AI in European Manufacturing Industries

2020

The Path to AI Value Creation

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Our insights show that we have only scratched the surface of the true impact of AI in Manufacturing, its workforce, and society more broadly.

— **Çağlayan Arkan**, Global Lead Manufacturing and Resources Industry, Microsoft

Contents

Foreword

Capturing value from AI in unprecedented times

The pace of digital transformation continues to accelerate, with technologies like Artificial Intelligence raising the bar ever higher for technology's potential to address some of society's biggest challenges.

In the Manufacturing Industry, the opportunity is extraordinary, especially when looking at critical topics such as innovation, workforce transformation and sustainability. In reality, with the help of AI, manufacturing businesses secure their seat at the forefront of innovation, talent acquisition and operational efficiency and effectiveness.

For a deeper understanding of AI in the Manufacturing Industry, and to measure companies' expectations and priorities around AI, Microsoft and EY conducted this study across 15 countries in Western Europe. With responses from more than 80 Manufacturing leaders in the industry, we see clearly that AI is top of mind for manufacturing decision-makers across Europe, and there is widespread interest in having a broad, unified approach to long-term AI development. But there is still much work to be done to implement AI solutions at scale, to develop a workforce with the skills necessary to do so, and to take advantage of all that AI has to offer.

At Microsoft, we recognize the complexity inherent in strong AI development, as well as the deep responsibility we have as a technology provider to ensure that AI is developed responsibly and in a way that fosters trust and protects innovation.

The leading manufacturing organizations we surveyed in this study show boldness in scaling their AI efforts by allocating necessary funds, building robust governance, and transforming the organizational culture. A culture that needs to become increasingly open and agile, from top to bottom to really embrace change and to allow AI to thrive. These leaders realize concrete cost reductions, improve their decision-making capabilities use AI to further boost customer engagement.

One of the key learnings is that true "AI transformers" have made AI integral to the business, anchored the AI agenda and plan with the C-suite, and are allocating significant resources to AI initiatives.

Fostering such an AI-innovation culture is most of the times in conflict with the more traditional approach of production systems. A model with incubators – allowing people to freely use all kind of new technologies and ideas to work out pilots – can foster that innovation and only when proven valuable they are moved to a more robust platform.

At Microsoft we support the combination of the needed innovation and robust scalability. We are deeply committed to working with Manufacturing companies and many additional partners to develop and deploy AI in a way that benefits all people equally. We hope that you will find this study helpful, and that it accelerates your organization's path towards becoming an AI transformer.

Marianne Dahl
Vice President of Sales, Marketing & Operations,
Microsoft Western Europe

At a Glance

What is the ambition of this report?

Putting AI into a greater Manufacturing context

The role of new technology, with Artificial Intelligence (AI) as a key component, is significantly improving business and production processes, creating a wide range of new opportunities in Manufacturing and generating value in entirely new frontiers. In continuation of Microsoft's previous European study of AI's potential role as a driver of transformational change in business, this report focuses on what Manufacturing companies are doing in particular to reap AI's benefits.

To understand AI's role in Manufacturing and how the technology's great potential can be fully exploited, Microsoft commissioned EY to carry out quantitative surveys and qualitative interviews with 110 business executives from 86 leading players in European Manufacturing across four industries: Automotive, Life Sciences, Process Manufacturing, and Discrete Manufacturing.

Here is the brief summary of what they told us.

AI has increased in importance over the past 12 months

We found that AI has increased in importance for 81% of surveyed Manufacturing companies in the past 12 months. Clearly, the increasingly dynamic and competitive environment Manufacturing companies face has put even greater pressure on the sector to reinvent itself by positioning technology ever closer to core operations.

Yet despite the growing importance of AI, only 10% of surveyed Manufacturing companies have formulated a distinct AI plan with clear objectives covering initiatives, responsibilities, and allocated resources. Surprisingly, 16% of companies – a relatively large share – are still developing and implementing AI on an ad hoc basis without a distinct plan.

Achieving significant competitive business advantage

A relatively small share, 12% of surveyed companies, have managed to successfully scale AI company-wide, and report having achieved significant internal and external value from implementing AI. These are the AI Manufacturing leaders, which on average have been on their AI journey for more than five years. These AI leaders have realized concrete cost reductions and improved decision-making capabilities, and are using AI to further boost customer engagement.

On the other hand, companies that embarked on their AI journey within the past 12-18 months have yet to see significant results. Despite the need and inevitability of AI in the sector, it is evident that there is no quick and dirty way of becoming an AI leader.

C-suites see substantial future opportunities

AI is gradually becoming a greater part of the C-suite led digital transformation, preferably anchored in the core strategy and aligned with overarching business targets, thereby accelerating the AI journey. However, it is important to emphasize that AI is only one part of the greater digital transformation.

Surveys and interviews indicate that there are substantial future opportunities for AI in Manufacturing. Yet when looking at the identified AI use cases across the value chain, there is still a significant gap between achieved impact and assessed future potential. This is especially true for use cases within Operations and Innovation.

Data is considered to be the most important aspect of AI …

For 77 of the 86 surveyed companies, data is the most pivotal element for AI solutions to perform properly. Interestingly, according to Manufacturing executives, the quantity of data is not a problem in the sector; instead it is a question of collecting and cleansing data so it can be easily plugged into AI solutions in production. Since many production processes have traditionally been run manually, digitalization is required in order to get the necessary data points for AI solutions to run efficiently.

110
business executives

from **86** Manufacturing companies in Europe have been surveyed and interviewed for the report

81%
of companies

have seen AI become more important over the past 12 months

Only 10%

of companies have formalized a distinct AI plan

This is the main reason that technological infrastructure is seen by the majority of surveyed companies as a far bigger issue than building AI solutions, as various processes and sensor-based data points need to be interconnected. In addition, the survey indicates that robust governance and structure surrounding AI solutions are viewed as critical for company-wide implementation and utilization of AI.

... but the knowledge gap needs to be closed by external partners

According to a number of Manufacturing executives in our interviews, historically slow adaptation of new technologies is impeding the move to complete digitalization. In these companies, the workforce has had a difficult time integrating new technologies in their work processes, leading to company-wide reluctance to adopt AI due to the complexity of the technology and the time required to integrate it.

The way forward is by upskilling the existing workforce, democratizing data science throughout the organization, hiring new AI experts such as data scientists and data engineers, and obtaining top management support. In other words, the corporate culture needs to become increasingly open and agile, from top to bottom, in order to embrace change and allow AI to thrive.

A valuable way of closing the organization's intermediate AI knowledge and skills gap is by creating a dynamic ecosystem that involves external partners such as tech leaders, consultancies, academia, and startups. This makes it easier to get started with internal development of AI solutions. Even though this approach is broadly acknowledged by the surveyed companies, only 8 view themselves as highly competent in building a dynamic ecosystem.

Getting started on the journey is key to reaping AI's benefits

The benefits from AI in Manufacturing have been modest up to this point. However, the growing importance and rise in awareness of AI, combined with improved access to AI knowledge, is powering the AI train that is ready to leave the station. The AI journey is long, and there is no time to waste. Companies need to immediately get on board and start experimenting, and begin their "Path to AI Value Creation."

The most AI-mature companies in Manufacturing have been on the "Path to AI Value Creation" – read more on pages 68-71

1. Acknowledge AI Potential
2. Transform & Plan
3. Data Foundation & Structure
4. External Partnership Ecosystem
5. In-House AI Expertise
6. Architecture & Infrastructure
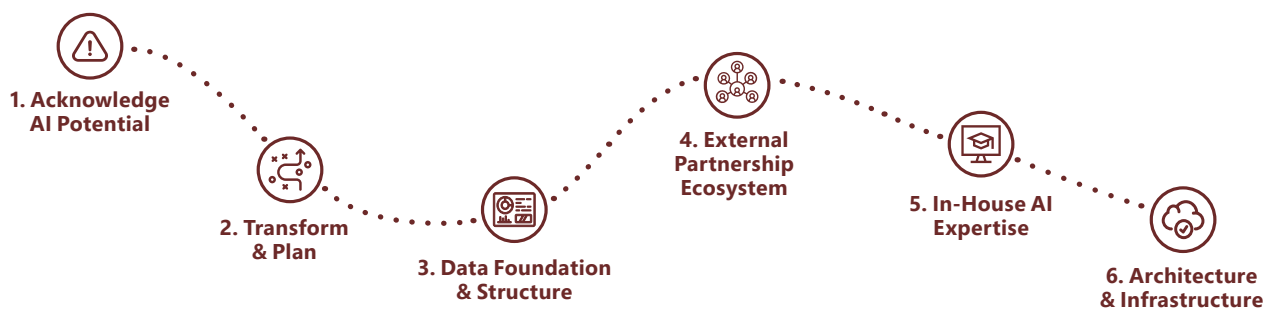
12%
of companies

have managed to scale AI company-wide and achieve significant internal and external value

AI leaders have on average been on their AI journey for more than

5 **years**

Only **8**
companies

see themselves as highly competent in building a dynamic ecosystem

"

AI is not happening in 5 years, it is not happening in 10 years. It started yesterday.

— **Essity**, Discrete Manufacturing

86 Companies

Who are the companies that have contributed to the report?

Abertis Infraestructuras, Ahlstrom-Munksjö, AkzoNobel, Alexion Pharmaceuticals, Alfa Laval, Altri, Ambu, ANDRITZ Group, ArcelorMittal, ASSA ABLOY, AstraZeneca, Atlas Copco, BA Glass, Baker Hughes Company, Bayer, Bemsiq, BMW - Bayerische Motoren Werke, Bühler Group, Cargotec Corporation, CEVT - China Euro Vehicle Technology, Clariant, Coloplast, Corticeira Amorim, Daikin Europe, Danfoss, Efacec Engenharia e Sistemas, Electrolux, Essity, FAES FARMA, FCA - Fiat Chrysler Automobiles, Ferring Pharmaceuticals, GN Audio / Jabra, Gonvarri Industries, Grundfos, Grupo Ferrer Internacional, Grupo Salvador Caetano, Gränges, Hexagon / Leica Geosystems, Husqvarna, Kemira, KONE Corporation, Konecranes, Laboratorios Cinfa, LafargeHolcim, LEGO, LEO Pharma, Lonza Group, Lundbeck, Merck, Metso, Nilfisk, Novartis, Novo Nordisk, Novozymes, Permobil, Perstorp, R. STAHL, Royal DSM, Royal Philips, SACMI - Società Anonima Cooperativa Meccanici Imola, Sandvik Group, Schindler Group, Secil - Companhia Geral de Cal e Cimento, SGS, Solvay, Sonova, Stora Enso, Sugal-Alimentos, Syngenta, UCB, UPM-Kymmene Corporation, Volkswagen Autoeuropa, Volkswagen Group, Volvo Cars.

Note: 12 participating companies have chosen to remain anonymous, while one company cannot be displayed due to being an EY US SEC Channel 1 client.

The Formula

What is the data foundation of the report?

The report is comprised of primary and secondary data

Understanding data is key to success for Manufacturing companies working with AI. This report builds on a robust foundation of primary and secondary sources of data, and clear distinctions have been made in terms of industries covered. These distinctions are central to benchmarking and comparing results. Comparability across industries is used in several places in the report in order to distinguish between participating companies on an industry level.

Participating companies are predominantly based in Europe, yet have global operations. Some non-European companies (e.g., headquartered in the U.S.) are also included, with focus on their European operations.

Primary data based on online survey and management interviews

Primary data was collected via an online survey covering the why, where and how of AI usage, providing a foundation for understanding the degree of AI maturity in the surveyed companies.

The participating 110 business leaders from 86 companies represent various business functions, and as such several areas of the companies' business, providing a comparative perspective on the data in terms of the impact of AI, and where responsibility for AI lies within the organization.

In addition, in-depth interviews were held with 40 high-seniority key stakeholders responsible for the AI agenda at the strategic or operational level.

These interviews supplement the survey results by deep diving on findings specific to the individual companies, whether it be a strong use case, a structural process for establishing a business case, or for instance embedding AI in the core strategy.

All data was collected in the beginning of 2020, prior to the outbreak of COVID-19. However, a post-COVID-19 perspective has been applied throughout the report.

The report covers the industries Automotive, Life Sciences, Process Manufacturing, and Discrete Manufacturing
What is the representation of participating companies per industry?

Automotive

17%

Automotive and commercial vehicle OEMs, including their suppliers and distributors of vehicle parts as well as other providers of mobility services.

Life Sciences

26%

Pharmaceutical, biotech, healthcare, and medical device (medtech) companies generally focusing on discovering, developing and producing drugs.

Process Manufacturing

26%

Companies whose production processes are mostly either continuous or batch, such as chemicals, steel, pulp and paper.

Discrete Manufacturing

31%

Producers of heavy industrial machinery, automation, and robotics solutions, measuring and monitoring equipment, as well as consumables and wearables excluding Automotive.

Note: The percentages are rounded numbers.

AkzoNobel

Getting the C-suite's blessing for company-wide commitment

After a slow start in identifying AI use cases, AkzoNobel got its C-suite involved, elevating AI to the strategic level. The company's Digital strategy is based on New Digital Products and Disruption, Manufacturing Excellence, and the Customer Experience.

Onboarding the C-suite

AkzoNobel spent about 8 years looking for applicable case studies. Over the past two years, they have become experts on the business intelligence side, and are accelerating from Prescriptive Analytics to Predictive Analytics. This acceleration was made possible due to the onboarding of the C-suite at a high strategic level, allowing the company to infuse AI into its core. The past couple of years, AkzoNobel has been developing a Data and Digital strategy centering on AI and Machine Learning.

The Digital strategy consists of 3 core legs:

New Digital Products/Disruption: Creating new transformative business models based on Big Data, which is often overlooked in Digital transformations.

Manufacturing Excellence: Using Data to further embed the principles of Lean manufacturing. Predictive Maintenance reduces downtime and optimizes manufacturing schedules.

Customer Experience: Creating an experience that keeps customers coming back. Creating new ways to engage customers, delivering desirable products before customers know they want them.

New Digital Products and Manufacturing Excellence

The value proposition behind AkzoNobel's New Digital Products is to fully engage with customers by integrating them in development, ensuring customer-centric products and delivering products and services that go beyond customer expectations. Advances in computing power and Big Data permit state-of-the-art research in paints, while Big Data and AI are enabling color development. Giving AI tools to those who run the business processes is extremely positive, leading to Manufacturing Excellence through automation of internal processes.

Enhancing the customer experience with AI

Experiences, rather than products or campaigns, are what people remember and talk about with their closest friends. AkzoNobel's uses AI to understand what customers want, aligning supply and demand through forecasting, and adapting production accordingly. The company constantly monitors the market for what competitors are doing, as well as what customers think of its products. It then uses its understanding of what customers want in order to find new Digital marketplaces in which to operate.

About AkzoNobel

AkzoNobel is the world's largest Paint and Coatings company, headquartered in Amsterdam, Netherlands. The company operates 53 brands in over 150 countries, manufacturing, selling and distributing decorative paints and performance coatings. AkzoNobel employs ~35,000 people globally. Fiscal year 2019 revenue: €10 billion.

Upskilling the workforce

With a lack of new AI talent entering the industry, and skilled AI practitioners being quickly employed at high wages by tech giants, AkzoNobel is upskilling its workforce for large, rapid gains in Data utilization. In addition, AkzoNobel's Paint the Future (PTF) Accelerator program engages new technology companies, startups, and disrupters in the Coatings industry to find partners that have exciting technology and share AkzoNobel's values.

> **We explored AI use cases for about 8 years, but the defining moment came when we got the C-suite onboarded. Their acknowledgement is crucial for scaling a Digital strategy.**

Executive's Lens

Who are the respondents that have contributed to the study?

Wide reach among surveyed and interviewed respondents

With survey responses and interviews among 110 stakeholders, this report draws on knowledge and experience from a broad spectrum of highly relevant respondents. The perspectives span broadly as a majority of the surveyed stakeholders also had the opportunity to expand their insights in qualitative interviews ensuring full understanding of the specific company and/or business function's work with AI. All respondents hold roles influencing AI, within their respective companies, providing a comprehensive overview of AI in the Manufacturing sector.

Respondents are exclusively from Management and above

Respondents represent various leader-

ship positions at the largest European Manufacturing companies. At the C-suite level, the focus was on survey respondents with the title of Chief Information Officer, Chief Digital Officer, and Chief Technology Officer as these have insights into the organizational development including the use of AI while also having excessive responsibilities and mandate to ample the use of technologies company-wide.

Simultaneously, respondents were fairly evenly distributed among C-suite, SVP/VP levels, and specialist roles such as Head of IT and Head of AI. A fewer number of respondents have a lower seniority position, yet with a deeper knowledge of AI within the respective companies, for instance with the title of Innovation Manager. The split allows to

capture both operational and strategic perspectives of the use of AI, understanding the barriers and challenges on an operational level. The split also captures management discussions from C-suite and digital committees putting AI at the forefront of new digital innovation within core strategy and operations of the surveyed and interviewed companies.

Capturing AI know-how from the entire value chain

Holding roles influencing AI in their respective companies, respondents covers the entire value chain. The ability to understand the variances of use, and the varying benefits achievable from AI, gave the opportunity to separate these and provide highly specific insights. Looking into the split

More than 100 participants
What is the number of participants interviewed/surveyed in the study?

110 participants

Majority of participants hold a top management or executive position
What is the organizational level of the participants in the study?

C-suite — 22%
Top Management (non-executive) — 38%
Management Level — 41%
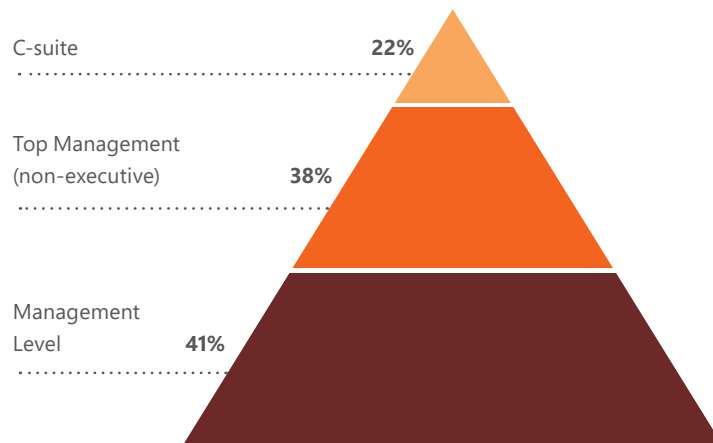
Note: The percentages are rounded numbers.

of respondents across the four business functions, there is an overweight in the Support business function, which covers IT as well as HR, Finance and Legal (referred to as "Admin"). IT consists of respondents holding digital and technology roles, under the IT umbrella, where one would often find some of the most AI and data knowledgeable stakeholders in many organizations. In some cases, however, the experience was that the most digitally mature companies (typically illustrated by a digital transformation and strategy) have established a lone standing digital and/or technology (eventually AI) unit outside of the IT scope but still closely connected to the core business and business process owners across business functions.

Four Manufacturing industries with a varying use of AI

The respondents of the report are rather evenly distributed across the four industries covered. While there is 26% in both Process Manufacturing and Life Sciences, there is a minor overweight of Discrete Manufacturing companies with 31% and a minor underweight of Automotive companies with 17%.

The majority of the heavy industrial Manufacturing companies are found in Process Manufacturing and Discrete Manufacturing (a few exceptions in the latter) that historically have been relatively stable in terms of working within the same scope or niche of business for an extensive period of time. On the contrary, Automotive and Life Sciences have a greater flexibility due to their

natural consumer-facing processes, where especially Automotive original equipment manufacturers (OEM) to some extent are consumer-facing through own dealerships. Common for all are, that their use of AI varies greatly as their operational focus differentiates their need for automating specific parts of the value chain.

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In the next decade, business workflows in Manufacturing across the full value chain will fundamentally change. Winners will integrate AI into the critical path of their business, unlocking its value.

The time is right for an AI report on the state of play and future direction of AI in the European Manufacturing sector.

The AI train is departing...

— EY

A balanced split of respondents across the four business functions
What is the split of participants by business function?

Commercial	13%
Operations	15%
Innovation	20%
	18% Admin
	16% Digital
	17% Technology
	52% Support

Interconnected Future

Why an AI report in Manufacturing?

Industry 4.0 has drawn attention to new Manufacturing technologies

The financial crisis, globalization including intense Chinese competition, and increasing asset prices from large private equity funds are some of the main changes Manufacturing companies have dealt with during the past 15 years. While early adopters were already introducing digital technologies before the financial crisis, the broader adoption started slowly with the introduction of the Industry 4.0 concept in 2011, picking up pace over the past 4-5 years.

Accelerating focus on AI in Manufacturing

Data suggests that Business Intelligence and AI solutions are technologies getting the most attention from Manufacturing companies in the coming years. 45% of respondents say funding activities will increase.

This is also apparent in Mergers & Acquisitions (M&A) trends in Manufacturing over the course of the past half a decade. Manufacturing companies have been involved in 179 transactions of AI-related businesses with a compounded annual growth rate (CAGR) of 64% from 5 deals in 2014 to 59 deals in 2019, with a total transaction value of €1.4 billion for the period. This culminated in June 2020 with Volkswagen Group investing $2.6 billion into Argo AI, a self-driving car startup.

Putting AI into a greater business context for executives

The advantage of combining technological aspects of AI, for instance system integration or data foundation, with a Manufacturing sector business perspective speaks for itself. Hundreds of global Manufacturing companies have defined and mobilized AI strategies and concrete AI initiatives since Industry 4.0 emerged.

Significant increase in recent number of M&A transactions focusing on AI in the Manufacturing sector
What is the development in number of AI-related M&A transactions in Manufacturing?

The data is sourced from **EY Embryonic**
M&A scan on global Manufacturing sector – a proprietary AI-powered tool covering multiple databases.

Compounded Annual Growth Rate

64%

2014	2015	2016	2017	2018	2019
5	13	21	26	55	59

━ Number of M&A transactions focusing on AI

The AI Toolbox

Which AI and supporting data technologies are used in Manufacturing?

Four overarching AI technology clusters are supported by five technologies for data collection
What are the most profound AI technologies included in the AI definition used in this report?

AI Foundation

Machine Learning
Ability of computers to learn and adapt to new data without human interference. Key component of most AI solutions.

AI Technologies
Bigger circle size denotes higher adoption

Supporting Data Technologies

Neural Networks & Deep Learning
Algorithms emulating human brain functions via several hidden layers. Broadly used across the entire value chain.

Smart Robotics
Intelligent robots refining and modifying actions by learning from its environment. Predominantly used in Operations.

Intelligent Operations

Computer Vision
Computers' ability to recognize targeted subjects from image data as human eyes. Extensively used in Innovation and Operations.

Blockchain

Additive Manufacturing
3D printing of product designs, enabling rapid prototyping in Innovation processes such as R&D and Product Development.

ICPS*

Industrial IoT

Simulation
Provides ability to virtually experiment for the purpose of optimizing manufacturing and operational processes, etc.

Vision

Big Data & Analytics

Biometrics
Measurement and analysis of people's unique physical and behavioral characteristics, such as fingerprint or retina. Often used for access control for vehicles, labs, etc.

Cloud & Edge Computing

Natural Language Processing
The ability of computers to process and analyze large amounts of natural human language. Broadly used across the entire value chain.

Language & Speech

Virtual Agents
Computer-generated virtual personas used for customer service interactions in Commercial or factory floor FAQ in Operations.

Text Analysis
Transform unstructured text in documents and databases into structured data suitable for analysis. Predominantly used in Support.

Speech Recognition
Enables computers to interpret spoken language and to transform it into written text. Broadly used across entire value chain.

Industrial Cyber Physical Systems

Strategy & Plan

When embarking on the AI journey, the time horizon is often underestimated, particularly as organizations struggle to fully leverage AI due to a number of barriers.

The first step after acknowledging the opportunities that AI offers is to define a clear plan, typically as part of a broader digital transformation that includes other technologies.

A common starting point is a centralized AI or data unit. Yet, as AI solutions move from piloting to scalability, close collaboration between domain experts and AI experts is key to success.

A Learning Quest

The progression of the AI journey

COVID-19 is the epicenter of a great technology shift

The increased focus on automating core business processes, particularly post-COVID-19 where there's a need for robustness, will speed up the pace of technological change in Manufacturing. For instance, there may be an increased need for a varying number of employees on the factory floor.

Cultural barriers challenge the leveraging of technology

It's complicated to fully leverage the technological shift in many traditional Manufacturing companies. Many respondents are market leaders, yet are still relatively slow in embracing new technologies. Lower attrition rates among staff have contributed to the inertia, yet market demands in combination with an increasing use of personal

technologies are gradually reducing the reluctance to change. A central barrier is the cultural transformation required to go from an 'inside-out' to an 'outside-in' company. Companies with an 'inside-out' culture often have a strong track-record of delivering excellent products, relying primarily on internal capabilities. Going forward, a cultural shift is needed before a successful transformation can take place.

An accelerating AI journey

On average, AI leaders have been on the journey for more than five years. Nineteen percent of respondents say that AI has become significantly more important, while the remaining ~81% have not experienced a significant increase in importance of AI over the last 12 months. One key trend across all participants is that the involvement of

the C-suite accelerates the AI journey. Putting AI on the core strategy agenda enables company-wide commitment starting at the top. This often leads to a greater incentive to invest capital into building robust governance, a strong data foundation, and hiring people with the right skills.

However, even with C-suite support, one cannot expect to become an AI leader overnight. For the most AI-immature companies, 12 months is a short time frame; industry leaders that embarked on the journey within the past 24 months emphasize that AI can't be rushed.

AI is accelerating in importance on a strategic level
Has there been a change in the importance of AI in your company over the last 12 months?

	1	2	3	4	5
	0% 8% 8% 3%	13% 17% 8% 17%	38% 21% 54% 52%	19% 25% 25% 10%	31% 29% 4% 17%

Not at all
The focus of AI may have changed, but the importance of AI has not increased nor decreased

To some degree
AI has become more important, but is prioritized at the same strategic level

To a very high degree
AI has become significantly more important and is prioritized at a higher strategic level

Avg. Score	Automotive	**3.7**	Life Sciences	**3.5**	Process Manufacturing	**3.1**	Discrete Manufacturing	**3.2**

Note: The percentages are rounded numbers.

Planning AI

What are the most important aspects of an AI plan?

A clear vision and direction are central for a solid AI plan

Building a distinct AI plan is necessary to become an AI leader. The plan needs to contain an ambitious yet realistic vision consistent with core business goals so that AI becomes a key enabler in daily operations. If the AI plan is driven solely from a detached unit, the plan will be ineffective. Starting out with a centralized unit is common practice, but it is crucial to establish buy-in from divisions and business functions where the overarching vision is divided into a manageable number of objectives, each connected to tangible targets.

Transparent allocation of budget, resources, and roles

Allocation of resources and budgets are required to ensure full commitment to the AI plan. Initially, the spend on AI will often come from either the R&D,

Innovation and/or IT budget. However, when the results become apparent for top management, AI leaders tend to quickly obtain a mandate to secure a sufficient resource pool for AI.

A major cost related to AI is building a data unit with all the necessary competencies. Without an exclusive AI resource pool, progress is unlikely. Therefore, AI experts need to be hired or upscaled internally. Simultaneously, AI agents across the organization need to be identified to drive business push. Without dedicated agents, developing Advanced Analytics or even just applying data to AI will be difficult.

Few companies position AI as a standalone digital priority

Only 10% of surveyed respondents have formalized a distinct AI plan. According to 45% of respondents, AI is

still predominantly positioned as a central part of a greater digital strategy, without a distinct AI plan. Interviews indicate that the AI leaders have formalized and distinct AI plans in place.

The most immature companies, being 20% of respondents, have yet to define an AI strategy, indicating that quite a large share of industry players have yet to begin their journey towards becoming proficient in AI.

Few companies distinct AI from general digital priorities

To what degree has your company defined a distinct AI plan with e.g., clear objectives, initiatives, responsibilities, and resources allocated?

	1	2	3	4	5
	19% 17% 25% 21%	0% 17% 8% 17%	50% 38% 54% 41%	19% 21% 4% 10%	13% 8% 8% 10%

Not at all
The focus of AI may have changed, but the importance of AI has not increased nor decreased

To some degree
AI has become more important, but is prioritized at the same strategic level

To a very high degree
AI has become significantly more important and is prioritized at a higher strategic level

Avg. Score — Automotive (3.1) — Life Sciences (2.9) — Process Manufacturing (2.6) — Discrete Manufacturing (2.7)

Note: The percentages are rounded numbers.

Organizing AI

How should Manufacturing companies organize AI responsibility?

Optimal AI responsibility is a mix of domain and AI experts

The organization of responsibility for AI varies greatly as indicated by survey data. The most frequent is AI responsibility which is split across business areas and/or hierarchical levels. Typically, the best mix of skills is a hybrid between a domain expert from core business processes and an AI expert. This can be supported by establishing a centralized digital committee supporting the AI agenda.

Ad hoc approach to AI yields limited impact

Often, the first way to organize AI responsibility is ad hoc driven from various places in the organization without a defined structure. This is a sign of companies merely trying out AI. Yet this is the least impactful way to organize AI, as commitment throughout the company is required. With an ad hoc approach, AI often becomes a lower priority, as it is expensive and takes time to become successful. In addition, lessons learned from previous experience are not captured without a proper structure.

Strategic and operational responsibility need to be separated

The second way to approach organizing AI responsibility is from a group or business function management perspective. In this approach, there is a difference between strategic and operational responsibility. Management has the strategic responsibility, yet execution is by dedicated employees. With successful Proof of Concepts (PoC) completed, the company move on to other ways of organizing AI responsibility, as they realize the challenge of scaling needs a more holistic and structured approach.

AI Center of Excellence works as a knowledge hub

The third way to organize AI responsibility is with an AI Center of Excellence (CoE). It is typical among capital-strong companies willing to invest significant funds into the development of AI capabilities and projects. However, it is not necessarily the most effective way. An AI CoE can work well as a centrally driven knowledge hub.

The more involved, the greater the impact

The fourth and most effective way to organize AI responsibility is spreading it among units across business areas and/or hierarchical levels, typically supported or even facilitated by the local IT organization. This is because operational ownership needs to be integrated throughout the lower levels of the organization yet supported by AI experts. Usually, those involved in AI pilots are also the agents. Thus, involving more relevant employees leads to increased commitment and in turn chance of success. Therefore, having dedicated company agents who can make AI initiatives soar in the organization is integral.

Most Manufacturing companies organize their AI responsibility across business areas and/or hierarchical levels

Where is the responsibility for AI organized in your company i.e., define and/or develop governance (e.g., metrics, use-case selection, etc.)?

Across business areas and/or hierarchical levels	39%
Driven ad hoc	16%
AI Center of Excellence	15%
IT	14%
Group Management	10%
Business Function Management	6%

Note: The percentages are rounded numbers.
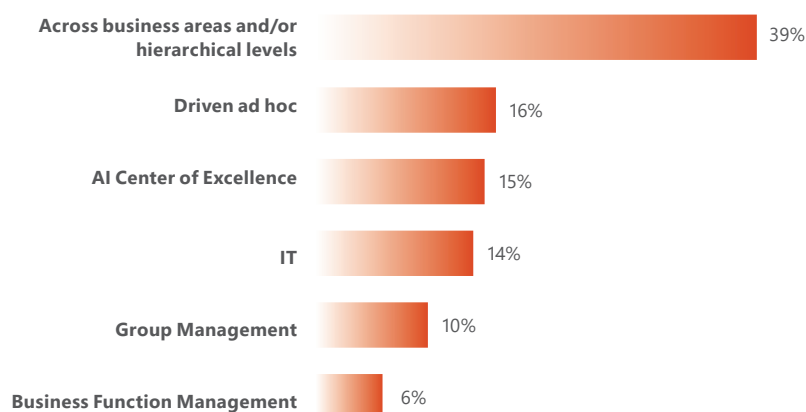
Novartis

AI is at the heart of digital innovation

AI has been an active part of automating drug discovery at Novartis for almost a decade. A recent AI strategy was established as part of a formal digital strategy embraced by the C-suite, and supported by a dynamic community of external partners.

A nonlinear journey

Although AI has been an integrated part of the value chain at Novartis for almost a decade, an enterprise-wide approach to AI was undertaken in recent years with the establishment of a digital strategy.

Previously, AI was initiated on a business line level, where various parts of the organization evaluated their individual strategies and experimented with AI, trying to understand how they could apply AI within their own context. With each team pursuing their own approaches, Novartis had a bottom-up approach, which was good initially, and helped deliver value in pockets. Substantial headway was made in some areas, both in terms of business experience and how to apply AI. Novartis went through the typical learning cycle of AI, starting by believing AI can solve all problems; finding out that AI is hard work and getting basics right; and then starting to build its AI foundation by cleansing data, establishing robust governance, skill building, establishing platforms, etc.

Infusing AI into the core strategy

For many Manufacturing companies, the most important point is how the business understands AI and the journey, i.e., how to properly apply the technology and where to apply it.

Novartis is at the latter stage of its AI cycle. Executives have a clear vision and an idea of where AI can and cannot help them, and what it takes to implement and integrate AI, not from a technology perspective, but from a business perspective. Its C-Suite has embraced and built an experimental culture, and with an end-to-end understanding of AI, the company is maturing enterprise-wide.

The company is transitioning from a bottom-up approach to a central hub with business driven spokes, where thinking about common practices, networks, communities, lesson-sharing, and common tools and platforms are emerging. The hub is a centralized AI and data science function that supports strategic AI-based initiatives across business lines, and fosters a community, best practices, and infusion of external innovation. Novartis wants to keep AI close to the business, with the central hub expertise supporting the business in areas where domain experts lack know-how. It employs a pragmatic approach, evolving on an as-needed basis and a set of principles about what is steered centrally and what is controlled by the business lines. Main strategic initiatives are called lighthouse projects, which are the top 10-12 ambitious digital bets that are driving the focus on cooperation across functions.

About Novartis

ᚼ NOVARTIS

Novartis is the world's second largest Pharmaceutical company, headquartered in Basel, Switzerland. It consists of 2 central medical divisions, manufacturing and distributing 87 drugs across 155 markets, with +200 projects in the clinical pipeline. Novartis employs ~125,000 people across 60 manufacturing sites globally. Fiscal year 2019 revenue: €44 billion.

A dynamic ecosystem

Even though Novartis has internalized many of its competencies, it has built a strong digital community involving tech leaders like Microsoft as well as a number of startups in order to understand how to interconnect AI skills, tools, practices, and competencies with the organization. AI needs to be embedded into the core to fully succeed, and the community provides an outside-in perspective, helping accelerate areas such as capability building and access to the required infrastructure.

> **From big tech to academia to the startup community – we need an ecosystem of partners to really advance AI in Life Sciences.**

AI Impact

There's an immense impact gap between "Emergents" and "Transformers," due to the challenge of scaling the AI solutions and achieving significant outcome from leveraging AI.

Outcome includes internal value, such as cost- and time savings, as well as enhancing the delivery of customer-facing value, leading to new revenues and improved customer satisfaction.

The biggest hurdle to becoming a Transformer is the complexity of scaling, as capability alignment, a distinct AI plan, and a formalized structure are crucial.

Creating Impact

How does Scale & Outcome lead to Impact?

The true measure of AI's impact is the ability to scale AI solutions and achieve outcome from their use. Manufacturing companies are not yet at a high level of maturity. There are twice as many Emergents (28%) than Transformers (12%). Opportunists (27%) and Innovators (33%) are also well represented, indicating that Manufacturing has embarked on its AI journey.

The majority are either Emergents or Innovators with fewest being Transformers

What is the Impact achieved from AI measured by Scale and Outcome?

OUTCOME

External Value Creation,
Internal Efficiency
Improvements,
Solution Enablement

Transformers
12%

Innovators
33%

Opportunists
27%

Emergents
28%

SCALE

Implementation in Business Functions, Number of Solutions, Managing AI
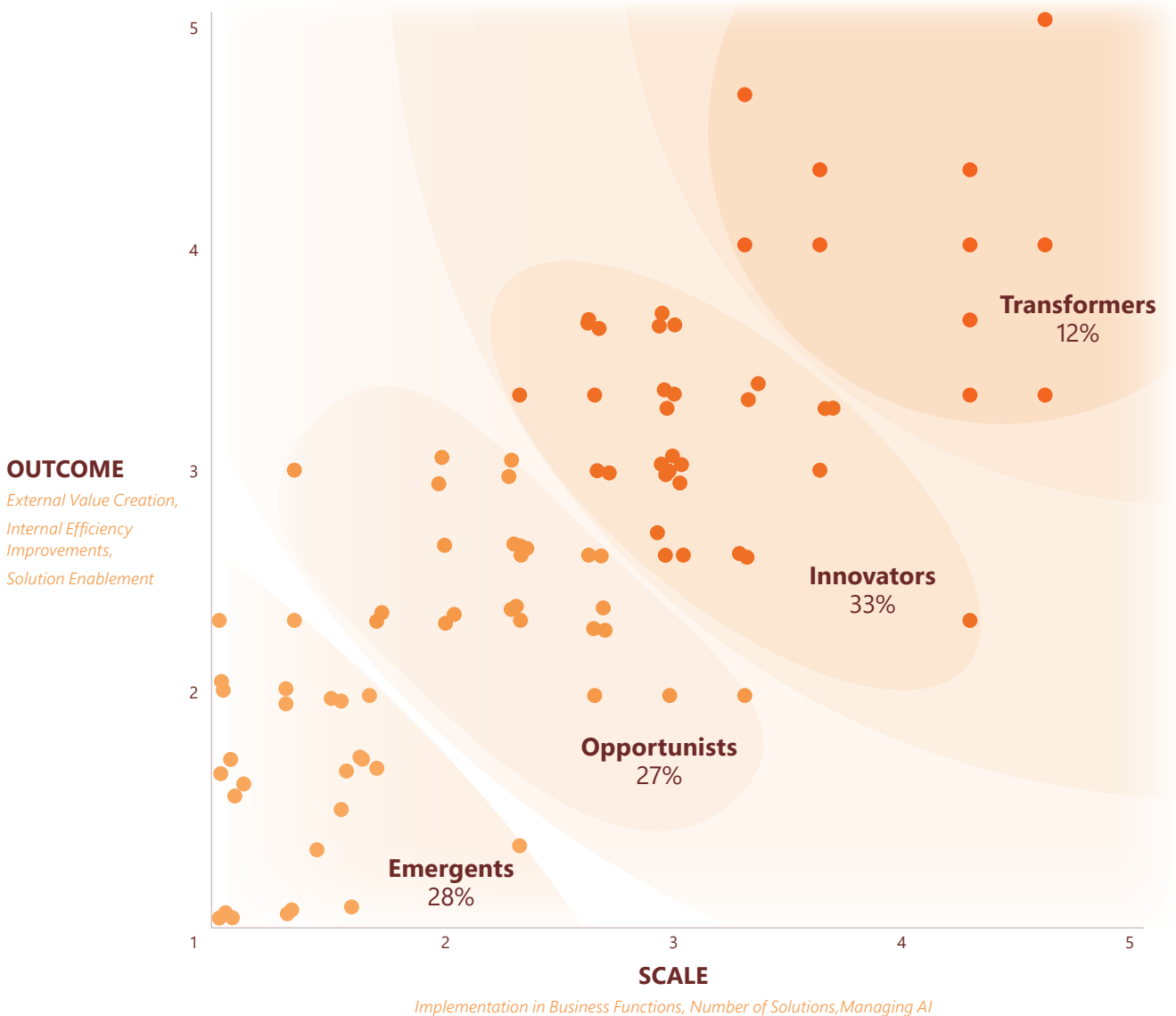
% of respondents

Transformers

For Transformers, AI is significantly impacting the business model, solving tasks that were not previously solvable. AI is embedded in internal and external processes, as well as products. A distinct AI plan has been defined with clear objectives and acknowledged by the C-suite for whom AI is a key core strategy enabler, with substantial capital earmarked for further investments.

12%

Innovators

Innovators have put AI at the heart of their digital transformation. The cultural transformation is progressing, with strong collaboration between business and tech. Innovators are adapting, for instance by establishing cross-functional data units, or by hiring AI experts. Selecting AI initiatives is a strict process, with approval of PoCs based on comprehensive business cases that have key performance indicators (KPI).

33%

Opportunists

Opportunists find AI to be a compelling technology and see it as a future value creator, but operationalization is lacking. However, they have achieved some value from limited efforts such as initial pilots, and are considering expanding the AI agenda. Yet they are cautious, as they lack know-how, competencies, and a structured plan for progressing on a company-wide level.

27%

Emergents

Emergents have only leveraged AI to a very limited extent. They have gradually acknowledged AI's potential, but have yet to prioritize it. Lacking top management support impedes scalability, as allocation of resources is limited or unstructured. Although use cases are identified, there is no consistency in clearly defining a business case or measuring impact. Emergents struggle to convert PoCs into production.

28%

R&D Lab Acceleration | **Innovation** » Commercial » Operations » Support | 📁 **Use Case**

Accelerating time-to-market at the R&D and Innovation Lab

Activity — The R&D Lab uses technologies such as Computational Science, Image Recognition, and Machine Learning to develop and design new products and services for release.

Technology — R&D Lab Acceleration is an AI solution fostering and expanding the lab experience by empowering the innovation process with development of new products and services.

Impact — The use case enables real-time ideation and innovation, allowing for continuous self-disruption through faster iterations, reducing the number of development loops and time-to-market.

AstraZeneca has adopted the use case to reduce their drugs' time-to-market.

AstraZeneca

" AI has the potential to transform the way we discover and develop new medicines – turning yesterday's science fiction into today's reality.

Scaling the AI Agenda ...

How advanced is the scaling of the AI agenda?

The AI agenda does not yet cover all business functions

Scaling AI is difficult and takes time. For the majority of Manufacturing companies, AI is integrated into very few business functions, being a sign of silo-based AI infusion or limited focus (e.g., testing in a single unit before scaling the solutions). This is evidenced by 87% of all surveyed companies having AI solutions implemented in no, very few, or some business functions, i.e., very few are driving a company-wide scaling of AI.

The number of implemented AI solutions is limited

Twenty-five percent of respondents have no or very few AI solutions in place, with only 9% having a significant number of solutions implemented. This indicates that AI maturity among Manufacturing companies is still

quite low. The companies that have a difficult time scaling their use of AI can learn from the AI leaders, particularly in allocating the necessary funds, building robust governance, and transforming the organizational culture to allow for agility and a certain degree of risk taking.

> **We started with AI in 2011 – back then it was called Advanced Analytics. Today, we have many different AI initiatives across the value chain focusing on insights generation and automation.**
>
> **— UCB**, Life Sciences

SCALE

Implementation in Business Functions
How many business functions have implemented AI solutions in your company?

Average Score

33%	18%	36%	8%	5%	**2.3**

Few business functions
AI has been implemented in few or no business functions

Some business functions
AI has been implemented in some business functions

Significant number of business functions
AI has been implemented in most or all business functions
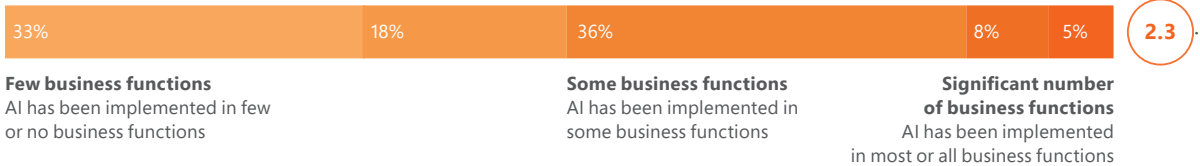
Number of Solutions
How many AI solutions have been implemented in your company?

25%	18%	40%	9%	9%	**2.6**

Few solutions
Few or no AI solutions have been implemented

Some solutions
Some AI solutions have been implemented

Significant number of solutions
Significant number of AI solutions have been implemented

Scale Average 2.5
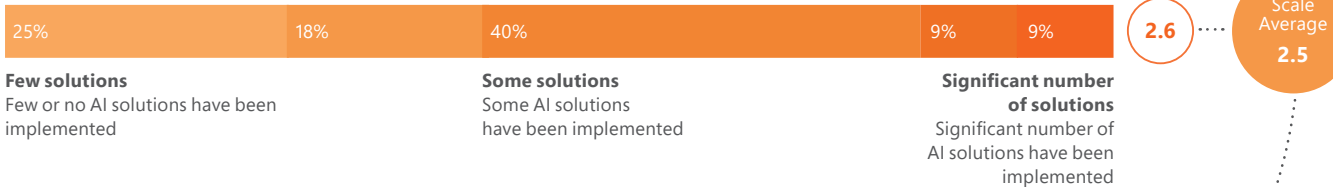
Managing AI
How structured is your company's work with AI?

28%	16%	40%	15%	1%	**2.5**

Limited structure
Limited or no formalized structure for planning, development or maintenance of AI solutions

Some structure
Some formalized structure for planning, development or maintenance of AI solutions

Complete structure
Formalized structure for planning, development or maintenance of AI solutions have been fully implemented

● 1   ● 2   ● 3   ● 4   ● 5

Note: The percentages are rounded numbers.

Managing AI solutions in a structured way is a struggle

According to the survey, 84% of respondents have no to some structure in place and are thereby struggling with managing their AI solutions in a consistent way across the organization. This indicates that the AI agenda is still largely ad hoc driven rather than carefully planned. As only 1% of respondents have a complete structure, there is space for optimizing the steering of AI as a topic and tool, as most companies lack a formalized structure (i.e., developing, planning and maintaining AI solutions).

Three things to get right when scaling AI

The combination of scalability and utilizing the ability of AI to empower employees creates a powerful opportunity to increase operational efficiency.

When summarizing interview insights, the most AI-scalable companies are mainly doing three things right:

Firstly, from an organizational perspective they are moving from siloed functional work to cross-functional teams, where domain experts and AI and data experts are achieving significant impact by working side by side.

Secondly, these companies are changing how they make decisions. The decision-making process is much less top-down compared to how these companies made decisions in the past. The approach empowers frontline teams to make decisions based on a robust data foundation, increasing the visibility and knowledge behind their decisions.

Thirdly, the acceleration of AI implementation also changes the mindset in the transition from being risk averse to being much more agile, iterative and willing to experiment. The open and dynamic culture that naturally occurs with AI increases the ability to adapt to a changing environment, and enable executives to not only fail fast, but also learn fast.

The scalability of AI is highly correlated with the ability to master the components of a robust AI plan and building up all the capabilities needed for developing and managing AI solutions.

Predictive Inventory Management : Innovation » Commercial » **Operations** » Support   📁 **Use Case**

Adapting Inventory Management to real-time demand

Activity
Predictive Inventory Management is an AI solution leveraging Machine Learning and IoT-based warehouse sensors to adapt production to real-time supply and demand by tracking stock.

Technology
Predictive Inventory Management connects ERP-systems with real-time demand via IoT-based inventory sensors and Machine Learning to align optimal reorder points and component quantity.

Impact
The use case reduces the risk of overstocking leading to excess supply, or understocking leading to potential lost sales. It also reduces inventory planning time.

FCA has adopted the use case to plan the procurement of vehicle parts in warehouses.

FCA
FIAT CHRYSLER AUTOMOBILES

"

Predicting market demand allows us to adapt the numbers directly to Warehouse and Inventory Management.

... and Achieving Outcome

How much value has been realized by solving business problems with AI?

Creating significant value with AI is currently only for the AI leaders

AI has the potential to enhance and extend the capabilities of humans, and help Manufacturing companies achieve results faster and more efficiently. However, implementing AI involves adjustments and adaptation throughout the organization.

Some of the respondents indicate, that AI helps optimize processes or solve tasks that previously were not always feasible using human labor and intelligence, with 11% saying that

their AI solutions are solving complex problems. This indicates that they are increasing their use of AI to solve complicated tasks rather than simple ones. A good example is the use of AI, Blockchain, and intelligent sensors and tags in supply chain operations to increase transparency and traceability of

products and materials. Yet, to a large extent this is only used by the most mature AI companies. Looking broader across the sector, value creation is not yet present, with only 89% of respondents creating minimal to some external value, and 82% creating only minimal to some internal value.

"

We are using AI internally to make products faster, better and more efficient, but in the end the overarching goal is to satisfy our customers.

— AkzoNobel, Process Manufacturing

OUTCOME

External Value Creation
How much external value has been created from AI solutions in your company?

Average Score

| 28% | 19% | 42% | 8% | 2% | **2.4** |

Minimal external value creation
Minimal or no increase in customer satisfaction, revenue stream or brand value

Some external value creation
Some increase in customer satisfaction, revenue stream or brand value

Significant external value creation
Significant increase in customer satisfaction, revenue stream or brand value
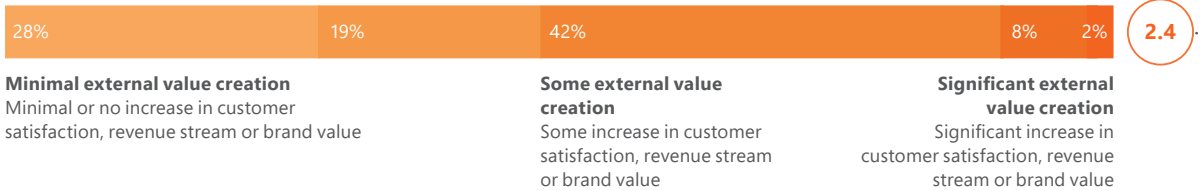
Internal Efficiency Improvements
How much internal value has been created from AI solutions in your company?

| 18% | 27% | 37% | 11% | 7% | **2.6** |

Minimal internal value creation
Minimal or no increase in cost savings or efficiency improvements

Some internal value creation
Some increase in cost savings or efficiency improvements

Significant internal value creation
Significant increase in cost savings or efficiency improvements

Outcome Average
2.7

Solution Enablement
How does AI improve your company's ability to solve problems?

| 14% | 14% | 39% | 22% | 11% | **3.0** |

Simple tasks
AI is used to reduce simple tasks that previously required human interaction

Optimize processes
AI is used to optimize processes and deliver better results

Complex problems
AI is addressing problems of vital importance that could not otherwise have been solved

1 2 3 4 5

Note: The percentages are rounded numbers.

External value creation is next area of focus

According to the survey, there is a greater tendency of achieving internal value with AI rather than external value. Respondents indicate that the extent of significant internal outcome achieved, such as cost savings or increased productivity, is greater than the external outcome achieved such as revenue growth. While 7% of respondents have realized significant internal value from AI, only 2% responded that they have realized significant external value. However, with almost half of respondents stating minimal or no benefits achieved so far, either internally or externally, it is clear that Manufacturing companies have yet to reap big rewards from AI.

Looking at the internal processes where AI can be most beneficial, improving production process efficiency and reducing human errors are key optimization areas leading to increased quality. A good example is Automotive OEM quality assurance (QA) processes, where improvements in metrology hardware with image recognition capabilities are being supplemented with increasingly sophisticated sensors and software with embedded AI functionality. Together, this both improves the accuracy and pace of the QA process.

Based on interviews, there is a lack of focus on integrating AI solutions in highly tangible products. It is mostly Automotive companies, and to some degree Life Sciences, that are accelerating the integration of AI into the product portfolio. Reputational risk in case of failure is high, and is a key barrier mentioned in many interviews concerning integrating AI into the product portfolio. Only the most mature companies dare to embark on that journey.

However, timing also plays a role. The AI journey is long, and reaping rewards from pilots in customer-facing processes may take as much as 6-18 months.

Outcome can be accelerated by mastering core competencies

The scalability of AI solutions in production, and the number of business functions they are implemented in, is highly dependent on putting a robust AI plan in place. This includes executive ownership, sufficient funds, clear prioritization of the framework, and business value creation measured through KPIs.

On the contrary, the outcome achieved from the solutions are closely linked to mastering core competencies (see "Pillars of AI" section) associated with AI. This is the case for both internal process optimization and when leveraging AI in more externally facing functions and processes.

Demand Planning & Forecasting ┊ Innovation » **Commercial** » Operations » Support 📁 **Use Case**

Predicting market demand and adapting forecasts with AI

Activity

Demand Planning & Forecasting is an AI solution that leads to increased accuracy of forecasted demand and also production by for instance utilizing market trends to optimize production levels.

Technology

Demand Planning & Forecasting uses Semantic Technology and Machine Learning to align production with predicted sales through a detailed understanding of sales patterns and anomalies.

Impact

The use case improves financial planning and capacity planning, leading to improved profit margins, as well as risk assessment decisions to increase accuracy and optimize replenishment processes.

Volvo Cars has adopted the use case to adjust production to real-time demand.

❝

AI provides better analysis and forecasting on the factory floor. It creates significant value for us, as we can predict demand more accurately.

Value Creation

How much value have Manufacturing companies extracted from AI?

Correlation between robust structure and number of AI solutions

There is a correlation between the number of AI solutions and the implementation in business functions. In other words, the more companies test and pilot new AI solutions, the more they succeed in implementing and driving value in multiple business functions. Also, companies that have a robust structure have the ability to scale their solutions and implement AI solutions across several functions and processes. This indicates that ad hoc driven PoCs have a lower probability of being scaled company-wide than if robust governance is in place that addresses planning, development, and maintenance of AI solutions.

Large AI maturity discrepancy across all industries

Even though Life Sciences and Automotive have the highest share of Emergents, these industries also have the highest share of Transformers, which is a promising sign for the future.

Only 4% of Process Manufacturing respondents are Transformers, while 50% are Innovators, meaning they are heading towards becoming highly AI-mature. Even though the industry has many companies operating in niche markets with rather squeezed margins, market conditions have pressured industry players to incorporate technologies in their processes. With high-volume production, even minor improvements can mean large savings.

Automotive has the highest maturity when looking solely at the number of Transformers, while having the second-highest maturity when measuring percentages of respondents in Innovators and Transformers.

Generally, the maturity span is typically smaller in Discrete Manufacturing and Automotive relative to Life Sciences and Process Manufacturing. The sector's best-practice AI players are often also market leaders, while the most AI immature companies do not (or at least very seldom) enjoy a market-leading position.

Time is a central factor in becoming a Transformer

The acceleration of scaling AI solutions or the achievement of outcome is feasible to some extent by defining a robust AI plan or building core AI competencies. However, the combination can rarely be sped up. The story of giant corporations abruptly deciding to force a digital and/or AI agenda, yet not achieving the desired outcome, supports the fact that the AI journey takes time. This is very much the case with Manufacturing companies that have evolved into Transformers.

A formalized structure will lead to an increase in number of AI solutions across business functions

Are there any correlations between the responses across the six Impact questions?

The Correlation Matrix displays the relationship between each of the Scale and Outcome questions. Meaning, the closer the score is to 1.00, the bigger the relation is between the variables.

	Implementation in Business Functions	Number of Solutions	Managing AI	External Value Creation	Internal Efficiency Improvements	Solution Enablement
Implementation in Business Functions	1.00					
Number of Solutions	0.86	1.00				
Managing AI	0.55	0.67	1.00			
External Value Creation	0.51	0.54	0.51	1.00		
Internal Efficiency Improvements	0.63	0.69	0.58	0.56	1.00	
Solution Enablement	0.50	0.58	0.63	0.45	0.49	1.00

When looking at surveyed and inter-viewed companies, Transformers have on average been on their AI journey for more than five years. While the journey did not start out with a distinct AI plan and/or significant investments in build-ing AI competencies, these companies managed to quickly understand what is required to accelerate AI, for instance onboarding the C-suite, or transform-ing the organizational culture towards being more open and agile, with a digital foundation.

❝

Forget about 5-year plans. AI is a dynamic technology requir-ing an agile and flexible environment.

— Electrolux, Discrete Manufacturing

The number of Transformers are limited but all industries are slowly catching up on the AI agenda
How are the overall distribution of participating companies across the Impact spectrum?

	Automotive	Life Sciences	Process Manufacturing	Discrete Manufacturing
Transformers	19%	17%	4%	11%
Innovators	31%	17%	50%	32%
Opportunists	19%	33%	25%	29%
Emergents	31%	33%	21%	29%
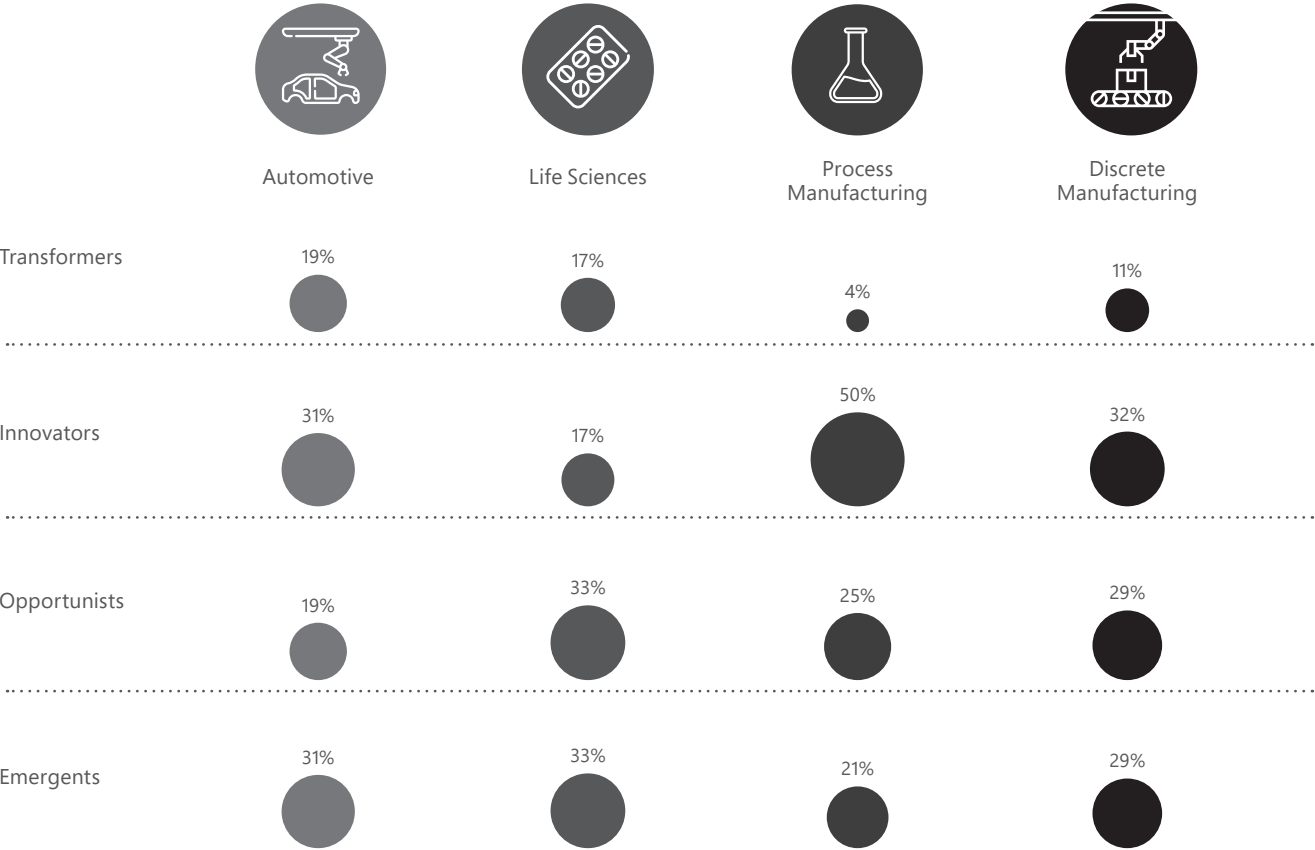
Note: The percentages are rounded numbers.

Atlas Copco

AI is one piece of the puzzle

By combining connected products, cloud and AI, Atlas Copco is finding solutions to drive customer productivity through optimizing equipment performance, and by implementing Predictive Analytics and Maintenance.

AI is driving customer productivity

Atlas Copco's equipment and tools are critical parts of their customers' industrial processes, with around 35% of revenues coming from services, including spare parts. As for many other companies in similar situations, this makes customer productivity, quality, and uptime critical factors. Atlas Copco delivers this through a combination of hardware, electronics and control systems, and software. AI comes into play as one piece of the puzzle. Like many Discrete Manufacturing companies, Atlas Copco aspires to have their installed base of equipment and tools connected. A main benefit is the ability to continuously calibrate products for improved performance, based on data received from the customers' assembly lines and production cells. Another benefit is the opportunity to support customers with Predictive Analytics for maintenance purposes. In this context, predictability and traceability of failure are especially important. Predictive Maintenance is also used to ensure that tool performance is in line with tolerances.

AI is one of several technologies used to continuously improve products and production processes by leveraging data from connected products. Since Atlas Copco's equipment and tools are often in use in highly competitive industries such as Electronics and Automotive, even minor improvements are significant for their customers. By processing large amounts of data and identifying improvements, this is where AI can really make a difference. While AI plays an important role in driving customer productivity, specific factors are challenging, including having access to the right data at the right time.

Building and developing talent and culture

Atlas Copco also leverages AI for internal processes, yet customer-facing solutions add complexity since they rely on customer interaction as well as the Sales and Service organizations, thereby involving a large group of people. This puts great demand on developers to make AI solutions easy to understand and easy to implement. It also requires training of front-end staff in order to make them feel comfortable using these solutions in the sales process, and there is great interest among front-end staff in these solutions. AI and other customer productivity technologies are generally high on the agenda throughout the business.

About Atlas Copco

Atlas Copco is a global industrial group headquartered in Stockholm, Sweden, with some 39,000 employees. The company manufactures products at approximately 100 production sites in over 20 countries, with customers in more than 180 countries. Fiscal year 2019 revenue: €9.6 billion.

Crafting AI capabilities in-house

All AI development is currently done in-house, although the amount of activity can vary over time depending on need. This works quite well, with clearly defined projects being delivered on time and within budget. Yet, it is still a challenge to scale the results by driving the solutions from a product life-cycle perspective compared to what the larger software companies can achieve.

> **To succeed with AI, it is really down to hard work and perseverance.**

Future Benefits of AI

The benefits of AI can be divided into distinct focus areas and objectives. The future importance of these benefits varies across industries.

The most important focus area in the near future is Optimize Operations. It also seems likely that the focus on leveraging AI will end up becoming increasingly customer-centric in the future.

The most important future objectives are straightforward, as all industries have their eyes on cutting costs, improving decision-making, and revenue growth through the use of AI.

The Future Aim of AI

What are the most important focus areas for AI in the future?

Broad AI benefits across key focus areas and objectives

Achieving benefits is the true driver for starting and expanding the role of AI. The benefits of AI can cover the entire organization. The most important benefits over the next 24 months, across focus areas and objectives, vary slightly across the Manufacturing industries.
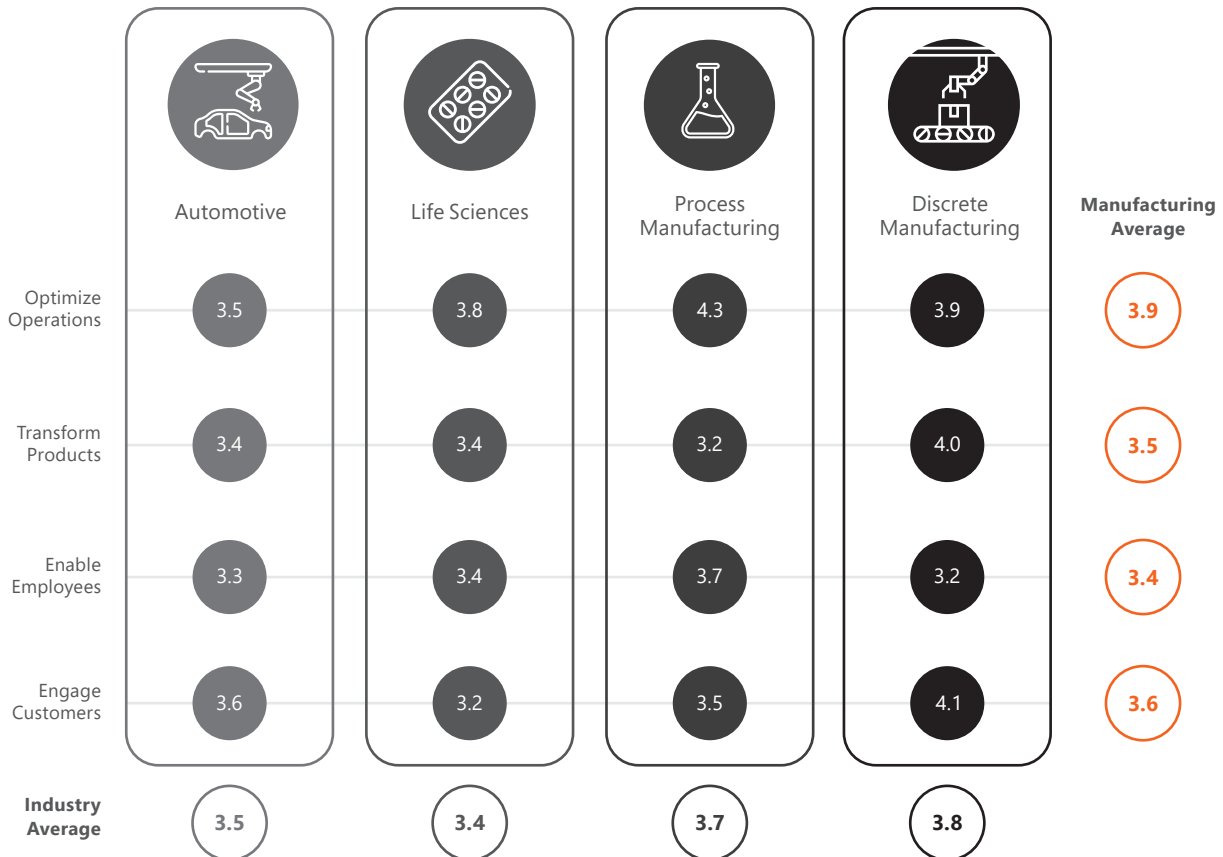
The main aspiration is optimizing operations with AI

There are four key focus areas for AI, each having almost equal future importance for the surveyed respondents. Among the four industries, Optimize Operations scores highest in both Process Manufacturing and Life Sciences, while Engage Customers scores highest

in Discrete Manufacturing and Automotive. Overall, Optimize Operations scores highest on average across all respondents, and is the area of greatest focus for AI. This is also considered the lowest hanging fruit, as Predictive Maintenance, Predictive Forecasting, Intelligent Automation or similar AI use cases are widely deployed.

The most important focus area is Optimizing Operations with AI, closely followed by the remainders
Within the next 24 months, how important do you expect AI solutions will be for your company in each of the following focus areas?

	Automotive	Life Sciences	Process Manufacturing	Discrete Manufacturing	Manufacturing Average
Optimize Operations	3.5	3.8	4.3	3.9	3.9
Transform Products	3.4	3.4	3.2	4.0	3.5
Enable Employees	3.3	3.4	3.7	3.2	3.4
Engage Customers	3.6	3.2	3.5	4.1	3.6
Industry Average	3.5	3.4	3.7	3.8	

Note: Scores are assigned by 1-5, with 1 being "Not important at all", 3 being "Moderately important", and 5 being "Highly important".

AI industry leaders focus on becoming customer-centric

The second highest future importance across focus areas is Engage Customers, which is usually a focus area at a higher stage of maturity. This is because companies are more reluctant to implement customer-facing AI initiatives until they are completely capable of using AI internally.

All focus areas will grow in importance with increased maturity

The final two focus areas, which are seen as only slightly less important, are Enable Employees and Transform Products. While some of the most AI mature companies score high in all four focus areas, as they widely recognize the advantages of AI, it is expected that as AI maturity grows, these two focus areas will also increase and catch up on the small gap currently present. In addition, one of the biggest misconceptions about AI is that it simply takes jobs from employees. In reality, AI typically changes employees' jobs.
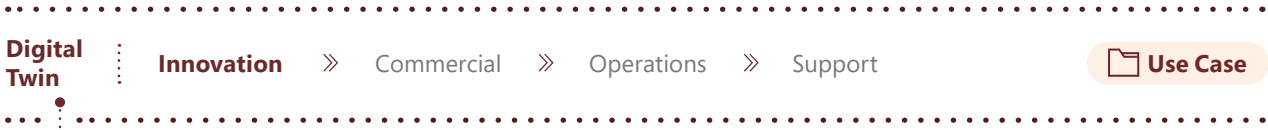
Some of the simplest tasks will be taken over by AI completely, yet for more complex tasks, AI will enable employees to perform tasks better. There will also be new jobs generated by AI like model managers, business translators, and AI maintenance functions. This is why the focus area Enable Employees is expected to increase greatly in importance as AI maturity grows. Additionally, by enabling employees, AI will increasingly help transform products for the better, making these two focus areas even more important.

With the outbreak of COVID-19, there's a particular focus on Optimize Operations and Enable Employees. AI can facilitate remote factory operations. There's an emphasis on data quality so AI solutions run flawlessly, since performing manual checks has become more difficult. By making employee training easier, AI provides increased resilience, and can be a back-up for unavailable employees who have extensive knowledge about the company and its operations.

> **One of our main purposes with AI is trying to understand and identify the customer experience and churning. At the end of the day, the customer is the most important stakeholder no matter what we do.**
>
> **— Fiat Chrysler Automobiles**, Automotive

Digital Twin · **Innovation** » Commercial » Operations » Support · 📁 **Use Case**

Replicating machinery with Digital Twins in the Smart Factory

Activity
Digital Twin is an AI solution that is digitally replicating a physical entity, typically factory machinery or equipment, which is adding a layer of analytics, dynamically adjusting to changes.

Technology
Digital Twin uses IoT and AI, combining machine and software analytics with spatial network graphs to create and visualize real-time digital simulations of remote processes and physical assets.

Impact
The use case enables faster problem detection and resolution by predicting and replicating actions. The minimized need for activities and steps reduces the use of energy and materials.

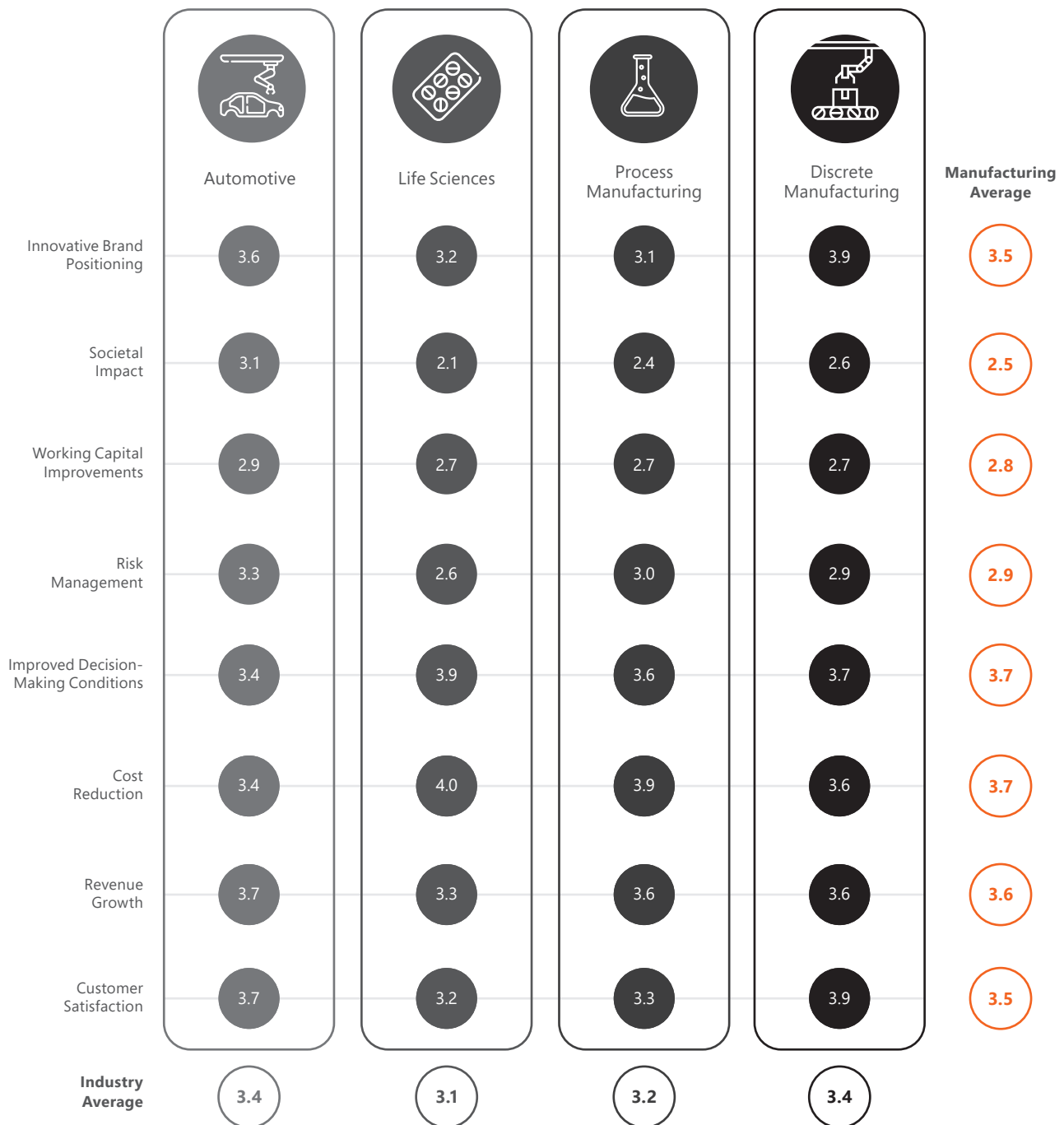**Novo has adopted the use case to simulate commercial scale of drug development.**

novo nordisk®

> **The Digital Twin can help us forecast and optimize behavior of the production system in real time or simulate emerging processes ahead of time.**

The Targets of AI

What are the most important objectives for AI in the future?

Almost all objectives are prioritized while Societal Impact is lagging behind as a core driver for AI
Within the next 24 months, how important do you expect AI solutions will be for your company to realize each of the following objectives?

	Automotive	Life Sciences	Process Manufacturing	Discrete Manufacturing	Manufacturing Average
Innovative Brand Positioning	3.6	3.2	3.1	3.9	**3.5**
Societal Impact	3.1	2.1	2.4	2.6	**2.5**
Working Capital Improvements	2.9	2.7	2.7	2.7	**2.8**
Risk Management	3.3	2.6	3.0	2.9	**2.9**
Improved Decision-Making Conditions	3.4	3.9	3.6	3.7	**3.7**
Cost Reduction	3.4	4.0	3.9	3.6	**3.7**
Revenue Growth	3.7	3.3	3.6	3.6	**3.6**
Customer Satisfaction	3.7	3.2	3.3	3.9	**3.5**
Industry Average	3.4	3.1	3.2	3.4	

Note: Scores are assigned by 1-5, with 1 being "Not important at all", 3 being "Moderately important", and 5 being "Highly important".

Cutting costs and improving decision-making with AI

A wide range of AI objectives score high across industries in the survey, with Cost Reduction and Improved Decision-Making Conditions having the highest future importance. The highest score is 4.0 from Cost Reduction in Life Sciences. For Process Manufacturing, the highest score is also Cost Reduction at 3.9, while for Discrete Manufacturing it is Customer Satisfaction and Innovational Brand Positioning, also at 3.9. For Automotive, the highest scores come from both Customer Satisfaction and Revenue Growth, at 3.7 each. In general, there is a broad spectrum of objectives for AI that are important in Manufacturing.

Deep diving in the most important objectives, Improved Decision-Making Conditions and Cost Reduction are objectives on two different levels. Cost Reduction is directly achieved from the focus area Optimize Operations. Improved Decision-Making Conditions can be a facilitator for all other objec-

tives. It can therefore be the first step towards achieving additional objectives, and may be expected to hold the highest future importance.

Less important objectives can yield significant value from AI

Societal Impact, which is currently a highly discussed business theme, is not deemed a particularly important objective for AI in the future. AI can play a vital role in Sustainable Operations, for instance in waste reduction, and could therefore be expected to have a higher future importance.

Other objectives for AI with lower scores are Working Capital Improvements and Risk Management. Examples of Risk Management use cases in Support are Fraud Detection and Credit Risk Identification. These have a lower probability of impacting the business negatively, yet a higher actual impact if encountered. Companies having experienced these issues will most likely rate them higher, as experiences are more tangible and therefore more important.

> **By the end of the day the customer benefits, or for that sake the internal improvements are what matters, and the underlying technology is of secondary importance.**
>
> **— Atlas Copco**, Discrete Manufacturing

Sustainable Operations · · · Innovation » Commercial » **Operations** » Support — 📁 **Use Case**

• **Using AI as a key component of the sustainability agenda**

Activity

Sustainable Operations is a non-universal AI solution, using AI-enabled technologies to solve critical issues in sustainable manufacturing by suggesting environmentally efficient solutions.

Technology

Sustainable Operations primarily uses Deep Learning, Neural Networks and Machine Learning to focus on optimal infrastructure, energy use, and improved waste reduction opportunities.

Impact

The use case enables improvements of the corporate sustainability agenda, and includes reuse of materials, reduction of waste, optimal energy consumption, and efficient supply chain management.

Bühler has adopted the use case to bring down waste via sorting machine algorithms.

BÜHLER

> **By developing an algorithm suggesting best settings for our sorting machines, we have reduced the amount of good product in waste by 50-70%.**

Volkswagen Group

The transformational Data:Lab Munich

Some companies see AI as a way to boost PR. Yet AI is fundamentally transforming Volkswagen Group by enabling reduced costs and increased revenues across the value chain. Hundreds of use cases have been scaled globally. It all started at the Data:Lab Munich in 2013.

Starting with someone in charge

Volkswagen Group had the courage and vision to found Data:Lab Munich in 2013. Although corporate headquarters is in Wolfsburg, Germany, the Data:Lab was established in Munich, which is the data capital of Europe. Volkswagen Group envisioned that data science and AI could become an essential service provider for the entire organization. Initially, many areas of the business and use cases were identified where there would be a significant increase in efficiency in company work processes. The existence of Data:Lab Munich incentivized other business units around the world to establish smaller data science and AI labs, creating an internal network across several brands over time. Volkswagen Group is no longer in the testing phase, where AI is used to demonstrate what is possible. AI is now scaled to the point where it's delivering profitable solutions.

Creating value with strategy and direction

Volkswagen Group has a formalized AI strategy which is fundamentally changing the company. When putting together a business case, the three core metrics for its AI solutions are cost savings, time savings, and increased revenue. In terms of integrating AI into internal processes, there needs to be tangible benefits and improvements that provide employees with tools that let them do a better job. For AI-enabled products, the process starts by identifying use cases that can turn into a project based on its revenue generating potential. The project then turns into products. Currently, Volkswagen Group is in the middle of the transformation from projects to products, as it incorporates AI into its vehicles.

Combining data science with domain know-how

One of the critical early tasks of Data:Lab Munich was to show business units what AI could do and not do. Volkswagen Group diverges from the traditional way of development when it comes to its AI products, as it is not sufficient to only involve data scientists or AI experts. They need to understand the perspective and language of domain experts as well. There is an increasing number of data scientists at Volkswagen Group who have a combined skill in software development, including employees with triple qualifications, ensuring that what is invented and built can be integrated into existing systems that keep operating during the AI migration.

About Volkswagen Group

VOLKSWAGEN AKTIENGESELLSCHAFT

Volkswagen Group is the world's largest automobile and commercial vehicle manufacturer, headquartered in Wolfsburg, Germany. Additionally, Volkswagen Group offers a wide range of financial services. It comprises 12 brands from 7 European countries, and employs 670,000 people across 124 production plants globally. Fiscal year 2019 revenue: €253 billion.

Brutally honest feedback

The mission of Volkswagen Group's Data:Lab Munich is to deliver cost-saving and revenue-generating AI solutions. It has an excellent reputation, and is respected throughout the organization. It is brutally honest in its feedback on individual use case ideas, as it is not interested in overpromising or selling anything. It's saying is, "You shouldn't expect to be praised for your ideas, you should expect to be scrutinized."

"

Data:Lab Munich was the seed of everything. We have demonstrated that we are successful and are actually generating revenue from AI – something many companies struggle to do.

AI Use Cases Unfolded

While AI can be used across the entire value chain, the degree of current adoption varies between Innovation, Commercial, Operations, and Support, as well as between industries.

Support is often the place to start with AI, due to the simplicity of solutions, but as Operations represents the largest business function in Manufacturing, the focus here will only accelerate.

Despite fewest use cases in Innovation, it is a key area in the future, considered to hold the highest relative potential, yet it doesn't have the highest relative achieved impact.

Where to Succeed

What is the adoption, achieved impact, and potential of AI?

Narrowing +35 AI use cases to the top four use cases by function

More than 35 AI use cases across four functions were initially identified and presented to the 86 surveyed companies, asking about the individual use case's future potential, whether the company has already implemented the use case, and if so, how much impact has been achieved.
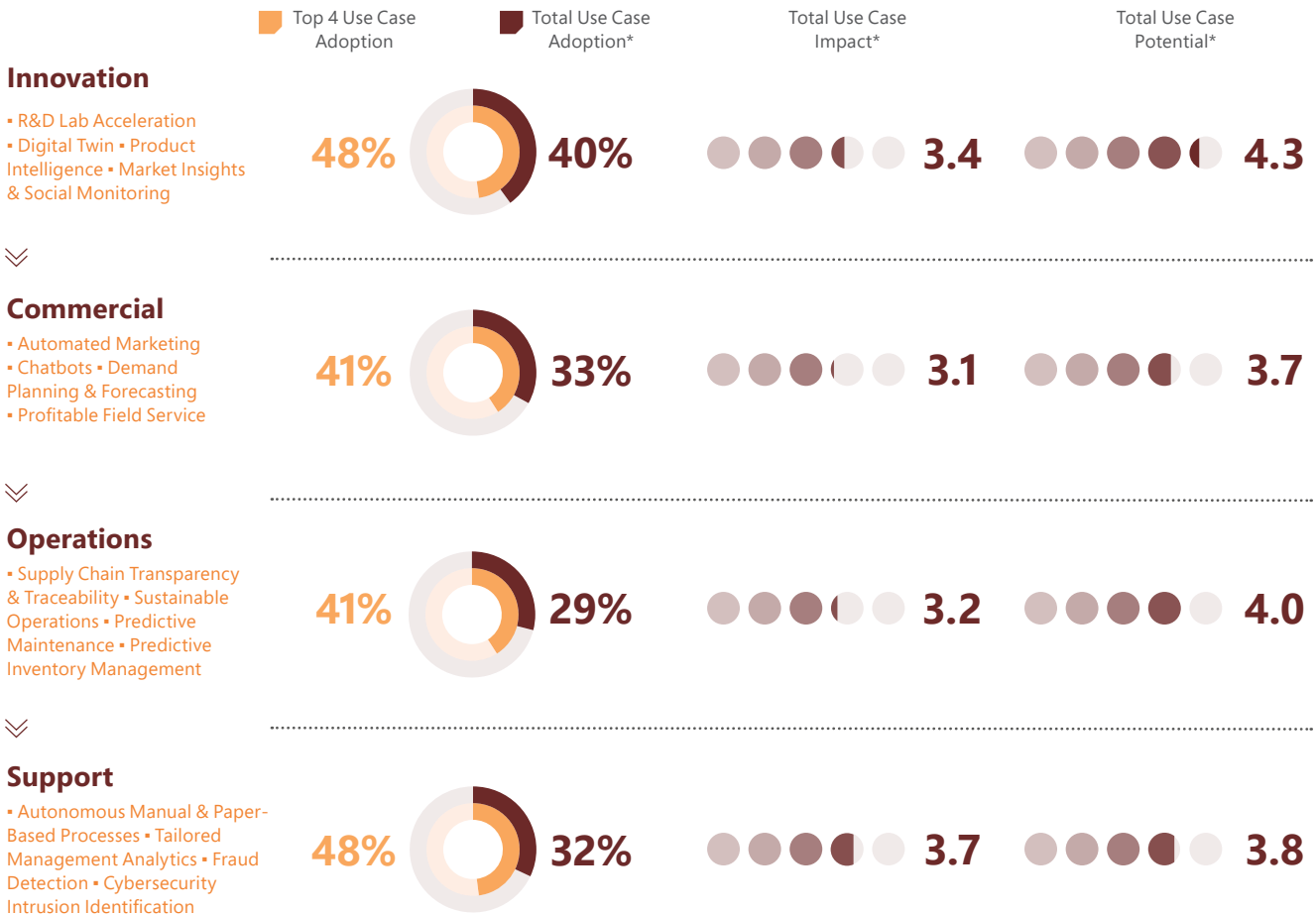
The most frequently adopted AI use cases are in Innovation and Commercial. The survey data also indicates that future potential is highest in Innovation and Operations.

In recent times, all AI use cases have been emphasized, but some have been moved even further up on the agenda for Manufacturing companies. Exam-

ples include Supply Chain Transparency & Traceability, Predictive Inventory Management, Demand Planning & Forecasting, and Digital Twin. This is to obtain a supply chain more resilient to external factors influencing the environment.

Innovation and Operations possess the use cases with the highest relative future potential

What is the top 4 average Adoption, and relative Achieved Impact and Potential of the AI use cases across business functions?

	Top 4 Use Case Adoption	Total Use Case Adoption*	Total Use Case Impact*	Total Use Case Potential*
Innovation · R&D Lab Acceleration · Digital Twin · Product Intelligence · Market Insights & Social Monitoring	48%	40%	3.4	4.3
Commercial · Automated Marketing · Chatbots · Demand Planning & Forecasting · Profitable Field Service	41%	33%	3.1	3.7
Operations · Supply Chain Transparency & Traceability · Sustainable Operations · Predictive Maintenance · Predictive Inventory Management	41%	29%	3.2	4.0
Support · Autonomous Manual & Paper-Based Processes · Tailored Management Analytics · Fraud Detection · Cybersecurity Intrusion Identification	48%	32%	3.7	3.8

Note: Scores are assigned by 1-5, with 1 being "No impact", 3 being "Some impact", and 5 being "High impact".

* Calculated as a flat average of all identified use cases across all surveyed companies (i.e., adoption of all use cases in all surveyed companies).

Novo Nordisk

Top management driving AI as a competitive differentiator

With its venerated history as a major healthcare innovator, Novo Nordisk's research and products help diabetes and obesity patients worldwide. The company has identified AI to be a game changer, all within the framework of its existing culture and values.

Empowering Digital transformation from the top

Although Novo Nordisk has been using AI and simulation software in isolated instances over the past decade, such as in R&D and Supply Chain, its AI journey intensified over the past few years. More recently, CEO Lars Fruer-gaard Jørgensen took command of the AI transformation, with the company thinking bigger and making the AI process more simple and agile. For the over 90-year old leading Pharmaceu-tical company, change is not new, yet an open, agile organizational culture is not easy to implement at such a big "ship" as Novo Nordisk, which was not built for fast end-to-end development cycles.

The overarching digital plan used to be revised annually, yet this is no longer the case, as the rules of the game are constantly changing. Flexibility and an agile approach are necessary to adapt to a continually shifting marketplace.

Digital health is a fundamental compo-nent of the future, and AI is at the heart of it. Yet the AI strategy is not only about building something new, but also scaling up what the company al-ready has. AI is positioned as a strategic differentiator and a competitive advan-tage in developing better drugs faster, thereby creating a market advantage in competition with Pharmaceuticals Eli Lily and Sanofi.

Circular for Zero by 2030

A key vision for Novo Nordisk is that Sustainability and the Green Agenda permeate every process. Circular for Zero by 2030 is a Corporate Social Responsibility (CSR) and Sustainability vision to achieve zero environmental impact by 2030. AI is a central tool in this initiative, for instance in the pilot stage by using Digital Twin to replicate processes and physical equipment to reduce the number of development studies by simulating commercial scale.

Decreasing time-to-market with AI

In late 2018, Novo Nordisk restructured its R&D organization by positioning similar biotech units as satellites of the central R&D function, working on priority fields such as translational cardiometabolic research and stem cell research. This restructuring led to lay-offs, but also significant investments in automation and digital capabilities, including AI. Cutting time-to-market is a significant benefit and a central performance metric. AI is an enabler in reducing lead times, for instance in the product development phase.

About Novo Nordisk

Novo Nordisk is a global Healthcare and Pharmaceutical company with more than 90 years of innovation and lead-ership in diabetes care, head-quartered in the Copenhagen suburb of Bagsvaerd, Denmark. The company employs ~42,700 people in 80 countries, and markets its products in approxi-mately 170 countries. Fiscal year 2019 revenue: €17 billion.

Focusing on the core via external support

Acknowledging the shortage of internal expertise can be difficult for large multination-al companies. Novo Nordisk has embraced the importance and potential of AI, yet their strength is in developing high-quality drugs for diabetes and obesity, and not necessarily in AI development. By partner-ing with several small and large tech companies to support the use of AI in early target dis-covery efforts, Novo Nordisk is keeping its focus on the core.
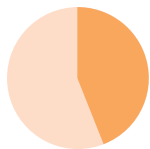
In conjunction with our Circular for Zero by 2030 initiative, we are using AI, and Digital technology in general, as enablers of the Sustainability agenda.

Empowering Innovation

What are the most profound AI use cases in Innovation?
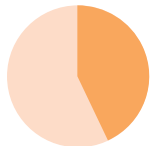
R&D Lab Acceleration

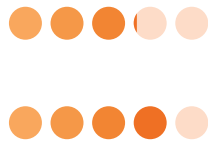ADOPTION
44%

IMPACT
3.2

POTENTIAL
4.2

Gives the opportunity to ideate and fail fast on early-stage innovations in a real-world setting via simulations or computational science, enabling an agile environment with faster iterations and shorter time-to-market.

Market Insights & Social Monitoring

ADOPTION
43%

IMPACT
3.1

POTENTIAL
4.0

Uses Machine Learning to predict market trends for products and competitors, enabling a greater understanding of market dynamics, guidance based on customer insights, and more customer-centric decision-making.

Life Sciences and Automotive most AI active in Innovation

The average adoption of Innovation across all four industries is 40%. The industry working with most AI Innovation use cases is Automotive, where on average 48% of the use cases have been adopted. In contrast, Process Manufacturing companies are least AI active in Innovation, with only an average of 17% adoption.

There is a quite clear difference in the scoring between the four surveyed industries. Life Sciences and Automotive companies are the top scorers with 3.6 – in line with the generally higher R&D spending in for instance Life Sci-

ences, representing 22% of revenue on average.

However, there are also opportunities by leveraging AI in Innovation, for instance by incorporating AI in products to benefit the end-customer and enhance data analytics capabilities.

There is an even larger potential in Automotive and Life Sciences, but for different reasons. In Automotive, AI is an integral part of the quest towards autonomous driving, and therefore pivotal for providing competitive products to the market. In Life Sciences, the goal is to ensure that the full scope of available technologies is used in the quest for discovering new drugs.

Improving R&D efficiency and time-to-market by leveraging AI

For R&D, the development time of new products is a key metric. For instance, time-to-market is a crucial parameter in Life Sciences, mainly because of the critical effect it has on how soon new drugs can be delivered to patients, and thereby drive new revenue. For all Manufacturing companies, the ability to do more faster, for instance by increasing the number of iterations in designing and developing products within a shorter time frame, allows for efficiency improvements through a quicker overall development process.

The remaining identified use cases in Innovation

Generative Design

An iterative process generating a broad scale of design options meeting certain constraints through cloud computing and Machine Learning.

Product Variant Generation

A Machine Learning-based algorithm processing Big Data and suggesting the most effective variant based on customer preferences.

Note: Scores are assigned by 1-5, with 1 being "No impact", 3 being "Some impact", and 5 being "High impact".

Digital Twin
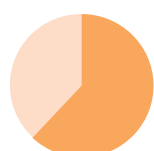
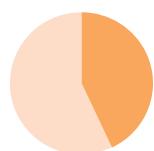ADOPTION

62%

IMPACT
3.5

POTENTIAL
4.5

A virtual replica of physical assets using sensors and cameras, enabling a significant reduction of cost, greater system diagnostics, and prediction of production performance, as well as supporting sustainable operations.

Product Intelligence

ADOPTION

43%

IMPACT
3.4

POTENTIAL
4.3

Uses Deep Learning and Machine Learning for a product portfolio based on real-time performance data; continuously assessing product lifecycles, trends, and demand, enabling an intelligent, data-driven product portfolio.

To further leverage this effect, some companies have established specific R&D or Innovation Labs outside the ordinary R&D organization. These labs are enablers for fast prototyping.

The use of Digital Twins is currently experiencing significant adoption that will only increase moving forward. In Innovation, Digital Twins typically drives faster, cheaper testing through reduced need for physical prototypes. Digital Twins in industrialization and manufacturing processes enable continuous adaptation and evaluation of factory floor operations such as machining. It is also used as a simulation tool for minimizing downtime and maximizing output based on real-time demand and virtual replicas of machinery.

Another popular Innovation use case is Market Insights & Social Monitoring. With AI-based Machine Learning algorithms, Manufacturing companies can monitor online communication channels to understand market dynamics,

such as competitors' product launches, and how customers experience their products and services.

Integrating AI into the product offering

The most mature Manufacturing companies have managed to integrate AI directly into their product portfolio. This is not limited to direct product intelligence based on customer-facing algorithms. It also includes the ability to use AI to monitor and manage the product portfolio based on real-time customer demand.

While Product Variant Generation recommends the most effective variant

based upon customer preferences, the integration of AI into products adds unprecedented individualization possibilities. This is especially the case for Automotive and Life Sciences, enabling an opportunity to enhance the customer offering by improving, creating, and shaping the product portfolio to the needs of the market. A common example is a device suggesting to the user how to reduce power usage or life of the equipment.

In general, embedding AI into Product Management enables real-time product innovation, delivering more relevant, customized products for customers based on historical and real-time preferences and behavior.

> **AI will play a huge role in our Innovation and R&D space going forward. With AI, we can significantly reduce time-to-market for our drugs with an intelligent drug discovery process.**
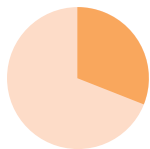>
> **— Novo Nordisk**, Life Sciences

Note: Scores are assigned by 1-5, with 1 being "No impact", 3 being "Some impact", and 5 being "High impact".

Customer-Facing AI

What are the most profound AI use cases in Commercial?

■ Automated Marketing

ADOPTION
31%

IMPACT
3.0

POTENTIAL
3.5

Utilizes a continuous cohesion between campaigns, messages, and analytics from Machine Language-based customer behavior patterns, enabling accurate targeting of leads.

■ Chatbots

ADOPTION
66%

IMPACT
3.0

POTENTIAL
3.3

Virtual agents conducting a customer service conversation through Speech Recognition and/or Text Analysis, enabling automated communication with customers, faster response rates, and customer experience at scale.

The number of customers drives the use of AI in Commercial

The driver for using AI in Commercial is highly dependent on the number of customers. The large volume of generated data points makes it easier to train models.

Discrete Manufacturing, with 36% adoption, has the highest adoption of Commercial use cases. With some Discrete Manufacturing industries selling to tens of thousands of customers, the utilization of AI can realize significant value if the data points can be structured and stored properly.

Process Manufacturing and Life Sciences companies have the lowest adoption rate, at 22% and 27% respectively. According to interviews, the lower adoption in these industries is mainly due to a generally lower overall number of customers.

Easy-to-implement use cases dominate

Across all AI use cases, Chatbots is the third most adopted use case. The fact that 66% of respondents have implemented Chatbots is due to the availability of market solutions that make Chatbots easier to implement than previously. The impact achieved is 3.0, with an average potential score at 3.5.

Automated Marketing is another use case that has been adopted by 31% of respondents in Commercial. As with Chatbots, the relatively high rate of adoption is due to the availability of tools such as pre-developed intelligent

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The remaining identified use cases in Commercial

■ Lead Qualification
Predicts capturing and leads quality based on Machine Learning-driven customer specification understanding.

■ Content Automation
Utilizes ML to enable content creation, distribution, and customer data analysis to personalize marketing.

■ Dynamic Pricing
Customizes pricing to buying patterns and customer specifications, screening Big Data with Machine Learning.

■ Churn Prediction & Prevention
Identifies churning customers, leveraging behavioral patterns to predict challenges, and intervene prior to churn.

Note: Scores are assigned by 1-5, with 1 being "No impact", 3 being "Some impact", and 5 being "High impact".

Demand Planning & Forecasting
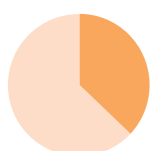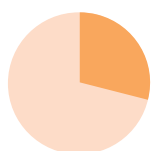
ADOPTION

37%

IMPACT
3.5

POTENTIAL
3.8

Aligns S&OP with expected Sales via Machine Learning, historical order data analysis, and prediction of various production cycles, enabling improved forecasting accuracy and visibility into underlying demand drivers.

Profitable Field Service

ADOPTION

29%

IMPACT
2.7

POTENTIAL
4.1

Uses Machine Learning-based dynamic scheduling and Augmented Reality assistance for operations, enabling higher first-time fix rates, reducing costs, and positioning technicians to drive profitability and up-sell on services.

algorithms. The achieved impact score among respondents that have adopted Automated Marketing is 3.0. However, the potential average is 3.5, indicating that refining these AI solutions may provide even higher future impact.

A Commercial use case that is also deeply embedded in Operations is Demand Planning & Forecasting. This use case, which aligns production and warehouse management with projected sales, has been adopted by 37% of respondents. This optimization typically results in the ability to more accurately predict demand based on a range of parameters such as geographic region and type of customer.

Leveraging integrated AI in the aftermarket process

While the adoption of AI in the aftermarket process has been somewhat slower than expected, at 29%, it is one of the areas where an increase in use is expected in the coming years. The

average achieved impact score is 2.7 by respondents that have already implemented the use case, with a potential score of 4.1. The potential score of those that have not implemented the use case is 3.0, indicating great impact for those companies that already have experience with this AI solution.

For Automotive companies, trying to understand what parts will need maintenance first is a good example. If a customer with an SUV lives in a mountainous area, the brakes are more likely to need maintenance compared to customers living in flat areas. This

allows the OEM to predict which parts to order in greater numbers relative to other parts, and for the dealers to provide proactive customer service.

For Discrete Manufacturing companies, the use of sensors in combination with AI and analytics can enable similar service opportunities. The benefits can be substantial, including securing spare parts sales rather than losing out to knock-offs. Another example is supporting customer productivity and enabling remote service solutions rather than on-site visits.

"

AI is definitely something that we can gain a lot of value from, not only internally, but also externally for our clients as we further integrate algorithms into our products.
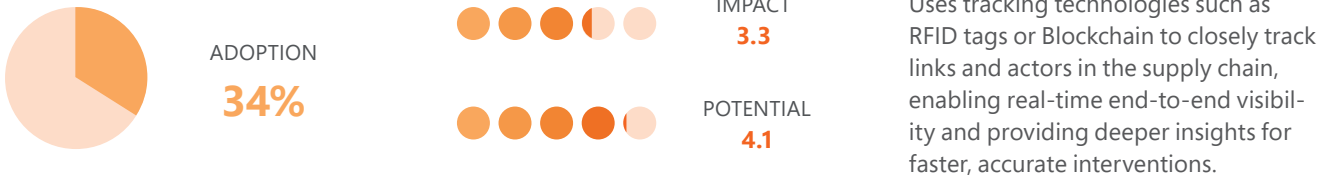
— Volvo Cars, Automotive

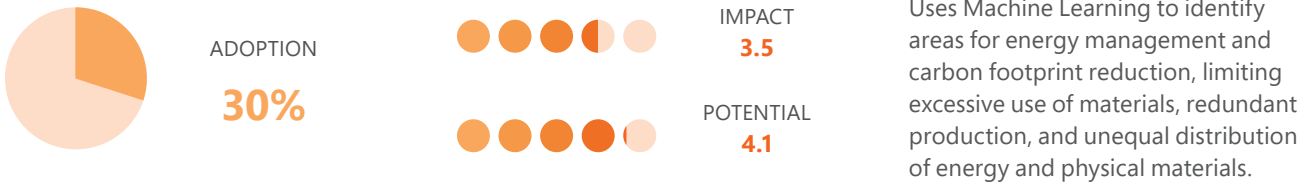*Note: Scores are assigned by 1-5, with 1 being "No impact", 3 being "Some impact", and 5 being "High impact".*

Intelligent Operations

What are the most profound AI use cases in Operations?

▮ Supply Chain Transparency & Traceability

ADOPTION
34%

IMPACT
3.3

POTENTIAL
4.1

Uses tracking technologies such as RFID tags or Blockchain to closely track links and actors in the supply chain, enabling real-time end-to-end visibility and providing deeper insights for faster, accurate interventions.

▮ Sustainable Operations

ADOPTION
30%

IMPACT
3.5

POTENTIAL
4.1

Uses Machine Learning to identify areas for energy management and carbon footprint reduction, limiting excessive use of materials, redundant production, and unequal distribution of energy and physical materials.

AI in Operations is a significant value-driver

Operations is the largest business function in Manufacturing, with significant potential in integrating AI. The current rate of AI adoption in the sector is 41% for the top 4 AI use cases, and 28% for total AI use cases. While all industries have adopted use cases in Operations, Automotive has the highest adoption rate for total AI use cases, at 36%. In contrast, Life Sciences holds the lowest adoption of total AI use cases with only 25%.

Predictive AI use cases

Predictive Maintenance is the second most adopted AI use case across all business functions. It has been around for more than 20 years, yet a clear gap between potential and achieved impact exists. This indicates the challenge for some companies to maximize impact even in areas where the benefits are clearly understood.

Another interesting use case is Predictive Inventory Management. It has one of the highest adoptions in Operations and has the highest achieved impact.

The remaining identified use cases in Operations

▮ Predictive Sourcing
Uses Prescriptive Analytics from historical data to assess the timing of purchasing raw materials and more.

▮ Automated Route Optimization
Predicting optimal distribution routes across the supply chain by using knowledge mining and signal processing.

▮ Autonomous Safety Management
Identifies, scans, and diagnoses factory floor anomalies and risks with AI-empowered cameras and sensors.

▮ Continuous Product Quality Improvement
Replaces human inspections through automation (e.g., optical inspection scanning) of quality testing for defects.

▮ Automated Guided Vehicles (AGVs)
Self-driving vehicles and/or portable robots in warehouse picking and distributing items based on Machine Learning.

▮ Supplier Risk Assessment
Uses Machine Learning to assess risk profiles of potential suppliers, including tier N analysis of the supplier network.

Note: Scores are assigned by 1-5, with 1 being "No impact", 3 being "Some impact", and 5 being "High impact".
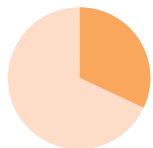
■ Predictive Maintenance
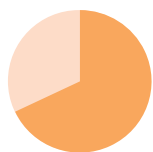
ADOPTION

68%

IMPACT
3.4

POTENTIAL
4.0

Ensures self-optimizing equipment and repair prediction by analyzing collected process data, enabling actionable insights to maximize uptime, extending lifetime of machinery and equipment, and minimizing downtime.

■ Predictive Inventory Management

ADOPTION

32%

IMPACT
3.6

POTENTIAL
3.9

Leverages Predictive Analytics through Machine Learning to align optimal reorder points, enabling optimized inventory management by reducing inventory planning time, minimizing inventory costs, and aligning with production.

Generally, Predictive Inventory Management can help generate revenue through optimized orders, prevention of loss from wrong inventory, and reduce working capital.

In general due to COVID-19, there was increased focus on all predictive use cases, with factory floors staffed with fewer employees and many employees working from home. Companies need to receive accurate input remotely in order for their AI solutions to be effective and accurate, substituting the need for employees being physically present at the plants.

AI can make Operations more sustainable

Today, an overall driver for many companies is Sustainable Operations, where AI has a great potential role in achieving this goal, for instance in terms of waste reduction. Surveyed companies have taken notice, as Sustainable Operations has one of the highest achieved impact scores in Operations. When looking at the potential, Automotive in particular rates it high.

Low adoption yet high potential for some AI use cases

Additional remaining identified use cases include Autonomous Safety Management, which scores 4.4 in potential, the highest potential in Operations. Yet the adoption rate is only 13%. The AI use case with the highest potential has been adopted by so few, which may be explained by the complexity and a lack of knowledge of how AI can best be applied to support the "safety first" objective. Yet it can have significant impact on people's safety if something goes wrong.

> **"**
>
> **When selecting new AI projects, sustainability is a core metric as part of the business case for us. It is on the highest priority level to put the environment into consideration, for instance by enabling the second life of our materials.**
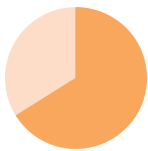>
> **— CEVT**, Automotive

Note: Scores are assigned by 1-5, with 1 being "No impact", 3 being "Some impact", and 5 being "High impact".

Automation in Support

What are the most profound AI use cases in Support?

▮ Autonomous Manual & Paper-Based Processes

ADOPTION
66%

IMPACT
3.6

POTENTIAL
4.1

Uses Machine Learning to automate processes that handle paper-based workflows and documentation, enabling prioritization of efforts, replacing the need for human interaction in low-complexity processes.

▮ Tailored Management Analytics
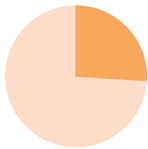
ADOPTION
26%

IMPACT
3.9

POTENTIAL
4.1

Leverages Prescriptive Analytics through Machine Learning to internally and externally provide data for management insights, enabling improved data-driven decision-making conditions for top management.

Support is a good place to start with AI

According to interviews, many companies start out by using AI in Support. One common example is that invoice processing can be facilitated by off-the-shelf software using AI. There are several reasons why companies start their AI journey with processes like this. Firstly, the use cases are to a large extent industry agnostic and many of them are transaction-heavy, which

have led to a large number of standard software solutions available at low cost. Secondly, the benefits of the AI processing are either direct, such as in document management, or easily fed into enterprise resource planning (ERP) systems. Thirdly, the risk is relatively low because these are internal processes, while the ease of implementation is relatively high due to the low number of data sources involved and no cross-functional complexity.

According to the survey, respondents that have implemented AI use cases in Support have realized positive impact. These companies report an average score of 3.7, with a potential of 3.8, leaving only limited additional value. This contrasts with those who have not yet implemented AI in Support, as they regard the potential as low, with only a 3.0 score on average. The conclusion is that implementing initial AI solutions encourages decision-makers to commit to expanded use of AI.

The remaining identified use cases in Support

▮ Interconnected Recruiting
Uses Machine Learning to detect, measure, and match job skills and personality with specific role requirements.

▮ Predictive Performance Management
Uses Machine Learning to identify early-stage health anomalies, and suggested treatment of employees.

▮ Virtual Factory Workforce Support
Predicts how to maximize workforce output by using Machine Learning based on historical productivity data.

▮ Customer Credit Risk Identification
Uses Predictive Analytics to identify optimal credit lines and avoid selling to late or non-paying customers.

Note: Scores are assigned by 1-5, with 1 being "No impact", 3 being "Some impact", and 5 being "High impact".

Fraud Detection

ADOPTION

31%

IMPACT
3.6

POTENTIAL
3.9

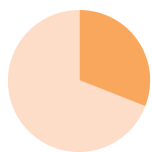Uses Machine Learning to complete data analysis within milliseconds, efficiently detecting difficult-to-detect complex patterns, enabling fraud risk mitigation, and thereby avoiding potential financial and PR-related costs.

Cybersecurity Intrusion Identification
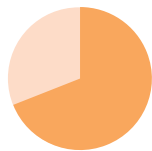
ADOPTION

69%

IMPACT
3.8

POTENTIAL
4.1

Uses Neural Networks to detect a classification of botnet attacks, minimizing threats from malware and other security breaches through more powerful, accurate identification of threats to critical infrastructure.

AI is increasingly used for cybersecurity purposes

Cybersecurity Intrusion Detection is the most adopted AI use case across all business functions, with an adoption rate of 69%. With a score of 4.1, it scores the second highest potential across all business functions.

Given the surge in cyber attacks in recent years, the adoption of AI in cybersecurity is not surprising. This is also an area where organized criminal networks are constantly changing and refining their tools and tactics. Supporting cybersecurity with AI capabilities enables companies to better scale their solutions while also be better equipped to swiftly respond to threats.

Other common AI use cases in Support

Autonomous Paper-Based Processes has a high adoption rate of 66%. It may even be higher, but is probably overlooked since it is embedded in standard software, or simply because it has been in use for many years.

Another interesting AI use case is warranty claims. Many AI use cases are based on specific improved efficiency business cases. However, Fraud Detection is about managing risk, helping companies avoid unknown and potentially severe costs. The potential for this use case is 3.9, yet with an already achieved impact of 3.6. Once again, this indicates good results, with some further potential by expanding its use.

Tailored Management Analytics has been experiencing strong growth in recent years. An AI use case in Manufacturing can be the usage of AI-based demand models in Sales and Operations Planning that enables you to perform real-time what-if analysis by changes in demand.

Finally, Virtual Factory Workforce Support scores an impressive 4.5 in achieved impact, which is the highest score across all business functions. However, the adoption rate is only 11%, suggesting there is an opportunity for many other companies to achieve potential benefits from implementing this type of solution.

The golden nugget is always the ideas. Finding the need and the pain-point is 80% of the journey with AI.

— Essity, Discrete Manufacturing

Note: Scores are assigned by 1-5, with 1 being "No impact", 3 being "Some impact", and 5 being "High impact".

Bühler

Supporting Sustainable Operations with AI

While Bühler has almost five years' experience with AI, over the past couple of years they have focused on making an impact with AI from an environmental perspective. Today, the company is using its experience to make AI a key enabler of sustainability.

Purpose-driven rather than algorithm-driven

In 2016, a data science and Advanced Analytics unit was established in Bühler. Initially, the AI focus was on customer-facing solutions. More recently, the focus has been internal as well, optimizing operations to save cost and time, and improve efficiency. The AI strategy is closely linked to the overall CSR strategy, and is designed to have a big global impact. The particular AI solution itself is of less importance, as long as it achieves sustainability in the value chain, i.e., AI is not so much algorithm-driven as purpose-driven.

Integrating AI in the sustainability strategy

Bühler views digital, and AI in particular, as enablers to answer the key question: "How can we feed a global population of nearly 10 billion people and help fulfill their mobility needs in 2050 while respecting the limits of the planet?"'

There are two central best practice sustainability AI use cases. Bühler's sorting machine Sortex uses an algorithm that recommends the best settings so different shapes and features can be discarded, for instance in sorting colors and stems when harvesting coffee beans. The algorithm has reduced sorting machine waste by 30-40%. The other is an internal use case focusing on optimizing operations by reducing power usage through collecting data from factory machinery and control systems, allowing machines to shut down when not in use.

Democratizing data science from a core strategy perspective

A major strategic focus area by the Digital Steering Committee is interconnected data-driven solutions. By connecting factory machinery and production plants, data becomes a strategic differentiator and competitive advantage.

The recent introduction of the data and analytics platform Bühler Insights has increased the requirement to globally grow in-house core data and AI competencies, for instance by sourcing external partners to assist in building internal expertise.

The company is also democratizing data science by imparting expertise from data scientists to other employees. Although the company will not turn every employee into a data scientist, there needs to be a shared understanding of how AI can help employees achieve individual targets.

> **Our ultimate goal is to use data to enhance sustainability globally. Whether we use advanced Machine Learning algorithms or a pragmatic rule-based approach does not matter, as long as it solves the business problem.**

About Bühler

BÜHLER

Bühler is a global technology company within plant, equipment, and related services for processing foods and manufacturing advanced materials. Headquartered in Uzwil, Switzerland, Bühler employs ~11,000 people in 140 markets, 100 service sites, 30 manufacturing sites, and 25 application centers globally. Fiscal year 2019 revenue: €3.12 billion.

Sustainability at the heart of Innovation

For Bühler and the entire sector, digital technology and collaboration are key to solving sustainability challenges over the next decade and beyond. The company is already leveraging the power of IoT, AI and Big Data to enable faster, smarter, and better decisions regarding the sustainability agenda.

Bühler Insights, the first cloud platform dedicated to the food and feed industry, is helping drive up yields, reduce waste, and improve food safety.

Pillars of AI

Data is undoubtedly pivotal to leveraging and fully utilizing AI. In addition, Talent, Culture, and Technology are significant for the successful implementation of AI in Manufacturing.

Despite the extreme importance of these capabilities, there is a substantial gap between most Manufacturing companies and the AI leaders.

While the large number of Manufacturing customers increases the availability of data for AI solutions, developing AI-specific skills in Manufacturing remains a struggle.

AI Capability Pillars

What are the most integral capabilities needed to succeed with AI?

How the four core AI capabilities in Manufacturing were identified

There are four core capabilities that are vital to fully leveraging AI in Manufacturing. For each core capability, three underlying sub-capabilities have been identified and included in the survey. Manufacturing companies must prioritize and master these critical elements in order to become AI leaders.

Building a robust toolbox of AI capabilities is essential

Specific short- to mid-term benefits and an overall vision is important in determining which capabilities to build first. In practice, this could mean that already available AI technology is put on hold until access to customer data has been secured, or until new production lines have been installed.

AI leaders in Manufacturing have demonstrated how AI can deliver value across industries and business functions if the proper toolbox is in place.

Equally important is access to relevant data in order to support business objectives. For example, if one of the objectives is to improve customer productivity, then a sufficient number of data points needs to be collected from' actual customer usage under various circumstances.

In addition to skills and data access, there is a need to develop and upgrade the underlying technology platform to allow AI solutions to be leveraged and integrated into the company's existing IT landscape, including infrastructure and architecture.

Many respondents have highlighted the importance of a digital-friendly culture that can unleash bottom-up creativity through a broad base of internal skills. A lack of such a culture can be one of the biggest barriers to the digital transformation of the business.

Building the core is so important – you simply cannot run unless you know how to crawl. It is impossible.

— Husqvarna, Discrete Manufacturing

1 Data

AI solutions cannot work properly without access to the necessary data. Data is the crucial component of AI; having relevant high-quality data is a capability that defines the robustness of the AI solution.

2 Talent

AI talent is assembled by a mix of hiring skilled data scientists and engineers, upskilling the existing workforce, and involving external partners to build a knowledgeable dynamic ecosystem.

3 Culture

Cultural transformation in Manufacturing requires company-wide commitment by the C-suite, a willingness to transform ways of working, and robust governance with the right incentives and KPIs.

4 Technology

Building an agile interconnected technology infrastructure requires a high-degree of connectivity between the company's IT architecture, the existing IT landscape, and new AI solutions.

FCA

The convergence of AI and domain experts

FCA's Parts Supply Chain has greatly benefited from the establishment of the Data Scientist Team, which has bridged the gap between AI experts and domain experts in the core business lines. This will help fulfill the AI vision of FCA.

AI-empowered Data Scientist Team

The Data Scientist Team at FCA was established in 2016, and today the teams' data scientists support all processes throughout the value chain. Ideation to optimize operational processes typically takes 2 days, developing into a PoC that verifies whether scalable conditions exist for the solution. The assessment includes whether an internal demand for the solution exists, and if the data foundation is sufficiently robust for the solution to be scaled. If so, the initiative is rolled out regionally or globally.

Optimize Inventory Management

One of the most developed use cases for FCA is demand forecasting for Parts, which uses Advanced Analytics for demand forecasting and calculating the optimal inventory level. This is done throughout the entire global logistics network (multi-tier warehouse network) in order to provide excellent service to customers in terms of parts availability while reducing safety stock. The AI solution simulates several stocking policies, ensuring that warehouse operations adapt to actual market demand by storing stock based on actual market demand for parts.

Prediction is global as well as country-specific, foreseeing and leveraging trends. For instance, knowing the number of Fiat Pandas or Fiat 500s in the market provides the basis for the number and types of parts ordered and processed through local warehouses.

Accelerating AI benefits through data and the right mix of people

Without correct relevant information, AI solutions cannot properly learn to adapt to the market. There needs to be sufficient data, and all this data needs to be stored. The enormous information databases combine internal and external data, structured and unstructured data, and historical and real-time data.

AI is highly dynamic and constantly evolving, requiring additional know-how. However, an AI CoE only makes sense when the company puts data scientists into the core business, prioritizing what can be achieved with AI, which is exactly what FCA has done. A dedicated organization is required to govern and coordinate data ownership and central business KPIs, supporting AI experts with high-quality data sets for AI solutions to run as efficiently as possible. Domain experts with insight into the business need to be constantly in the loop and close to the projects to ensure that output is in line with targets.

About FCA

FCA is an Italian-American multinational that is one of the world's largest auto makers. FCA designs, engineers, manufactures, and sells vehicles and related parts, services, and production systems world-wide. The Group, which operates over 100 manufacturing facilities and over 40 R&D centers, sells through dealers and distributors in more than 130 countries. Fiscal year 2019 revenue: €118 billion.

Access to high quality data is needed

The Data Scientist Team in FCA helped create a robust data foundation, which is a key challenge that must be met for AI to be successful. Without the right information, AI solutions cannot properly learn to adapt to the market. With a robust data foundation, FCA made it possible to develop PoCs into wider AI initiatives. Now AI can properly thrive, making it possible to fulfill the AI vision of FCA.

> **It is difficult to ensure an agile way of working with the AI solution if the business process owner is far away from the daily development of the solutions.**

Backbone of AI

What is the assessment of capability importance and competency?

While all capabilities are considered critically important, Data is pivotal for AI to work
How important and competent are each of the organizational capabilities for your success with AI?

1 Data **4.5** (3.3)

Data is rated as the most important capability, and is the initial barrier to successfully implementing AI and therefore is typically the starting point.

Talent is rated as the second most important capability, but is often a struggle, as evident from it being the lowest competency.

2 Talent **4.3** (3.0)

3 Culture **4.2** (3.3)

Culture starts with Top Management Support, which is already being established in the sector and advancing cultural transformation.

4 Technology **4.0** (3.3)

Technology has the lowest gap between importance and competency, although it's considered one of the most surprising challenges of AI.

Data quadrant values:
5.0 / 2.5 / 4.0 axis
4.7 (3.2)
4.6 (3.1)
4.4 (3.5)
4.3 (3.2)

Culture quadrant values:
4.0 / 3.5 axis
4.1 (3.6)
4.3 (3.5)
4.0 (3.2)
4.3 (3.0)

Talent quadrant values:
4.0 / 2.5 axis, 5.0 / 3.5
4.4 (3.1)
4.3 (3.1)
4.3 (2.8)
4.1 (2.8)

Technology quadrant values:
2.5 / 4.0 axis
3.9 (3.1)
3.9 (3.3)
4.0 (3.2)
4.2 (3.5)

x.x (x.x) Importance / Competency

Importance   Competency

⬤ Automotive   ⬤ Life Sciences   ⬤ Process Manufacturing   ⬤ Discrete Manufacturing

The core capabilities of the AI toolbox

Across all Manufacturing industries, all the core capabilities rate high on the importance scale. The competency score on the other hand is low.

Data is considered the most important capability to grasp across all industries. However, competency varies, with Life Sciences companies scoring highest, as they recognize their dependency on accessing high-quality data to successfully integrate AI into the drug discovery process.

Talent, and the ability to build the proper workforce around AI solutions, has a high priority, especially among

Process Manufacturing companies that are increasingly involving external partners to provide know-how. However, survey data indicates that it has yet to materialize in a high level of competency.

Full cultural transformation has still not materialized for most Manufacturing companies, reflected in the current lower competency level of sub-capabilities. It is evident from the survey data that Automotive in particular is on a positive cultural transformation trajectory, as AI is driving commercial activities. Interviews indicate that the remaining industries have started driving C-suite led cultural transformations which they expect to benefit from in the future.

Surveyed companies consider Technology to be the core capability of least importance. Yet the competency level is relatively high, illustrated by the smallest gap between competency and importance across all core capabilities. Interestingly, the majority of interviews mention Technology as a key barrier to successfully implementing AI.

❝

AI is the future.

— LEO Pharma, Life Sciences

Despite the high importance of all capabilities, most companies have a competency gap

How competent is your company within each of the organization sub-capabilities?

1 Data

Access
3.4

Quality
3.2

Governance
3.2

2 Talent

Upskilling
3.0

AI Expertise
3.1

Dynamic Ecosystem
2.9

3 Culture

Openness & Agile
3.3

Performance Metrics
3.1

Top Management Support
3.6

4 Technology

Architecture
3.2

Security
3.4

Infrastructure
3.2
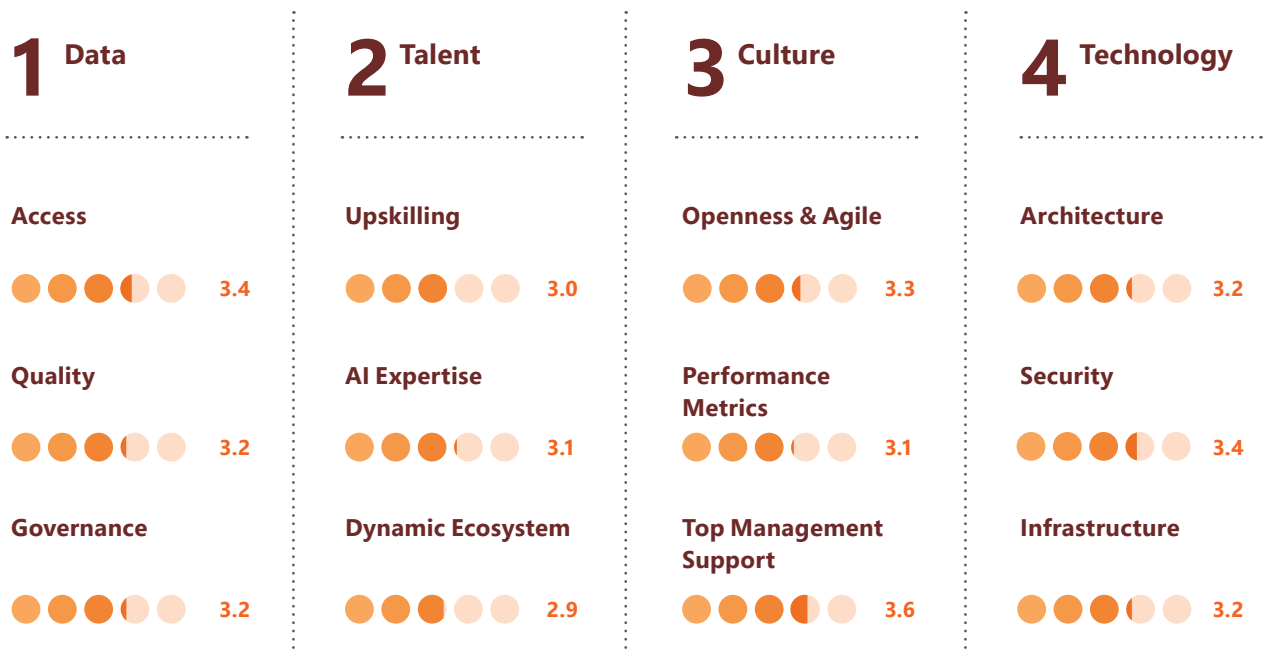
Note: Scores are assigned by 1-5, with 1 being "Not competent at all", 3 being "Moderately competent", and 5 being "Highly competent".

1 Data

How is Data supporting AI?

Key components of Data

The three central components of the capability Data are Access, Quality, and Governance.

Data is the foundation of AI

Data is quite simply the key foundation for driving the AI agenda. It is not possible to create value from AI without the right quality and quantity of data in place. This is clear from the survey, as the importance score of Data is the highest among the four capabilities across all industries, averaging 4.5, with 68% of respondents rating it as 5 in importance.

Eighty percent of a data scientist's time is spent on cleaning and preparing data, with the remaining 20% spent on creating the actual algorithm. Without the right data, AI will not work as intended. For many of the surveyed companies, access to data itself is not the biggest pain. The true pain is connecting all data points, especially pro-

prietary data, as it is dispersed across internal systems, customers, suppliers, and other potential stakeholders.

Data Governance is essential to structure data

Building robust Data Governance is one of the prerequisites for succeeding with AI. For Manufacturing companies, the single most important aspect of Data Governance is mastering data management. This is difficult for almost any sizeable company, but perhaps more difficult in Manufacturing relative to other sectors. There are several reasons for this, even if the level of difficulty and the associated root causes vary across industries and companies. An example is that the share of global enterprise-wide ERP-system rollouts is generally lower in Manufacturing. Combined with a high level of M&A activity, an additional level of complexity has been added to the master data management picture, since additions to the structure are frequently added.

The challenge can be met, but it is often very time-consuming.

Automotive is one of the industries that scores Data as highly important, at 4.7 on average. However, looking into the competencies of the sub-capabilities, the scores are quite lower, with Data Access averaging 3.5, and Data Quality and Data Governance scoring "only" at 2.9 and 3.0, respectively. For all industries, there is certainly a gap between desired and current competency levels.

A Discrete Manufacturing company interviewed discovered that the quality of data was not at a level required for AI to work. Each line of data was correct when it was generated, but as things changed, the lines of data stayed fixed, becoming unusable. They have now set up a process to update data going forward, but are struggling to clean historic data.

Customer Credit Risk Identification   Innovation » Commercial » Operations » **Support**   📁 **Use Case**

Mitigating risk by predicting customer payment behavior

◎
Activity

Customer Credit Risk Identification is an AI solution that automates the prediction of customer's credit potential and suggests optimal payment terms based on e.g., working capital and credit history.

Essity has adopted the use case to predict customers' payment reliability.

⚛
Technology

Customer Credit Risk Identification uses Prescriptive and Predictive Analytics to identify optimal customer credit lines, if any, and recognize late- or non-paying customers prior to initiate business.

essity

❝

☀
Impact

The use case predicts customer payment behavior to mitigate the risk of unstable debtors negatively affecting working capital and liquidity and avoids non-paying customers to minimize bad debt.

Implementing customer payment behavior prediction has brought huge changes to Accounts Receivable.

Data lakes to store and analyze data

The third key characteristic for building data capabilities is data storage and analytics. Effective data storage is required to ensure access to high quality data so AI solutions can perform properly. Companies need to match adequate data storage to the type of data collected in a relational database. Many companies leverage data lakes to ensure the collection of all pertinent data. A data lake is basically a large database of information combining internal, external, structured, unstructured, historical, and real-time data stored in their original formats.

A participating Automotive company realized they had generated a lot of relevant data for AI, yet they couldn't access it because it was spread throughout the organization and not stored properly. They are currently streamlining how they generate, collect and store data.

The volume of data is another interesting aspect of Data. Apart from perhaps Automotive OEMs, most Manufacturing companies have pockets of potential use cases where the volume of data is so low that it is questionable whether implementing AI makes sense. Examples include a low number of customers for some specialty product companies, for instance in Process Manufacturing, and high-mix/low-volume heavy machinery suppliers.

"

Data science and Advanced Analytics has become a strategic differentiator for us, and is an integral part of our long-term corporate strategy.

— Bühler, Process Manufacturing

Access to data is not a challenge in Manufacturing due to a large number of customers
How competent is your company within Data?

	1			2			3			4			5		
	0%	1%	1%	12%	19%	19%	51%	48%	45%	24%	20%	26%	13%	11%	8%

Not competent
Limited analytics skills beyond traditional business intelligence based primarily on historical data

Moderately competent
Semi-autonomous examination of data using sophisticated techniques and tools to predict future events

Highly competent
Significant data science activity using techniques such as complex event processing, neural networks, etc.

● Access   ● Quality   ● Governance

	Automotive			Life Sciences			Process Manufacturing			Discrete Manufacturing		
Avg. Score	3.5	2.9	3.0	3.6	3.7	3.3	3.3	3.3	3.1	3.3	3.0	3.3

Note: The percentages are rounded numbers.

2 Talent

How is Talent supporting AI?

Key components of Talent

The three central components of the capability Talent comprise Upskilling, AI Expertise, and Dynamic Ecosystem.

Data needs Talent

While Data is the most important capability pillar of AI, data cannot be acquired, processed, and leveraged without business acumen and technical skills. Talent has the second highest average importance score among the four capabilities, averaging 4.3.

While Discrete Manufacturing and Process Manufacturing companies rate the importance of Talent on average to be 4.5 and 4.4 respectively, Automotive companies are more restrained, with an average score of 3.9.

Talent is typically sourced in various ways. One way is internal by training employees with an interest in and talent for working with both business and AI. Another way is external through recruitment, where the focus is usually on specific capabilities that are lacking

in-house, e.g., data scientists, data engineers, and AI architects. Yet another way is external through the ecosystem.

In practice, most companies use a combination of these three methods to gradually build their capabilities. More specifically, most companies start by approaching the ecosystem for Talent. They then build up Talent internally while supplementing with external help, finally going completely internal, with the exception of technology providers and critical ecosystem talent.

When deep diving on the sub-capabilities of Talent, Automotive generally rates itself low in competency, as does Process Manufacturing. Distinct AI expertise and Dynamic Ecosystem score an average of 2.8, while Skilled (existing) workforce only scores 2.7. This is an interesting finding, as many Automotive companies are considered very attractive places to work with AI, first and foremost due to the ongoing quest for autonomous driving.

Find, develop, and foster AI skills

When building AI Talent internally, companies can either hire or reskill current employees. Most companies decide to do a combination of both. The most common approach to new hires is to recruit directly from school, for instance Master graduates or PhDs in Computer Science. By hiring directly from university, there is access to a well-defined and fairly large pool of candidates in a field where so much new development is taking place that the benefits of experience are not as tangible as in other professions.

Reskilling has its own challenges, as some existing employees may never have previously worked with data, and especially not data science. Several Life Sciences companies interviewed have started upskilling their existing workforce, as many AI opportunities are positioned with employees who are not data proficient and therefore not able to turn these opportunities into specific AI initiatives.

Profitable Field Service ⋮ Innovation » **Commercial** » Operations » Support 📁 **Use Case**

Improving aftermarket process by predicting maintenance

◎ **Activity**
Profitable Field Service is an AI solution that uses algorithms making it possible to predict needs of individual customers based on geographical area, type of customer, and use of product.

⚛ **Technology**
Profitable Field Service uses Machine Learning-based dynamic scheduling and augmented reality assistance to predict need for specific parts in specific locations and the timing of repair.

☀ **Impact**
The use case mitigates downtime of products and notifies the user when products needs to be serviced leading to reduced costs and efficient maintenance improving lifetime of products.

Volkswagen Group has adopted the use case to predict aftermarket demand of parts.

VOLKSWAGEN
AKTIENGESELLSCHAFT

"

Knowing who the customer is and where the customer is located supports our aftermarket profitability.

It should be noted that upskilling is more frequent than reskilling, as employees with analytics knowledge might be offered an AI education, while less data proficient employees might be offered courses in order to strengthen their data acumen. Not surprisingly, participating companies observe a generation gap, where younger generations that grew up with digital technology are keener to learn and engage in AI initiatives. This is an encouraging development, since those companies that can engage and leverage the expertise of their employees to the greatest possible extent will likely reap the largest rewards.

Maximize benefits from the ecosystem

The final way to build Talent around AI in an organization is by building a Dynamic Ecosystem, including technology providers, consultants, suppliers, customers, startups, and universities. For instance, in order to boost the internal AI talent pool, a Discrete Manufacturing company hand-picked 30 AI scholars from different universities around the world who were working with relevant research.

In the short term, it's faster and cheaper to get outside help. Even as the maturity of internal AI talent rises, the ecosystem can be highly beneficial, although differently than initially. Where initial external AI support is usually focused on training and direct implementation, it can evolve into expert sparring and inspiration. It can also be used on specific projects to bridge a need and thereby provide a great degree of flexibility.

"

We are using all three ways to build capabilities. We hire data scientists, upskill existing personnel, and use external partners in the ecosystem for our shortage of capabilities.

— Merck, Life Sciences

There is further ground to cover in order to build a sufficient Talent foundation
How competent is your company within Talent?

	1	2	3	4	5
Upskilling	6%	30%	31%	22%	11%
AI Expertise	8%	24%	31%	23%	14%
Dynamic Ecosystem	11%	24%	40%	15%	9%

Not competent
Limited analytics skills beyond traditional business intelligence based primarily on historical data

Moderately competent
Semi-autonomous examination of data using sophisticated techniques and tools to predict future events

Highly competent
Significant data science activity using techniques such as complex event processing, neural networks, etc.

● Upskilling ● AI Expertise ● Dynamic Ecosystem

Avg. Score	Automotive			Life Sciences			Process Manufacturing			Discrete Manufacturing		
	2.8	2.9	2.8	3.3	3.3	2.8	2.9	2.7	3.0	3.0	3.4	2.9

Note: The percentages are rounded numbers.

3 Culture

How is Culture supporting AI?

Key components of Culture

The three central components of the capability Culture comprise Openness & Agile, Performance Metrics, and Top Management Support.

Cultural commitment starts with leadership

Culture has the second lowest average importance among the four capabilities, with an average importance of 4.2. Among respondents, 48% rate Culture as 5 in importance. While Process Manufacturing and Discrete Manufacturing both rate Culture with an average of 4.3, Life Sciences scores lower, with an average of 4.1, and finally Automotive with 4.0.

Input from top management is critical

In interviews, Top Management Support is considered to be critically important for AI. It also appears to be an area which can be supportive in accelerating the AI developmental process. In other words, Top Management Support is seemingly one of the first steps in the cultural transformation priori-

tized by Manufacturing companies. Interestingly, Automotive companies score only 3.1 on average, following a pattern of generally lower scores than other Manufacturing industries. One hypothesis is that the competitive intensiveness in Automotive makes everyone aware of the huge importance of AI for long-term success. Therefore, the internal demands on top management and the sense of urgency is higher than in industries where AI is less transformative in the near-term.

A Process Manufacturing company interviewed described how AI was addressed for years, but until they gained Top Management Support, there was no impact. They subsequently quickly saw the benefits of AI, and are currently increasing their AI efforts.

The success of AI depends on all employees at all levels

Many companies have several employees who are AI agents, taking time out of their work calendar to focus on promoting AI within the organization. In contrast, employees who are not

involved in AI initiatives and use cases will often not prioritize AI, and may even work against it. Some companies take steps to involve large parts of the workforce in the AI process in order to have more AI agents and build a general commitment among employees to support and use AI. This is reflected in Openness & Agile, which is the second most competent sub-capability under Culture. Like many other capabilities, this is something more often seen in AI mature companies, because if there's not openness towards AI, then ideas and initiatives will be suppressed. Therefore, AI is something that needs to be promoted broadly, not just by individuals. Furthermore, companies need to develop a culture that is open and agile, as collaboration between domain and AI experts is a key aspect of successfully working with AI.

Another aspect is flexibility in decision-making. As technologies rapidly emerge, decisions regarding these technologies must keep pace. This means that companies need to be flexible in their plans and decisions, and be

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Autonomous Safety Management

Innovation » Commercial » **Operations** » Support 📁 **Use Case**

Improving factory floor safety with anomaly detection

Activity
Autonomous Safety Management is an AI solution recognizing anomalies via video and image analysis triggering an alert in case of safety violations such as understaffed operations or lack of helmets.

Technology
Autonomous Safety Management uses AI-enabled image and video analysis by scanning, identifying, and diagnosing anomalies to ensure compliance with safety protocols and general regulations.

Impact
The use case enables a safer work environment for employees through continuous improvement and monitoring of safety protocols and general regulations minimizing injuries and related costs.

Sandvik has adopted the use case to monitor factory floor anomalies.

SANDVIK

"

An emerging area of technology in our Safety Management routines is video and audio to detect anomalies.

able to quickly adapt to changes.

Cultural focus can overcome resistance to AI

The expectation of what AI will deliver varies between companies and segments of the workforce. Interviews underscored mixed expectations of AI among employees. Some expect AI can do everything, some expect it to take over their jobs, while others recognize it can improve their jobs, for instance by an increased focus on value-creating tasks or better information. When AI is introduced, some employees may assume that AI can do so much that it will take away their jobs, and therefore they may oppose it. For instance, they may resist providing use cases, vote down suggested use cases, resist using implemented AI initiatives, and simply not commit to the use of AI.

A cultural focus on AI within the com-

pany, as well as an openness to discuss AI, will generate curiosity about what AI can and cannot do. This curiosity and dialogue will make it easier for employees to participate in implementing AI across business functions, and let them participate in shaping the direction of AI within the company.

In order for AI to be accepted and recognized as value-adding, perfor-

mance needs to be measured using Performance Metrics. The most successful AI leaders use these metrics to decide when to move from a pilot to a broader roll-out. Without these metrics, AI will never be culturally accepted as having a significant positive impact. This is one of the central parameters where companies managing AI ad hoc without a distinct AI plan and direction are lagging.

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Your internal and external environment need to work together. You get the knowledge about the digital market externally, but internally you put the right people together for the actual business to get value.

— Baker Hughes, Process Manufacturing

Generally, the acknowledgement of AI is high among top management
How competent is your company within Culture?

	1	2	3	4	5
Openness & Agile	3%	17%	38%	28%	13%
Performance Metrics	3%	26%	38%	19%	13%
Top Management Support	1%	17%	28%	30%	24%

Not competent
Limited analytics skills beyond traditional business intelligence based primarily on historical data

Moderately competent
Semi-autonomous examination of data using sophisticated techniques and tools to predict future events

Highly competent
Significant data science activity using techniques such as complex event processing, neural networks, etc.

● Openness & Agile   ● Performance Metrics   ● Top Management Support

Avg. Score	Automotive			Life Sciences			Process Manufacturing			Discrete Manufacturing		
	3.4	3.2	3.1	3.5	3.3	3.8	2.8	2.9	3.4	3.5	3.2	3.8

Note: The percentages are rounded numbers.

4 Technology

How is Technology supporting AI?

Key components of Technology

The three central components of the capability Technology comprise Architecture, Security, and Infrastructure.

Integrating AI into the existing IT landscape is a major struggle

The rise of new technologies that are advancing the expansion of Industry 4.0 and Smart Factories requires robust connectivity between solutions and processes. Integrating these new technologies into the existing IT landscape is a difficult exercise, and for some companies by far the biggest challenge. Especially for larger corporations, IT integration is the most time-consuming part of AI operationalization. The maturity of underlying software architecture, its modularity, and 'plug and play' standardization of AI solutions all play an important role in the success of integrating AI.

Summarizing insights from the interviews from across all Manufacturing industries, it's clear that for a smooth transition when incorporating new technologies into the existing IT landscape, two things are required: upgrading and changing the existing technology platform to allow for AI solution implementation and modular architecture; and adopting cybersecurity measures required for secure AI integration.

Companies with the ambition of scaling AI across the organization need to understand their current and target enterprise architecture, and which AI platform components are crucial for intended use cases. Based on this, they need to build an AI platform that fits with the overall IT landscape. Architecture must be supported by an agile, scalable Infrastructure that can be dynamically extended when needed.

Off-the-shelf algorithms or build-your-own are available options

Algorithms to improve business processes and operations can be off-the-shelf, typically an open source application programming interface (API) algorithm or pre-trained model.

Selecting an off-the-shelf solution typically reduces the time to produce AI solutions, as the framework is already in place. This can be done by simply plugging in your dataset and train the algorithm to a 100% robust solution. It's a relatively 'quick and dirty' way of saving time and resources, yet it decreases the chance of fully customizing the algorithm. There is no shortage of open source cognitive software, but it still requires data scientists navigating software libraries and specific algorithms. Despite many open source AI algorithms to choose from, most of the respondents indicate that they would rather build algorithms from scratch, which requires a significant pool of dedicated AI experts. The rationale is to keep everything in-house, ensuring high security, and the opportunity to fully customize the algorithms to match the AI solution. Another important aspect is the risk of data manipulation. If the AI model trains on manipulated data, the model may be destroyed. The risk of this varies with the selected approach.

Continuous Product Quality Management

Innovation » Commercial » **Operations** » Support   📁 **Use Case**

Increasing quality of QA process with AI by detecting errors

Activity
Continuous Product Quality Management is an AI solution leveraging vision-based technologies with the aim of smoothening the quality assurance process and increase error detection.

Technology
Continuous Product Quality Management uses AI-enabled technologies such as optical inspection scanning and image recognition to test for defects or errors of products still on the factory floor.

Impact
The use case reduces inspection times in the quality loop, improves consistency in detecting product defects, and enables prioritized allocation of resources for a more streamlined production.

BMW has adopted the use case to detect product flaws prior to delivery.

"

We believe that today's quality specialists and shop floor workers need AI technology to improve their daily work.

The importance of a secure network

Industrial data is valuable, regardless if it is generated by AI solutions or not. Protecting this data is critical, which is one of many reasons why cybersecurity is one of the vital characteristics of the Technology pillar. For Life Sciences, due to privacy and the sensitivity of data processes, Security is a crucial component. High regulatory barriers and the use of data in the regulatory approval of new drugs set a high bar for security of technological infrastructure.

For Manufacturing companies choosing to build their entire Technology Architecture and Infrastructure in-house, Security is a key component, and hosting data in-house is prioritized over involving external parties. This also

goes for choosing to use open source-API algorithms. While leveraging external vendors might make security less complex to manage, it will increase the need for a greater focus on avoiding breaches and closing potential gaps as data flows in and out of the company.

With cyberattacks intensifying in frequency and levels of sophistication, the relatively low internal capability score is disconcerting, with an average of 3.5 in the survey. With expanding AI deployments over the coming years, this score is expected to improve.

❝

Building the AI was not really the difficult part of it. We trained some deep Neural Networks to 100% robustness on several use cases. The tricky part was the system integration into our old, legacy-based IT-systems.

— BMW, Automotive

Connecting AI solutions to the existing IT landscape is a key challenge
How competent is your company within Technology?

	1	2	3	4	5
Architecture	1%	30%	30%	29%	10%
Security	0%	15%	38%	36%	10%
Infrastructure	2%	21%	39%	31%	7%

Not competent
Limited analytics skills beyond traditional business intelligence based primarily on historical data

Moderately competent
Semi-autonomous examination of data using sophisticated techniques and tools to predict future events

Highly competent
Significant data science activity using techniques such as complex event processing, neural networks, etc.

● Architecture ● Security ● Infrastructure

	Automotive	Life Sciences	Process Manufacturing	Discrete Manufacturing
Avg. Score	3.3 3.4 3.2	3.0 3.4 2.9	3.0 3.3 3.2	3.5 3.5 3.5

Note: The percentages are rounded numbers.

Grundfos

Empowering the digital transformation with AI

In order to quickly scale their digital transformation, Grundfos built an internal Center of Excellence while using a dynamic ecosystem to immediately bring in expert knowledge when needed. With this approach, Grundfos achieved their goals faster than hoped for.

AI doesn't stand alone, but is part of the digital transformation

Grundfos' digital transformation journey began in 2017, based on five key elements:

Digital engineering: Digital tools for faster innovation.

AI/Data Analytics: Laying IoT and AI on top of a robust data foundation of analytics, visualization and engineering.

Ecosystems and Partnerships: Situating the company in an emerging ecosystem consisting of Microsoft and other global tech companies, as well as smaller agile startups with the environment and culture to deliver instant impact into legacy companies and speed up the innovation process.

How to go-to-market with new digital offerings: Ensuring that product development isn't for products and solutions that will be monetized in a few years.

How to deliver Things-as-a-Service: Focusing on S(oftware)aaS, P(ump)aaS, W(ater)aaS, etc. While the use of AI is inevitable when executing a digital transformation, at Grundfos AI is not viewed as a separate technology, but rather as part of the greater digital transformation.

Recognizing the need for assistance from the ecosystem

Grundfos began with an aggressive 3-year time plan. The company sought to upgrade itself not just with a digital initiative, but a digital transformation of the core business instead of just a corner of the business or infusing a digital unit into the company. This digital transformation is the Grundfos of tomorrow.

In the beginning of their digital transformation journey, Grundfos did not have a clue about how to execute this transformation. They needed help from the outside, which was initially hard for a legacy-oriented company. Yet they formed strategic partnerships with several major tech providers as well as small innovative startups. This was the right move and it still plays a role, as the dynamic ecosystem is key for the company's AI success.

Building an AI Center of Excellence with success

After reaping benefits externally from the dynamic ecosystem of tech leaders and agile startups, Grundfos started building its AI capabilities internally. They built an AI CoE, with data scientists tapping into the core business, fully supported by top management. What started as a small unit, now has 70 full-time data scientists.

About Grundfos

Grundfos is a global leader in advanced pump solutions and a trendsetter in water technology. Headquartered in Bjerringbro in Western Denmark, Grundfos employs ~19,000 people. The company has offices in 56 countries and is represented in even more countries through a network of partners, distributors, and dealers. Fiscal year 2019 revenue: €3.7 billion.

When doing something, do it right

Grundfos invested heavily in their digital transformation, as they knew they needed to scale fast in order to succeed. While being potentially expensive in the short term, it more than makes up for investments in the long term.

The company proceeded by selecting key personnel who knew what was required for the digital transformation journey. Also, tough decisions were made about requiring considerable adjustments from Grundfos' existing personnel.

> **With AI, people either buy into it and see it is the future, or ignore it and expect it to disappear. The latter are no longer working for us.**

"

Without a clear direction, you cannot become AI experts.

— **Electrolux,** Discrete Manufacturing

"

You need to understand what is doable and understand the impact on how we incorporate AI into our way of working already today, not tomorrow.

— **Essity,** Discrete Manufacturing

"

Our cars are becoming data centers on wheels. It is not just offline in the back-end – it is being embedded into the core of our organization.

— **Volvo Cars,** Automotive

Becoming AI Experts

Becoming an AI expert requires six necessary overarching steps, starting with acknowledging AI potential as a priority, followed by formulating a specific plan for transforming the company.

This plan needs to contain initiatives for improving or creating a data foundation and structure. In order to achieve this, one needs to leverage the external ecosystem through partnering.

After establishing external support, internal talent should be built by upskilling the existing workforce and hiring AI experts. The final step is establishing a robust technology infrastructure.
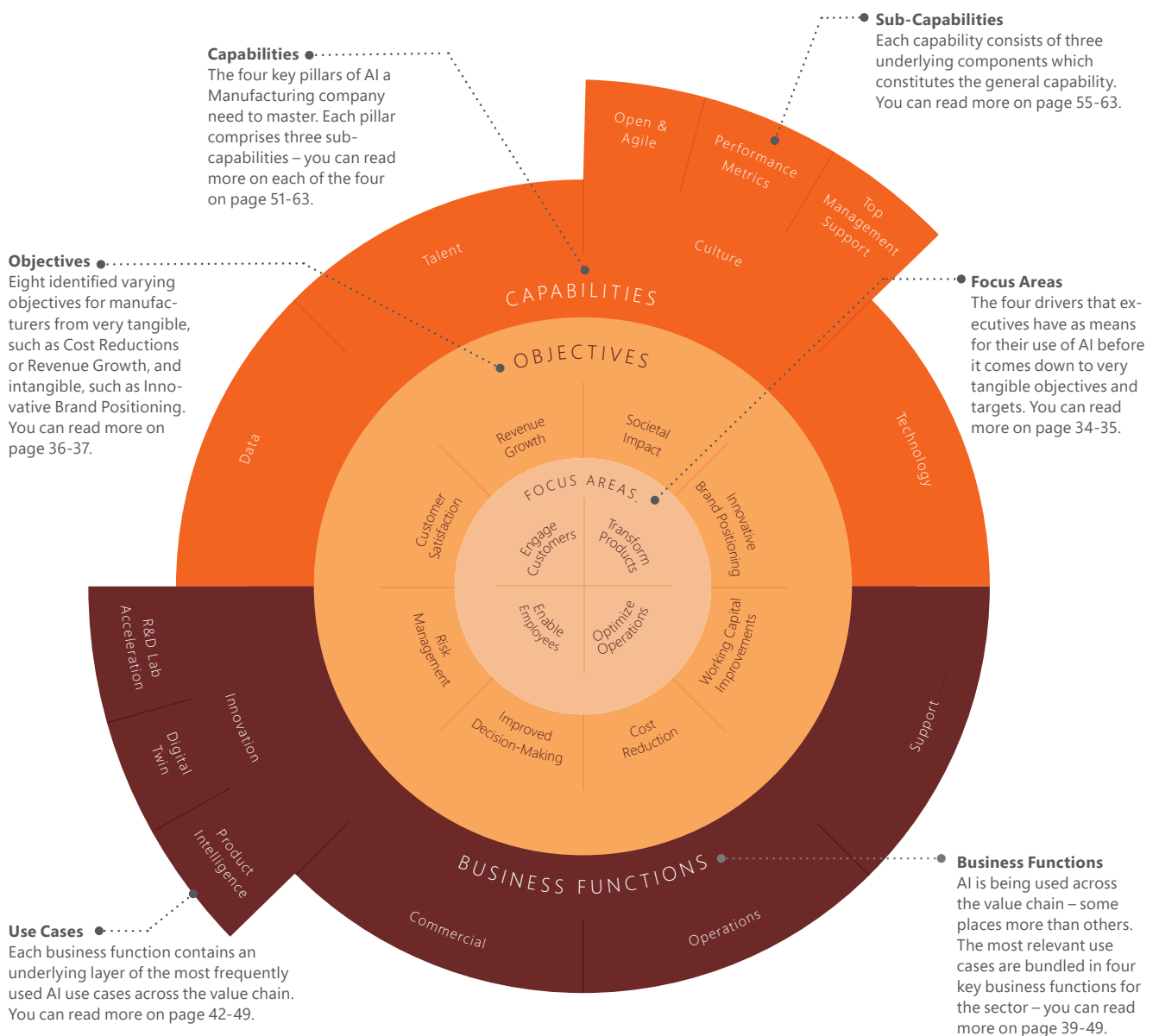
360° of Manufacturing

What are the central factors of working with AI in Manufacturing?

In 2018, Microsoft and EY published a Western European AI report. The report culminated in a model covering core aspects and findings called the AI 360° Model. In this report, the central message and content of the model have been adapted to the Manufacturing sector.
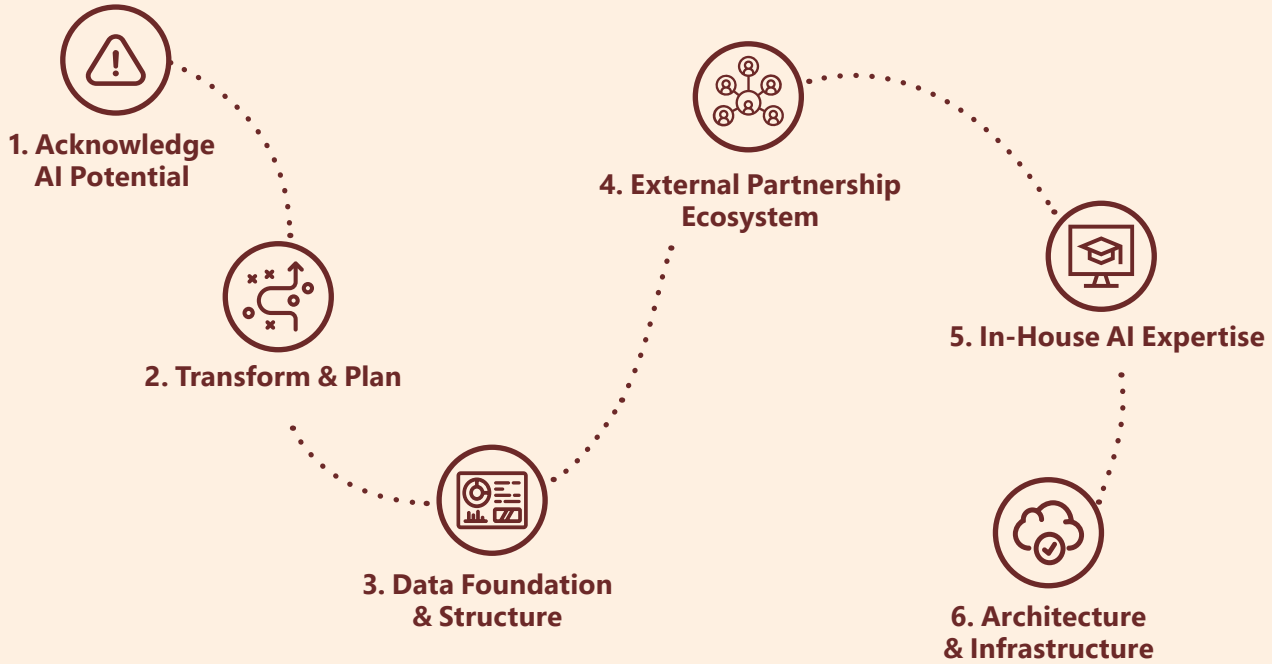
The AI 360° Model tailored to the Manufacturing sector
What are the core components of becoming AI proficient in Manufacturing?

Sub-Capabilities
Each capability consists of three underlying components which constitutes the general capability. You can read more on page 55-63.

Capabilities
The four key pillars of AI a Manufacturing company need to master. Each pillar comprises three sub-capabilities – you can read more on each of the four on page 51-63.

Objectives
Eight identified varying objectives for manufacturers from very tangible, such as Cost Reductions or Revenue Growth, and intangible, such as Innovative Brand Positioning. You can read more on page 36-37.

Focus Areas
The four drivers that executives have as means for their use of AI before it comes down to very tangible objectives and targets. You can read more on page 34-35.

Business Functions
AI is being used across the value chain – some places more than others. The most relevant use cases are bundled in four key business functions for the sector – you can read more on page 39-49.

Use Cases
Each business function contains an underlying layer of the most frequently used AI use cases across the value chain. You can read more on page 42-49.

Circular diagram labels:

CAPABILITIES: Open & Agile, Performance Metrics, Top Management Support, Culture, Technology, Talent, Data

OBJECTIVES: Revenue Growth, Societal Impact, Innovative Brand Positioning, Working Capital Improvements, Cost Reduction, Improved Decision-Making, Risk Management, Customer Satisfaction

FOCUS AREAS: Engage Customers, Transform Products, Enable Employees, Optimize Operations

BUSINESS FUNCTIONS: Support, Operations, Commercial, Innovation (R&D Lab Acceleration, Digital Twin, Product Intelligence)

Path to AI Value Creation

What are the key steps on the journey to become an AI expert?

1. Acknowledge AI Potential

2. Transform & Plan

3. Data Foundation & Structure

4. External Partnership Ecosystem

5. In-House AI Expertise

6. Architecture & Infrastructure

How AI can be differential in overcoming a global pandemic

An intelligent driven organization has a step ahead in embarking on the AI journey.

Supply chain disruption

AI has the ability to improve visibility from end-to-end, and support the mitigation of shocks arising from COVID-19, as the supply chain is transforming into digital supply networks where functional silos are broken down and organizations become interconnected to enable collaboration, agility, and optimization.

Read more about how AI can play a vital role in the disruption of supply chains.

Automation of manual labor tasks

AI-enabled advanced robots that can handle tasks previously requiring human labor will promote the operation of factories and other facilities 24/7 while the blue-collar workforce is furloughed. AI-enabled platforms will help companies better simulate live work environments and create on-demand labor forces.

Read more about how AI can automate manual labor tasks on the factory floor.

Adapting to new market demands

The lost momentum from variable supply and demand caused by COVID-19 can be solved by AI-enabled use cases tapping into the Innovation business function by autonomously identifying an optimal product design through Generative Design or R&D Lab Acceleration, rapidly adapting to new market demands.

Read more about how AI can support product development.

1. Acknowledge AI Potential

A slow adoption of new technologies has historically been the case in Manufacturing. It is crucial to change this, and acknowledge the opportunities AI offers.

Engage C-suite	Identify Company AI Agents	Build a Robust Business Case Framework

Over the past couple of decades, the hype around AI has been immense. The acknowledgement of the many opportunities AI offers for the Manufacturing sector often come from the top of the organization, in other words driven by the C-suite. The sooner the C-suite is engaged, the easier it will be for you to accelerate and scale the role of AI in your business, as they are the ones who manage the budget, allocate the resources, and prioritize the strategic agenda.

However, as the C-suite often does not come up with ideas about integrating AI company-wide or execute the broader roll-out, it is important to identify company AI agents who have the will and know-how to drive the agenda. These agents should be involved in the development of a robust business case framework, including the most important metrics required for an idea to develop into a PoC and then turn the AI solution into production.

Read more on our website about acknowledging the potential of AI.

2. Transform & Plan

The conservative approach to change in large parts of the workforce needs to be overcome. As part of the digital transformation, a distinct AI plan needs to be formalized.

Mobilize a Digital Transformation	Set a Direction for AI

Changing the Manufacturing workforce attitude toward technology is a prerequisite for a radical shift. However, this may be especially challenging in some Manufacturing professions. The first step of this change is to embark on a greater digital transformation, including a cultural transformation. For AI and other technologies to be properly leveraged for the business, an open and agile company culture is required.

Transforming the organizational culture may be a challenge. The journey will be long (+5 years), making it important to have a clear direction on how to unfold the potential. Formulating a distinct AI plan needs to be an embedded part of the digital strategy. The plan needs to have a clear set of KPIs, strongly aligned with the targets of the core business, and with distinct finance allocations. Apart from the initial company AI agents, a competent Data unit needs to be established. In addition, a digital committee or Center of Excellence can be established to support the journey.

Read more on our website about transforming your company and planning AI.

3. Data Foundation & Structure

Data is the most important aspect of AI. Collecting and storing data coming from sensors in factory floor machinery and products is critical through a robust governance.

Identify Data Owners	Set up Data Storage	Build Data Governance

Data is the key to AI success, which doesn't solely depend on quality and access. In Manufacturing, the large number of customers and different processes across the supply chain provide many data points, making it a necessity to identify a data owner. However, as many processes have historically been managed manually, not all data points are easy to integrate into digital solutions. Therefore, there is an important task for the appointed data owner to convert non-digital data, as well as clean the various data sources and provide structure to increase the quality of the data.

Structuring data is closely associated with the storage of data, where a database, such as a data lake, is needed to not only structure the data flow but also increase the ability to analyze the data. In general, establishing a robust data governance, including data processing, managing bias, explainability, and transparency, will help structure and store the data around the AI solutions, and ultimately increase the likelihood of success.

Read more on our website about building a robust data foundation and structure.

4. External Partnership Ecosystem

AI knowledge in Manufacturing can be expanded by building an external dynamic ecosystem of partners, but do not solely rely on the external ecosystem.

Engage in Partnerships	Do not solely rely on the External Ecosystem

Engaging with external parties such as startups, academia, consultancies, and tech leaders will help you understand the rules of the game. AI skills and know-how is not a natural part of the toolbox for Manufacturing companies, yet rather than losing out on the opportunities AI offers, companies should instead leverage external experts, as they can be a great accelerator for the AI journey, and skilled AI resources are scarce.

However, it might seem easy to fully outsource AI to external parties as they have the toolbox, skills, and insights on AI. On the contrary, they lack the insights about your specific business and how AI can be properly leveraged in your business processes. Therefore, be careful not to rely solely on the package that external partners provide. Building AI capabilities in-house will be extremely important, as internal AI experts are needed who also understand the core of your particular business.

Read more on our website about constructing an external ecosystem of partners.

5. In-House AI Expertise

Upskilling of the workforce is critical for AI to work. Hiring AI experts is required, as Manufacturing companies often lack know-how. However, involve domain experts.

Hire AI Experts	Upskill Existing Workforce	Combine AI & Domain Experts

With a solid knowledge foundation after involving external partners, the prerequisites of scaling AI capabilities internally are considerable. The first step is to hire AI experts, such as data scientists, data engineers, and AI translators. However, it is important to support the AI expertise they bring by upskilling the existing workforce. The cultural transformation will be beneficial, as the workforce will be more open to participating in training programs so they understand the importance of data, what can be realistically done with it, and where it can be deployed for data democratization to take place.

Putting AI experts and domain experts together is the final step in the journey of building internal AI capabilities. While AI experts may know what is possible to solve with AI, domain experts can provide important insights into which processes and segments of the supply chain that can benefit from AI. At the end of the day, AI will only work by combining the skills and experience of both the AI experts and domain experts, keeping them close to each other and constantly in the AI development loop.

Read more on our website about building AI expertise in-house.

6. Architecture & Infrastructure

Building a modular architecture and agile infrastructure is vital to ensure connectivity between factory floor machinery, products, and other sensors in the supply chain.

Build Modular Architecture	Build Agile & Interconnected Infrastructure

A critical part of the entire AI journey is connecting AI solutions to the existing IT landscape. Building algorithms behind the AI solutions is rarely the most difficult part of AI. The difficult part is plugging AI into the larger technological architecture. An important step is building a modular architecture. A way to manage the complexities of this is by breaking it down into smaller modules, with clear guidelines and principles that will allow for not only running PoCs, but also scaling AI solutions into production.

A robust, agile infrastructure is critical for interconnectedness, and can be built via standardized infrastructure service offerings with automated delivery and self-service tools. Solid connectivity can be achieved more easily with modular, API-based architecture using the existing IT landscape, AI-enabled solutions, factory-floor machinery, and other – often IoT driven – sensor-based capabilities.

Read more on our website about building a robust technology architecture and infrastructure.

Who to Contact

from Microsoft

The team that can help your company on the Path to AI Value Creation

Valerio Frediani

Director, Manufacturing Industry, Microsoft WE

Valerio is a Technology Strategist and Advisor of Digital Transformation journeys with +15 of experience in both Connected Factory and Connected Product & Services domains. He is a thought leader in the adoption of the Industry 4.0 principles in Digital Manufacturing and has a strong technical background spanning from automation, Industrial IoT, business systems and AI.

Prior to joining Microsoft gained experience in Engineering and Services organizations at Siemens and Rockwell Automation, today acts as trusted advisor for C-Suites in large digital transformation programs while leading the Agile Factory business development at Microsoft Western Europe.

Patrick Van Loon

Senior Industry Executive, Manufacturing Industry, Microsoft WE

Patrick has over 20 years' experience in managing global manufacturing and supply chain operations. In his role Patrick works closely with customers to determine new and innovative ways to improve their supply chains and transform them into resilient and customer-focused networks.

Patrick joined Microsoft 3 years ago, and prior to that was Product Manager for the Supply Chain Intelligence Suite of SAS Institute. Patrick also worked for Menlo Worldwide, a provider of global warehousing and transportation services to Fortune-500 companies within both automotive, retail and medical industries. Common thread in his career is combining an understanding of the process with a keen interest for new technologies, to find ways of unlocking value.

Christoph Pawlowski

Director, Manufacturing Industry, Microsoft WE

Christoph has +20 years of experience in consulting, sales and business development to the manufacturing industries and currently works as Director, Manufacturing Industry Solutions.

Prior to joining Microsoft, he gained experiences from Fujitsu Siemens Computers and from software services consulting. Today, his primary expertise is in intelligence driven connected sales, services, aftermarket solutions and workforce transformation. He engages with C-levels to unlock digital transformation by focusing on value creation, business model evolution in manufacturing, and sustainability.

Aydin Gencler

Regional Marketing Director AI and IoT, Microsoft WE

Aydin has +25 years of experience in software development, consulting, business development and marketing. Prior to joining Microsoft, Aydin held various positions in Oracle. In 2008, Aydin joined Microsoft Middle East and Africa Headquarters based in Istanbul, Turkey managing the data platform marketing. In 2016, Aydin took over a new role at Microsoft in Western Europe to lead the IoT business end to end.

Recently, Aydin has added AI in his scope and is leading IoT and AI business in Western Europe. Aydin holds an MBA in marketing and MSc in Computer Engineering.

Contributors

from EY

Team responsible for the 'AI in European Manufacturing Industries 2020' report

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Having pioneered SaaS, including embedded AI, in the late '90s, Magnus leverages several successful entrepreneurships in digital, advising clients on digital strategy, digital operations and tech-led transactions.

Magnus' twelve-year strategy consulting partner tenure has been focused exclusively on the Manufacturing sector. Magnus is responsible for this AI study across 15 markets in collaboration with central and local EY strategy teams and AI specialists.

Based in Lund, Sweden

Dr. Thomas Erwin

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Thomas is passionate about creating innovation-led cultures which understand and validate the potential of emerging technologies, while successfully building market-ready solutions when the time is right, thereby turning digital trends such as AI into tangible solutions that help clients solve their most pressing business problems.

With more than 20 years of experience in Consulting, Thomas has worked with clients around the world to define and execute their digital strategies.

Based in Mannheim, Germany

Kristin Ringland

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Kristin has worked intensively with developing the technology strategy for the most prominent Automotive OEMs, as well as supporting several large companies across the additional Manufacturing industries covered in this report.

Prior to EY, Kristin served as a Partner in McKinsey & Company, leading the EMEA Private Equity Transactions Service Line. As an advisor to Private Equity funds for nearly two decades, digitalization along with AI have been close to the core of Kristin's experience.

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Sachin Lulla

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Sachin has developed deep expertise in AI, IoT, and other emerging technologies with over 20 years of experience in the Manufacturing sector, leading technology-enabled business transformation. Sachin is one of the leading influencers for digital transformation, including being a keynote speaker on the topic of mobility and digital transformation in Manufacturing.

Prior to EY, Sachin established IBM's IoT services business for industrial companies, and also led the Automotive industry in North America.

Based in Tampa, Florida, United States