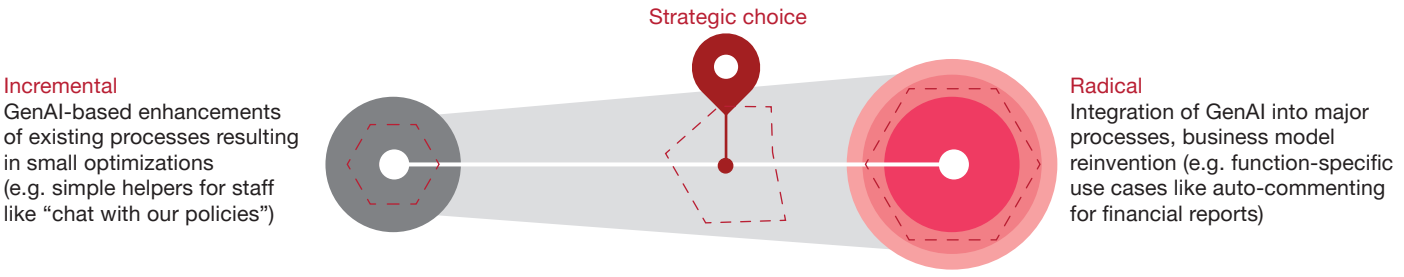
To bring structure and value-oriented thinking to companies' implementation programs, we follow a differentiated strategic approach, and defined three stages for the process of establishing a company-wide understanding of GenAI in the business:

1. Form the top-down vision: Define a clear strategy with a vision for the the ambition level, targets for top and bottom-line improvements and align with stakeholders.

2. Set up an AI incubator structure and process: Define WHY, WHAT, and HOW the incubator evaluates and selects GenAI use cases and launches initiatives.

3. Track and manage implementation for impact: Start initiatives, review progress, halt underdelivering initiatives, and roll out on a broad scale.

EXHIBIT 17
Define depth of GenAI integration



Source: Strategy& analysis

Define the vision, identify the targets, dismantle the roadblocks

Every company must define their own individual top-down GenAI vision: They need to decide in which parts of the value chain and how holistically they want to integrate GenAI. There is a range between incremental changes resulting in small optimizations and a radical reinvention of the business model in which companies can define their ambition for each part of the value chain. Therefore, the top-down vision must be a specific and value-focused decision for each company, and not every process needs GenAI (*see Exhibit 17*).

To achieve the defined vision the GenAI strategy must align to the set ambition. Assessing the needs and potential of the key factors will help companies define the overall ambition for their GenAI strategy. For each key factor they must define a target picture and conduct assessments of the current maturity of their GenAI strategy to derive to identify the roadblocks and focus areas for GenAI implementations.

To overcome the roadblocks to GenAI implementation for tangible value, we believe that the creation of a GenAI incubator will prove invaluable. An incubator is an organizational structure charged with driving fast innovation, attracting talent, and accelerating the time to market for industrial manufacturing companies.

Our client experience shows that companies cannot progress with current, standard capabilities. In fact, an incubator is a potential solution.

“We prioritize our AI activities based on our employees’ user requests. If we see specific use cases, we train our SMS-GPT solution accordingly. In doing so, we build on the current AI solutions on the market and thus gain significant speed.”

Roman Emonts-Holley, Project Manager Digitalization, SMS group GmbH

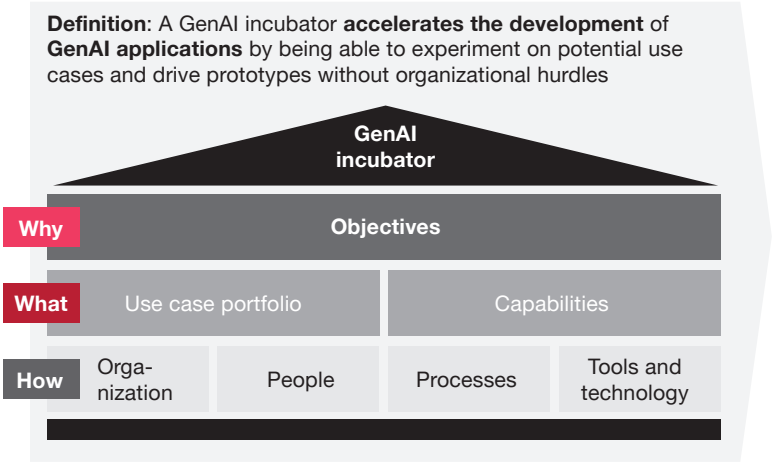
Structuring a GenAI incubator

As part of the study, Strategy& developed a structured framework for designing a GenAI incubator, which supports the implementation of GenAI ambitions. This framework is designed to solve the issues industrial manufacturers and other industries face in formulating and activating their GenAI strategies, and it is shaped according to the answers to three key questions.

Why Define the GenAI missions and objectives to be accomplished	The GenAI top-down strategic vision must be translated into clear objectives for the incubator: Examples include fostering innovation, accelerating adoption of new solutions, upskilling existing workforces to streamline processes, determining value pools and facilitating cross-functional collaboration for e.g. cost reduction potentials.
What Define the scope and prioritization of the GenAI use case portfolio	The use case portfolio must be selected, prioritized, and iteratively executed within the incubator. A 'long-list' of use cases is identified in accordance to the defined strategic vision for the depth of integration for each part of the value chain (potentially including existing use cases), and clustered into similar or overlapping cases. Cases are then prioritized in multiple iterations according to their profitability potential and reduced to a shortlist based on strategic importance, impact, business readiness, and profitability potential. Cases are then executed in the incubator and adapted in the organization to further drive and enhance the GenAI transformation.
How Define and create the human and technical capabilities demanded by the incubator	The required capabilities for successful incubator projects must be based on use case selection. Capabilities include value design, value delivery, human resources, strategy and steering, technology, and finance and legal capabilities. Partner collaboration structures must also be determined, according to whether the incubator maintains all capabilities in-house or whether an external incubator implements use cases externally, with a financial and legal interface to the manufacturer organization which steers the incubator's work.

EXHIBIT 18

GenAI incubator structure



Key takeaways

Who — **Specify the objectives** for the incubator according to the GenAI vision

What — **Drive innovation** by organizing **use cases** and defining **capabilities** of the incubator

How — Detail the **incubator's organization** and the **daily business** operations

Source: Strategy& analysis

The 'how' dimension of the GenAI incubator is challenging and critical, and it can be further broken down into the dimensions of organization, people, processes, technology and tools. Each of these has unique characteristics that may differ from the norms and practices of the core organization (*see Exhibit 18*).

- Management must commit to creating an incubator which acts differently from the 'in-line' organizations. The incubator should be seen as an independent collaboration platform between IT and the business departments.
- Expert capabilities might be bought in, independently of the regular hiring process, with independent compensation standards that will reward intensive projects in partnership with solution providers.
- Roadblock removal and rapid customer feedback processes must be defined, including how 'power promoters' accelerate processes stuck in conventional in-line procedures.
- The data and technology foundation needs to be defined, including the existing data base in terms of quality, accessibility and management and how solutions can be deployed on this case.

The quality of collaboration between business functions and IT that is facilitated by the incubator will be critical. While the incubator needs a clear mandate to operate independently, business departments must communicate business needs and help the incubator in ideation, selecting and prioritizing use cases, and supporting use cases to fit core and support functions. Meanwhile, IT must ensure the rapid development of use cases by providing a suitable development environment and supporting architecutre implementation.

Key survey insight

Sales, marketing and R&D

are where most companies see the biggest GenAI potential

What is the return?

Meeting financial targets and delivering return on investment are of course critical – however GenAI use cases cannot be evolved, tested and selected without a period of open-ended experimentation. Only then will return on investment follow.

- Stage one: Evolution. The process begins with accelerating the initial adoption, fostering innovation by minimizing management oversight and providing resources for experimentation without financial targets.
- Stage two: Implementation. Successful ideas move to organizing for delivery at scale, where prototypes are scaled, employees are upskilled, and pilot projects are implemented.
- Stage three: Optimization. This phase focuses on sustained ROI ensuring long-term value by rigorously monitoring KPIs, improving and standardizing processes, and scaling impactful use cases while eliminating non-performers (*see Exhibit 19*).

EXHIBIT 19

Incubator success: Enable, scale, monitor

Ensure that GenAI ideas deliver long-term financial and operational **returns**

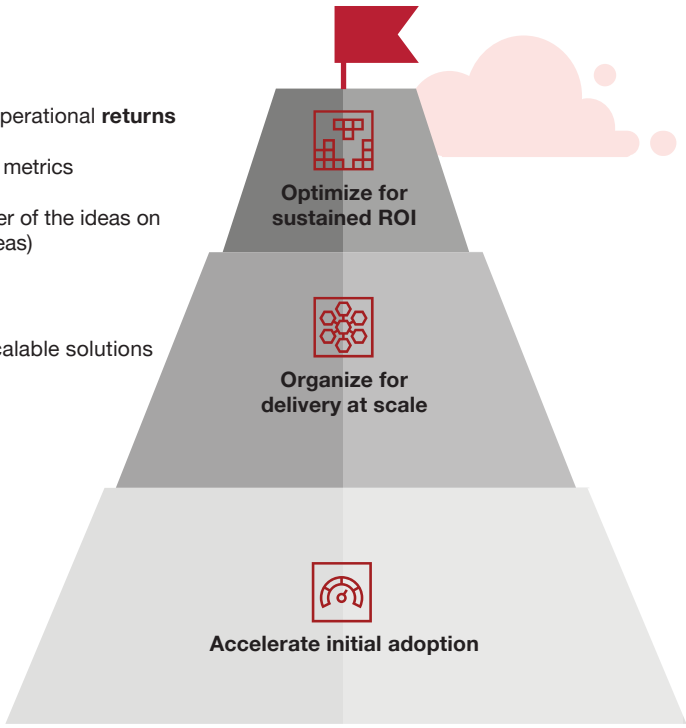
- Monitor success of use cases rigorously using defined KPI metrics
- Consistently sort out non-performing use cases
- Conduct process improvements to further enhance the lever of the ideas on the organization (i.e., standardized procedures for using ideas)

Transition successful prototypes and pilot projects into scalable solutions

- Implement and adapt initial pilot projects and prototypes
- Upskill 'accelerator' employees
- Provide resources to scale ideas within organization

Enable incubator to experiment with use cases without financial targets

- Limit guidelines and steering by management to a minimum
- Ensure that all requirements and support are provided



Source: Strategy& analysis

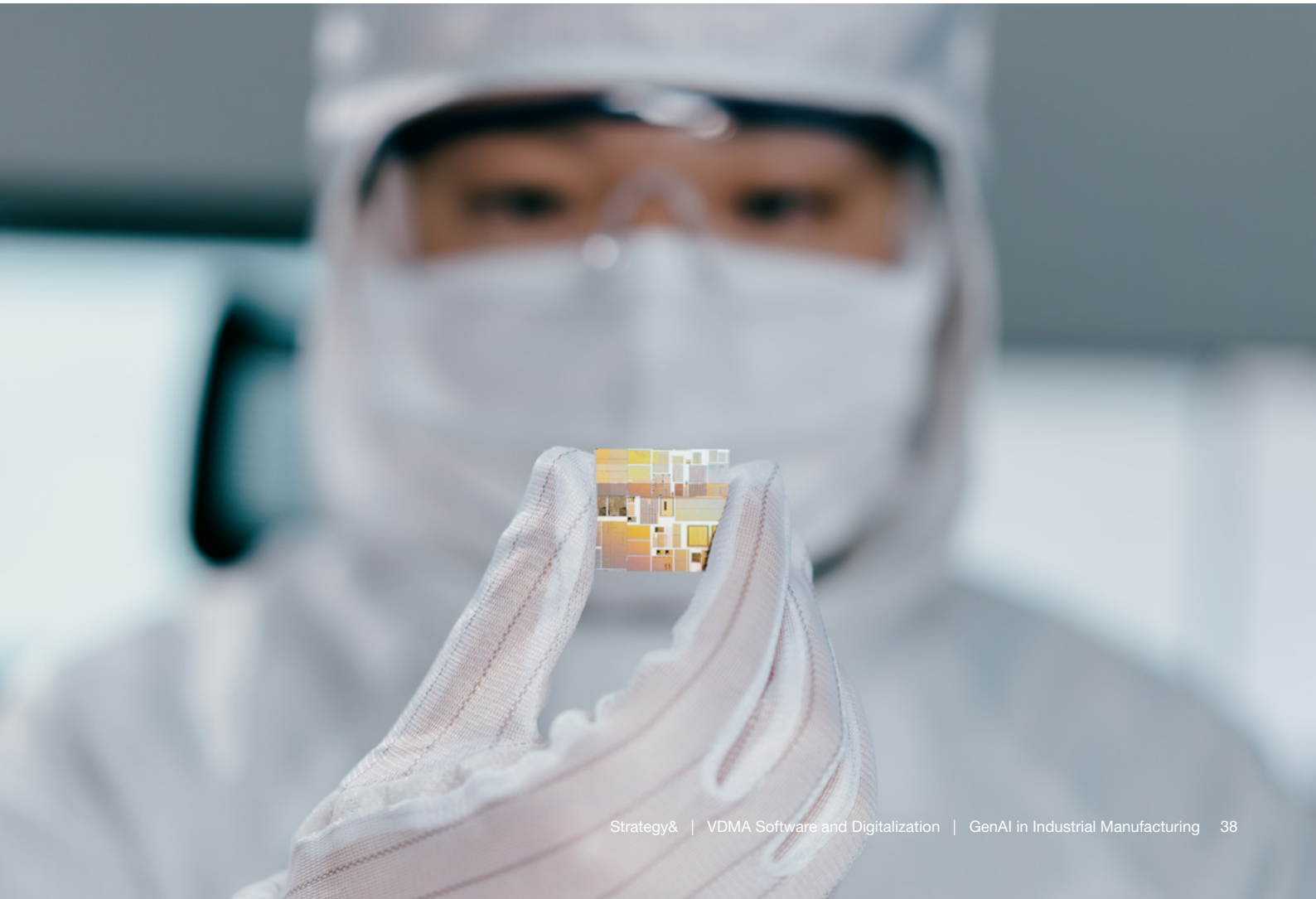
CONCLUSION

The developed GenAI incubator approach is a method for implementing this new technology, with a focus on profitability and scalability in the business environment.

Across the industry, companies face the challenge of selecting from a wide range of technological options while always keeping profitability improvement in mind. Typically, they have struggled with e.g. an overload of technology options, a mismatch of use case to profitability potential, and decision complexity about how to identify the most promising technologies, accelerate them, and monitor for performance.

We believe that the answer now is a clear-eyed insistence on GenAI vision, recognition of the need for structures enabling an accelerated implementation, intolerance of obstacles – and a willingness to act differently, even outside the standard playbook of the companies.

These are approaches that can be shown to work. The profitability potential they can unlock is too large to ignore – and the competitive implications of business-as-usual with a repeat of the last two decades of underperformance are too serious to risk.



Software and Digitalization

VDMA Software and Digitalization

The VDMA Software and Digitalization represents the interests of over 500 software manufacturers and reflects digital technologies in Industrial Manufacturing. The Informatics Department and VDMA Software and Digitalization work closely together and are managed as a single unit within the VDMA. The goal of both groups is to promote collaboration between the software industry and mechanical engineering, thereby driving digital transformation forward.

vdma.org/software-digitalisierung
vdma.org/digitalisierung-industrie-40

Additional information

Publication overview Software and Digitalization
Our publications deal with various aspects of digitalization in mechanical engineering companies as well as cybersecurity and information security and serve as recommendations for action.
All information about our publications:
https://www.vdma.org/viewer/-/v2article/render/77810045

VDMA industry podcast (German)
The audio blog for industrial manufacturing industry also highlights digital trend topics such as platform economics, digital sovereignty, artificial intelligence, smart factory, security and blockchain.
https://derindustriepodcast.podigee.io

Artificial Intelligence – Current activities:
https://www.vdma.org/viewer/-/v2article/render/87055925

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