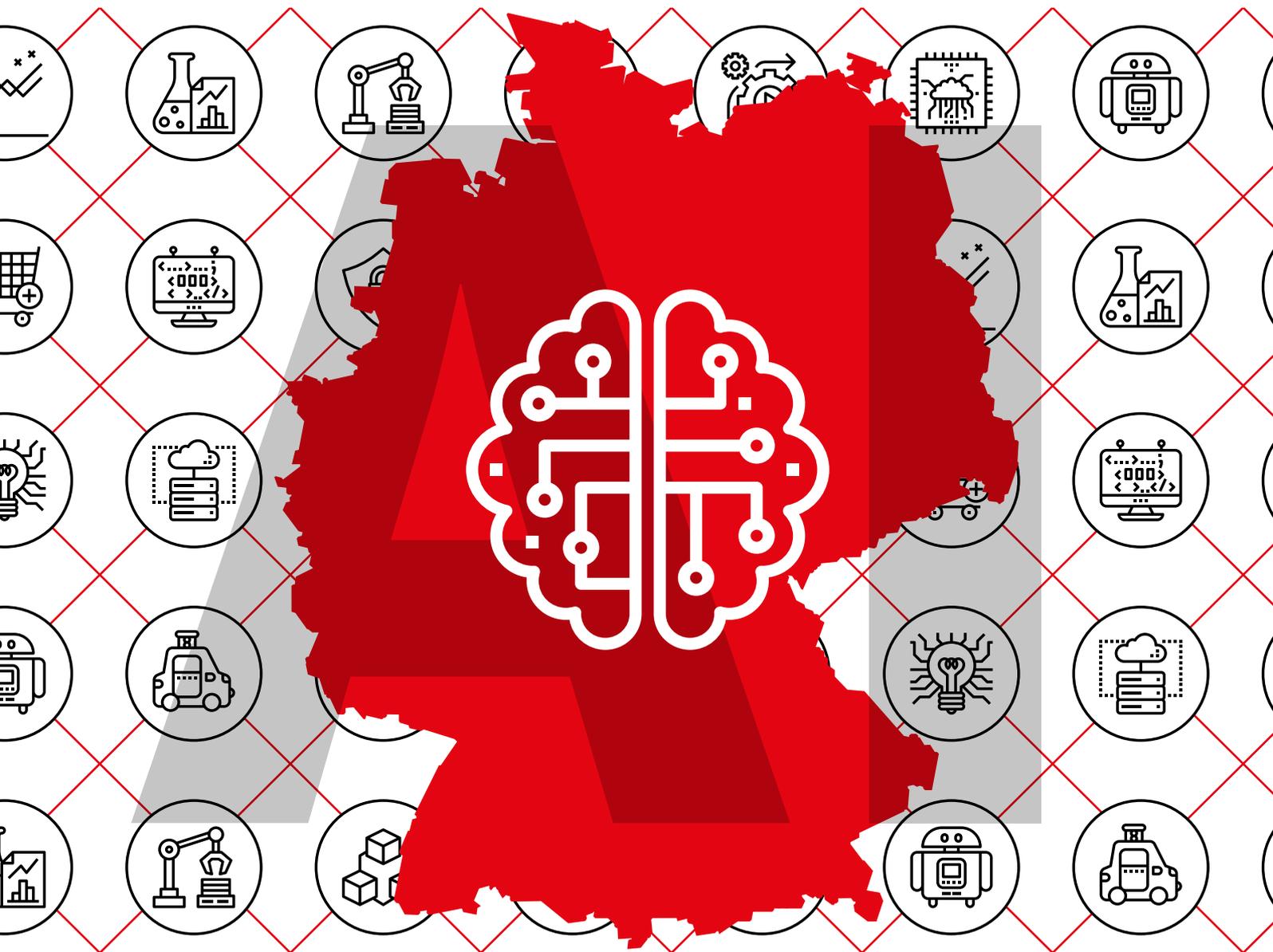


ARTIFICIAL INTELLIGENCE (AI)

ITS POTENTIAL AND THE LASTING TRANSFORMATION OF THE GERMAN ECONOMY

A Study by eco – Association of the Internet Industry and Arthur D. Little



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Foreword



Oliver Süme, Chair of the Board – Board Member for Policy, Law & Regulations, eco – Association of the Internet Industry.

Dear Readers,

I am proud to be able to present to you the results of months of interdisciplinary research and factual analysis with this study on the topic of "Artificial Intelligence (AI) – Its Potential and the Lasting Transformation of the German Economy." As the Association of the Internet Industry, we are convinced that the Internet of the future will be decisively shaped by AI technologies and applications. We believe that AI represents the next step in the evolution of the Internet.

But AI will not only shape and change the Internet industry; it will also influence the entire German economy.

In cooperation with our member company Arthur D. Little, and supported by the Vodafone Institute for Society and Communication, we have succeeded in developing a contribution to the current discussions about the "game changer" that is AI.

Which sectors of the economy in Germany benefit from the use of AI and how? What do these individual leaps forward in innovation mean for companies, for each of the respective sectors, and ultimately for the German economy as a whole?

The fact that the answers to these questions are so clear has surprised us – and we would like to think that such clarity will contribute to a more confident public and political discussion about the use of AI in the future. I hope that this will motivate those user companies who are still diffident about using AI technologies.

One thing is clear after reading these findings:

Germany as a business location can no longer afford to drag its feet in the use of AI in the respective business processes.

To stay competitive internationally, both the Internet and user industries must now move forward with openness and the readiness to experiment with and implement AI in our key economic sectors. This is the only way we will be able to profit from this use of technology as quickly as possible and generate new business models on the basis of our experience.

What the study also shows is that AI will not replace people, either in the short or long term, but will instead support them in their tasks. Therefore, AI is a tool we need to learn to use.

But AI also needs a home. It is therefore equally as important for us as representatives and part of the Internet industry that we maintain an innovative digital ecosystem for AI in Germany. Such an ecosystem is characterized above all by the fact that it provides a smart mix of digital infrastructure offerings, depending on the industry and application scenarios. As well as traditional data center operators, all types of cloud infrastructure providers are included in this ecosystem – with the possibility that edge or fog computing will also be integrated into this mix.

The full potential of all of this can only be exploited once we have established a nationwide fiber optic network in Germany and thus also established the basis for the use of 5G in all regions of Germany.

I am convinced that we still have the chance to make Germany and Europe an important AI location. To this end, all actors – companies, politics, research, and society – must work closely together to tackle the challenges of the digital transformation of Germany as a business location and meet the new technological opportunities with greater courage and optimism.

It will be worth it. This is what this study makes very clear.

I hope you find reading it informative and inspiring!



Leading-Edge Innovation for Germany



Rafael Laguna de la Vera, Founding Director of the German Federal Agency for Leading-Edge Innovations SprinD, Co-Founder and CEO of Open-Xchange AG

"How can you tell artificial intelligence (AI) and machine learning (ML) apart? If it's written in Python, then it's probably ML. If it's written in PowerPoint, it's probably AI."

Mat Velosso, Technical Consultant to the CEO at Microsoft

Hardly any other topic is currently more hyped than AI. And even if some things may seem exaggerated, it is easy to see how this technology and methodology will transform practically all areas of life and markets. Reason enough, then, to go deeper, to understand what is coming and how to deal with it. This trend is reinforced by the general digitalization of all sectors of the economy, with AI being an important sub-topic here. When you look at the big picture, the view becomes clearer:

Microcomputers, the Internet, and smartphones are the outstanding leaps in innovation of the last 50 years. They have changed the world as much as the great innovations did at the end of the 19th century. The most important of those earlier innovations was the car, which still provides us here in Germany with 20 percent of our economic output and 50 percent of our exports. This era is drawing to a close, but the new innovations are not coming from here. So it's high time to position ourselves. What could the European approach look like? Aren't we already way too late and streets behind Silicon Valley and China?

A suggestion

With the Internet, a new, prospering growth industry has emerged, also in Germany and Europe. More than 1,100 international member companies in the eco Association are the best proof of this, even if the centers of digitalization are more likely to be located outside of Europe

rather than here. The Internet was and is so successful because it is based on three essential principles: It is open, federated, and permissionless.

- Open protocols and implementations – under open and free licenses – enabled a global collaboration model for software development, operations, and connections, and kept prices low.
- Federated systems created a robust network in which anyone could participate at any time.
- This in turn meant that there was no platform to control everything, no entrance fees, no gatekeeper. The Internet is permissionless; the door is open to everyone.

A prosperous ecosystem developed in which everyone could participate, and spread rapidly. New industries were created and new technological leaps such as the smartphone were actually made feasible. At least in the beginning. In the meantime, a few closed, centralistic platforms have emerged on the Internet; monopolies that are actually the antithesis of the original success.

This is the opportunity for Germany, Europe, and all those who want to participate. The next wave of digitalization, driven in particular by progress in ML and AI, but also by very "banal" things like trustworthy cloud services, should return to the successful principles of the Internet. We should work together again in an open, federated, and permissionless manner. For a long time, this has worked very well in science and research, as well as in the open source software industry, and will dramatically accelerate progress in the development and networking of AI-based systems. In this way we contribute to the preservation of the ethical and humanistic foundations of our society, including our democratic, market-based social system.

This study by eco and Arthur D. Little helps us to recognize the enormous changes that commerce, automotive and mechanical engineering, metal and electrical industries, utilities, manufacturing, and telecommunications are facing – and thus that we all face. Work together. Open your systems, share (the anonymized) data and algorithms. Together we are faster and stronger!



From Using to Shaping



Inger Paus, Managing Director, Vodafone Institute

The Germans are already ahead when it comes to the consumption of artificial intelligence (AI). Be it shopping on the Internet, listening to music via streaming apps, or using card services. But only rarely do these applications come from Europe or Germany.

As far as the design and implementation of AI is concerned, there is still potential for improvement in Germany – to phrase it tentatively. Although many institutions in Germany conduct intensive basic research, it is not uncommon for many talented young people to move abroad, drawn not just by more attractive working conditions, but also by the availability of more capital.

A further obstacle for the German AI market is the lack of acceptance of future-oriented technologies in general. Only 48 percent of Germans are positive about digitalization, as the study "The Tech Divide" by the Vodafone Institute showed in 2018. In comparison: In both India and China, the figure is over 80 percent. And 58 percent of Germans even go as far as assuming that people will be controlled by algorithms in the future.

This attitude can also be found in politics and business. For example, public investment in AI is comparatively modest. A large part of the national economy does not regard AI to be relevant in their own companies.

And yet, it should be in our deepest interest to highlight the economic potential of AI. The aim of this study is to put this into figures that can be easily understood.

AI's expected exponential growth in revenue is a reminder that investments in digital infrastructure should be pushed ahead rapidly. High-performance networks – such as those Vodafone already provides and is expanding – are an important prerequisite for this. Last but not least, the study shows that investments should be of the utmost interest to the telecommunications industry, as here, too, great revenue potential can be expected from AI.

But aside from all the figures, it also becomes clear that AI has the greatest chance of success if it supports or expands human work – and not if it tries to replace it. I am deeply convinced that a coexistence of economic success, technical progress, and social responsibility is also possible in the field of AI.

I wish you a thought-provoking read.



Executive Summary



Lars Riegel, Principal, Arthur D. Little

For the purposes of this study, we have examined the potential of artificial intelligence (AI) for the German economy in 2025. A comprehensive analysis of more than 150 use cases across all relevant industries and all corporate functions shows: If the potential of AI is used comprehensively by companies, a total potential of approximately 488 billion Euros will be created for the German economy in 2025. This would correspond to a 13 percent increase in GDP compared to 2019. Of this amount, approximately 330 billion Euros would be accounted for by cost-saving potential, and approximately 150 billion Euros by revenue potential.

Of greatest significance: (1) We expect cost savings and revenue potential for all industries. (2) We see that AI will

affect every function in companies. The biggest impacts are expected to be in the Retail & Consumer Goods and in the Energy, Environment & Chemicals sectors, each with a forecast of just under 100 billion Euros. The greatest potential, at just over 50 percent of the forecast economic impact, lies in supporting manufacturing with AI.

Technologically and economically, there are no obstacles to using AI immediately in companies. Once the relevant data is available, machine learning and deep neural networks can already be used to apply AI applications to support employees and processes in processing image and language information and logical reasoning. By 2025, more than 70 percent of the applications will be used to support humans. AI will not replace employees, but strengthen value creation and competitiveness side-by-side with employees.

Massive investments are being made in AI in the USA and China. The Chinese AI-SaaS company SenseTime alone has a valuation of seven billion Euros and is a leading competence center with excellent prospects for the future. In Germany, we are a long way from this – but we see successful AI companies in attractive niches in the German core industries such as the automotive industry and mechanical engineering. We are optimistic that, in proximity to these sectors, internationally leading German companies will emerge in the medium term.

The most important use cases of AI are:

In Manufacturing:

approx. 11 % higher productivity

- Predictive maintenance
- Automation of quality control
- Optimization of the manufacturing network

In Logistics:

approx. 14 % higher productivity

- Automation of inventory management
- Autonomous warehouse

In Retail:

approx. 23 % higher effectiveness

- Support of sales staff through digital assistants
- Real-time market analysis
- Support for presentation and sales processes

In Marketing:

approx. 15 % higher productivity

- Automation of market analysis
- Knowledge management
- Recommendations for action

Companies in Germany are therefore urged – regardless of size, industry, and competitive position – to start implementing and using AI in their business environment as soon as possible. Companies can orient themselves around four strategic options:

- 1. AI in Sight:** carrying out first pilot projects, developing competencies, and tracking the technology
- 2. AI Strengthened:** strengthening a company's own value creation through process support and automation
- 3. AI Transformed:** enriching and transforming products, services, and value creation with AI
- 4. AI Player:** creating new business models through AI or by marketing the company's own AI solutions



1. Artificial Intelligence Today is Both Reality and Hype at the Same Time

1.1 Germany and German companies must act soon

In recent years, there has been a deluge of statements and announcements about the potential of AI in scientific articles, media reports, corporate announcements, and politics. There is a broad consensus that AI will directly or indirectly affect all economic activities. AI is fundamentally changing business processes and business relationships. Automation is only one aspect of this change, as the results of this study show.

While AI only became popular in the media and technology strategies of companies and entire countries in and around 2015, research on AI in the field of information technology can be traced back at least to the 1950s. Against this background, it is not surprising that AI is already a reality in many places today. An average user of popular online portals (such as Spotify, Amazon, or Zalando) comes into contact with AI solutions almost a hundred times a day.

In May 2017, the AI AlphaGo Master from Google Deepmind beat the Chinese master player Ke Jie in a game of Go. Ke Jie was the number one Go player in the world at the time. The author and computer scientist Kai-Fu Lee called this "AI's Sputnik moment." Many experts agreed just a few years earlier that it would take a long time for an AI to beat the best Go players. According to Kai-Fu Lee, China understood at that moment that, with AI, a new wave of technology was approaching, with signif-

icant economic and societal impact. The state actively promotes AI innovations and focuses on the structured development of an AI ecosystem. As a result, venture capital for AI in China quadrupled from 2017 to 2018 (relatively, from 11 to 48 percent of global AI venture capital). Since 2017, almost half of all global venture capital has been invested in AI start-ups in China. This development is accompanied by countless initiatives that are difficult to measure quantitatively.

OUTLOOK: In 2025, we expect AI to make a total value contribution to the German economy of around 488 billion Euros or 13 percent of the gross domestic product (GDP).

The benefit and value contribution of AI will develop exponentially between 2020 and 2025 with an average annual growth rate of 34 percent. Society, politics, and companies are called upon to adapt to this dynamic.

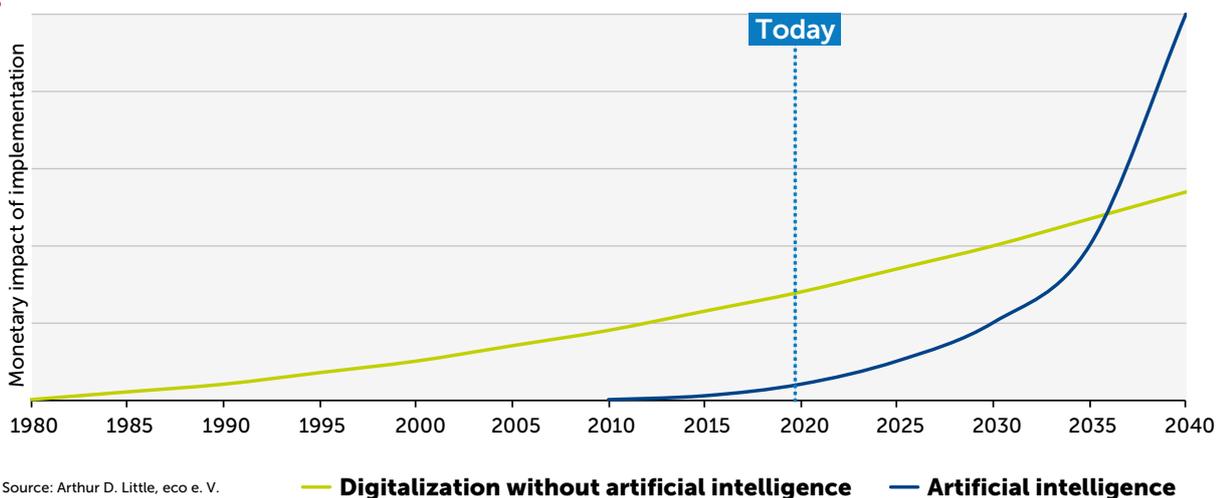
The value contribution of digitalization has been linear – the value contribution of AI will increase exponentially.

A look at the development of digitalization in Germany over the past 40 years shows: The impact of AI is 200 percent faster and will exceed the value contribution of traditional digitalization by 2035/2036.



FIG. 1

The monetary impact of the implementation of artificial intelligence will exceed that of digitalization in volume and speed.



Source: Arthur D. Little, eco e. V.

— Digitalization without artificial intelligence — Artificial intelligence



FIG. 2

The deployment of artificial intelligence in everyday and business applications must be active, reflective, and coordinated.

- Germany-wide increase of 50 % in annual AI patents
- Annual provision of public funding of 1 % GDP
- Legal and entrepreneurial framework for "sandboxing" – to gain experience today
- Immediate transfer of research into practice and strengthening of AI research locations by 25 %: Research partnerships are relevant for all companies



- Concrete ethical standards for the protection of privacy, but a secure framework for the rapid use of anonymized data
- Immigration and visa facilitation for AI researchers and developers (EU principle)
- Full and monthly transparency on the use of public funding

- Creation of a government tech fund for the active provision of venture capital including a premium for private investors
- Holistic development of competencies through targeted promotion of data science, software development, and user experience study programs



Source: Arthur D. Little, eco e. V.

In order for this potential or "promise" to be achieved, it is not enough just to create the conditions; active measures are needed. Politicians, researchers, and business people are challenged to actively reflect on and coordinate the nationwide, company-wide, and function-wide introduction of AI. Some countries already have their own ministries for AI that are intended to support exactly these measures.

In order to promote the potential of AI for Germany, the Federal Republic of Germany published a national strategy for AI in 2018. Core elements are the targeted promotion of research and development, the transfer of knowledge across industries, and the adaptation of the regulatory framework (e.g. legal framework for data, but also the legal security of AI systems). In this way, the national AI strategy supports a reflected and coordinated approach.

We recommend that every company in Germany implement a minimum of two AI pilot projects in 2020. These pilot projects can be carried out with existing resources and without impinging significantly on operations. Depending on the scenario, the strategy can be worked on either in parallel or once the initial findings from the pilot projects are available.

1.2 What is AI and what impacts can we expect?

AI, in the simplest sense, is when machines replicate individual capabilities of humans. Today, AI solutions are mostly capabilities adapted to a specific problem. Examples are the optical inspection of goods for defect detection or the analysis of job application letters. AI will influence the entire value chain and, in the long run, AI solutions will solve more than just pre-specified problems.

For companies to be able to use AI successfully and thus generate sustainable benefits, four factors must be considered. AI is only a factor in two of these.

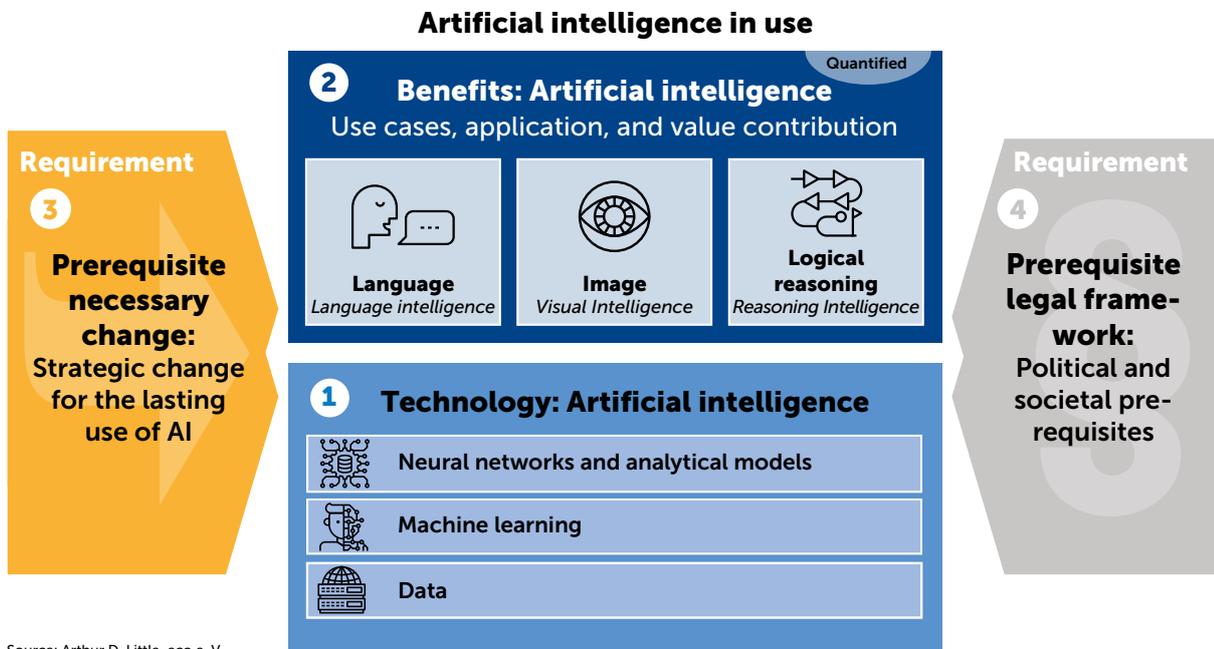
1: Which technology is AI based on?

AI is not a single technology, but consists of three essential building blocks that result in AI applications. This is a significant difference to other technologies that can be considered as single building blocks, such as database systems. The building blocks for the development of AI applications are data (including databases), machine learning, and neural networks or analytical models. Only the combination of these can create AI applications. AI does not create any benefits at the exclusively technological level, unlike other technologies.



FIG. 3

Four factors for the successful use of artificial intelligence



Source: Arthur D. Little, eco e. V.

In comparison: Blockchain is already creating technologically-secure database systems. A detailed examination of the technology is undertaken in Chapter 3.

2: What are the benefits of AI?

The added value and benefits of AI arise from the practical application in business processes. We divide the added value into three areas: language recognition, image recognition, and logical reasoning. More than 150 specific AI applications are known to support business processes today. We assume that by 2025 one third – at least 50 specific applications – will be established in practice and will be part of normal operations. AI will support employees and increase the degree of automation in manual and repetitive activities by at least 50 percent.

In addition to the technology and the benefits of AI, a lasting successful deployment calls for conditions to be met in terms of the strategic change of companies and the creation of legal framework conditions.

3: How can AI be implemented?

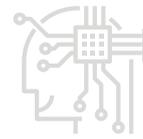
AI will have a direct or indirect impact on all business areas along the value chain. Enterprises should begin implementing AI application cases in 2020 to leverage the technology. This requires not just a pragmatic approach to the introduction of AI applications (and technology) but, in particular, an analysis of their structural impact.

As is the case with digitalization, companies need to build the right competencies and adapt business processes and models for the long-term. This begins with the question of whether assets and capabilities in an "AI world" still allow differentiation between products and services. It also factors in aspects of future cooperation between humans and machines.

This calls for innovative concepts for overarching governance and, in particular, ownership of data – two challenges familiar from digitalization and which have been resolved by very few companies. A more detailed outlook on the necessary strategic change is given in Chapter 5.

4: What is the regulatory framework for AI?

The handling of AI and its impact on the state, society, and economy raise questions about the political, legal, and societal regulatory framework for AI. Chapter 6 presents the strategic approaches taken by governments and intergovernmental organizations on this issue.



1.3 AI is reality

All technical hurdles for the use of AI can now be overcome by companies from Germany. Practical experience shows that every company today should be able to deploy AI solutions within a three-month period.

**Case study:
Digital Service Assistant TOBi supports customer service**

Vodafone GmbH

Cell phone customers expect a service which is fast, uncomplicated, and always available. Dealing with the telephone hotline is often frustrating for customers, because long waiting times and interactive voice systems delay being put through to the right employee.

The digitalization of customer service makes it more flexible and reliable. Vodafone is using AI to establish instant messaging as a new service channel – TOBi.

Use is made of the IBM Watson AI and IBM Watson Assistant technology. These allow image and voice messages to be processed and over 100 different subject areas to be identified.

TOBi currently processes approximately 250,000 conversations per month and can resolve almost 30 percent of them fully automatically without having to hand them over to an agent. This contributes significantly to the reduction of end-to-end process costs. Customers send voice messages and pictures via WhatsApp. Using AI, the images are categorized and irrelevant material is detected. In particular, non-relevant customer service requests can be closed before an agent has to process them.

The customer experience is improved as the customer can contact Vodafone 24 hours a day through their preferred contact channel and receive a quick response. For the employees, the introduction of AI is creating completely new job profiles. Bot trainers teach TOBi new content and continuously improve the quality of the answers. Bot designers then build this new content into the Watson Assistant. These roles have been filled by former hotline employees, as they have the necessary know-how due to their proximity to customers.



FIG. 4 Number of support requests and requests processed by TOBi



Source: Vodafone

■ Conversations ■ Resolved by TOBi — TOBi Ratio



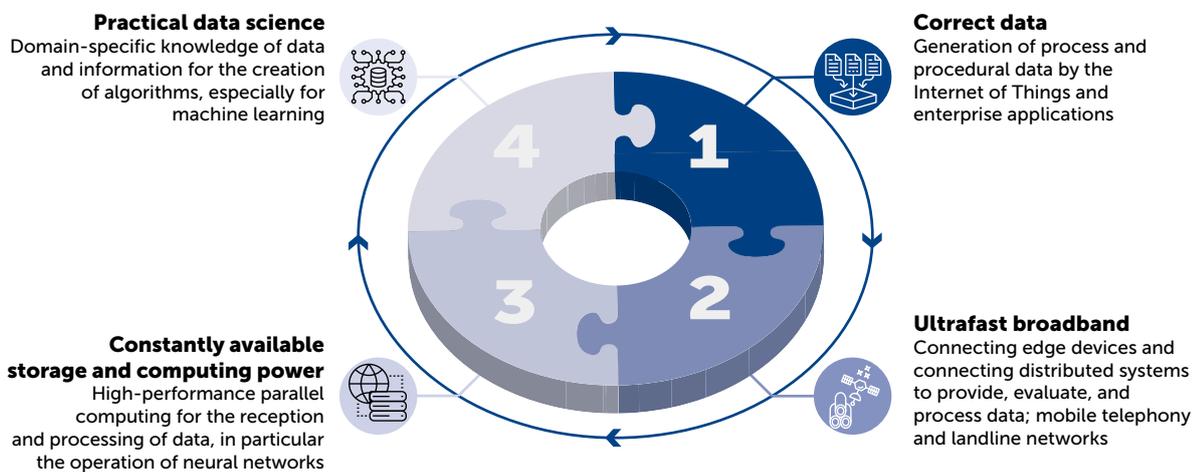
Creating basic prerequisites for AI in Germany

AI solutions are already market-ready in many application areas and are distributed by specialized companies, but often also by hyperscale IT companies. In order to leverage the aforementioned AI potential, German companies primarily need a suitable, modern ICT infrastructure with nationwide availability throughout Germany. This is a key criterion for profiting from the impact potentials. A majority of the AI applications are based on cloud-based solutions, which is why the majority of the case

studies analyzed require a nationwide stable Internet connection with sufficient transmission speed to be able to transmit data almost in real time. Economies wishing to promote AI must ensure that the four foundations for AI are provided in the best possible way. For the majority of German companies, the technological prerequisites for the implementation of AI are already in place today.



FIG. 5 Technical prerequisites for the implementation of artificial intelligence



Source: Arthur D. Little, eco e. V.

1 Correct data: The impact of AI today is very strongly determined by the underlying data. AI solutions use existing data to learn. Thinking along the lines of “the more data, the better” no longer holds up; the right kind of data is needed. Companies must consider their data strategy in advance and ensure that the relevant process data is generated by the Internet of Things and enterprise applications. In addition, data usage rights will be an essential success factor in future for companies that want to secure a sustainable competitive position.

2 Ultrafast broadband: AI applications require fast transmission – whether in the landline network or in mobile telephony. In 2019, Germany was in second-last position in Europe with about 3 percent “fiber to the home” penetration – i.e. with fiber optic connections to the home – and needs to catch up. Even though the availability of fiber optic connections for companies is 21 percent and cable and DSL technology is used for broadband access in addition to fiber optics, transmission solutions need

to be continuously improved in order to increase the reaction rates that can be used by AI and to avoid bottlenecks with increasing data volumes. In mobile communications, users in Germany are hoping for a significant improvement in network capacities as a result of the expansion of 5G. The provision of the 3.7–3.8 GHz band for industry will enable the establishment of high-performance and secure campus networks that will promote the use of AI.

In general, the majority of AI applications will rely on Software-as-a-Service (SaaS) applications operated in the cloud. There are bandwidth-intensive AI applications such as video analytics that require low latency. Here we are seeing that the required computing power must migrate out of the cloud and be available decentrally. This trend is shifting data processing to decentralized fog and edge computing.



3 Constantly available storage and computing power:

The generated data must be stored in near real-time and the operation of AI applications is computationally demanding – depending on the applications, three to four times more computing power is required when compared to normal analytic applications. To ensure that data and computing power are always available, the operation of AI solutions requires new architectures. By leveraging cloud infrastructure offerings, enterprises have the ability to access storage and computing power instantly and without a large infrastructure investment. In particular, the capability for hardware acceleration is limited in classical server architectures and is necessary for the operation of neural networks.

4 Practical data science:

The theory underpinning AI has existed for some time. But the algorithms that work best in relevant applications have evolved rapidly in recent years. A decisive breakthrough is the introduction of domain-specific knowledge in order to classify and interpret the data correctly. In addition to this knowledge, deep neural networks are coming into play, which understand the data provided and can respond to new findings almost in real time.

Correct data, ultrafast broadband, constantly available storage and computing power, as well as competence in data science: these are the basic prerequisites for AI and ones that are already familiar from digitalization.

In addition to these technical prerequisites, companies must also master structural challenges. This includes, for example, adapting the organizational structure or introducing DevOps and agile working methods. Here, too, digitalization has often given a foretaste of the challenges that have to be overcome in order to implement AI.

AI is a profound disruption with challenges familiar from digitalization.

Our analysis of the individual use cases in the area of AI points to the likelihood of AI changing the (operational) economic landscape of Germany lastingly in its breadth and depth of impact by 2025. Across all sectors, the potential benefits of AI by 2025 add up to 488 billion Euros. Most companies have recognized this immense potential. The first step towards the use of AI has thus been taken.

As an economy, in order to leverage the potential associated with AI and thus make a decisive contribution to securing the competitiveness of Germany as a location of the future, a course must be set that goes beyond the provision of the basic prerequisites.

We expect a sustainable impetus for the German AI industry if the development of key technologies is promoted, the regulatory framework is clarified, and the fear debate is tempered with more facts and greater objectivity.

1. Promoting key technologies

What appears to be much more realistic than fears of AI technologies is the risk of being outflanked by major AI forerunners and thus falling into unwanted dependencies. The technologies around AI consist of a multitude of know-how-intensive sub-areas. Depending on the application architecture, type, or area, these are critical for the success of AI products to different degrees.

Politicians and companies in Germany are called upon to actively provide venture capital for this key technology.

Assuming that the development of key technologies will continue to be driven primarily by major providers in North America and Southeast Asia, dependencies will develop in the long-term that will lead to competitive disadvantages. AI is a scale-driven business in which large technology companies can quickly take market-leading positions. The development of key AI technologies (e.g. convolutional networks and transfer learning) requires supportive framework conditions for companies and research institutions in Germany, especially in the training, attraction, and retention of companies and people who have the relevant know-how.

For providers in Europe and Germany, the aim is to develop competitive alternatives or other long-term solutions to prevent situations of dependency.

2. Clarification of regulatory issues

In order to promote the targeted development of AI technologies in global competition, transparent and supportive framework conditions are required. Many companies are unsure about the use of AI technologies. The existing legal framework, in particular the provisions on the use of data, is currently still under development in relation to the EU's General Data Protection Regulation (GDPR) and is overshadowed by further regulatory projects. However, unclear or draft specifications on the use of data do not create clear guidelines for companies.

At the same time, there are very strict sector-specific regulations that slow down innovation and leave little room for maneuver. The sensible design of the regulatory framework will therefore be a central task for politicians and administrators in the coming years.



Among other things, the following questions must be answered: Who is responsible for the decisions and actions of an AI application? Which rules apply to the handling of data by AI solutions?

3. Move existing fear debates to a more objective footing

The progress in AI and the societal and political discussion of the past years were characterized to a particularly high degree by a focus on potential dangers of and associated fears about AI. These fears are often based on vague notions of how AI works and what the impact of the new technologies might actually be.

Nevertheless, the debates surrounding the new technologies do not reflect their opportunities and potential as much as they reflect the fear of surveillance and loss of control.

Policy-makers and education systems are therefore called on to bring the discourse around AI to a more objective footing and to communicate the relevance of technology across the board. A resulting, more open attitude towards the subject area is necessary as a foundation so that German companies can position themselves successfully and sustainably in the global technology competition – for example through lower implementation hurdles for employees and trade unions or easier development and training of AI specialists.

2. AI in Use

2.1 AI is a prompter, helper, and automaton

AI is programmed today for specific capabilities. AI applications therefore have "island skills," but still no general intelligence comparable to the broad capabilities of humans. We have analyzed over 150 use cases of AI and categorized the impact of AI in terms of three steps:

1. Assistive AI: This area includes AI applications that support and assist human tasks. In doing so, they act as "prompters" of people. They carry out repetitive tasks or use the ability to compare huge amounts of information in a structured way in almost real time. For an employee in maintenance, the results can be, for example, instructions for action and supplementary information provided by augmented reality glasses. The decisions and responsibility remain with the human being, who uses the processing power of computers and the logic of algorithms as support.

2. Automated AI: In this area, AI applications carry out an entire process step without human intervention – they are "helpers" for everyday human work. This also applies to recurring tasks that can be processed according to a predefined structure. Very time-critical applications can also be automated by AI, e.g. hazard detection in modern passenger cars.

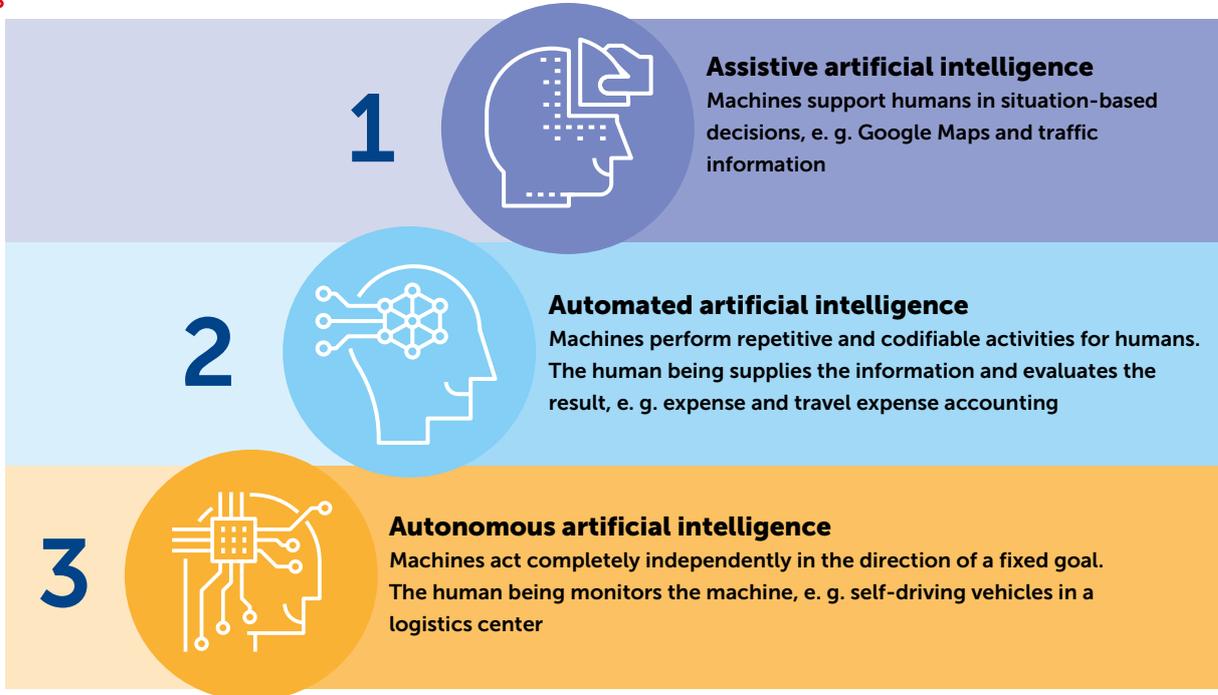
3. Autonomous AI: When AI applications are needed to execute an entire process based on a defined goal, autonomous AI is what is used. It acts as an independent "automaton" and the human being or a third system defines only the goal. This applies, for example, to autonomous vehicles in a logistics center that are dispatched by a goods management system and then navigate, load, and unload independently. These systems are monitored by people.

In principle, there are already AI solutions in use for all three modes of action. However, most AI solutions and applications will focus on "assistive AI" and "automated AI" until 2025. Our detailed analysis shows that, in 2025, almost 70 percent of the value added by AI will be generated by "assistive AI."



FIG. 6

Artificial intelligence can support humans in three ways



Source: Arthur D. Little, eco e. V.

Until 2025, AI will primarily enhance and improve the impact of human activity, not replace it.

The type and scope of such AI-based support can vary greatly from case to case. At the core, however, it can be seen from all use cases that AI can improve the effectiveness and efficiency of work processes – especially through analytical data-driven support. More precisely, AI evaluates a large part of the data, processes it, and thus allows a more targeted use of the available resources. AI thus supports human activity by, among other things, assuming secondary activities and preventing procedural inaccuracies or errors. The strengths of human labor can thus be used more selectively where they are particularly effective.

The use of AI improves the effect of human actions and thus also leads to added value for employees.

“The interaction of AI and people – augmented intelligence – leads, if done right, to more job satisfaction.”

Maurice Gonzenbach, Co-Founder & Machine Learning Engineer, Caplena GmbH

By 2025, anticipating processes and process steps will not be possible without human intervention and, in particular, without decisions made by human beings. This is particularly evident in the example of bots in sales. These can hold human conversations to a certain degree and are therefore suitable for establishing initial contact with potential customers in instances where time for such contact would barely be feasible in normal day-to-day business. When the initial contact is positive, the bot passes the customer with all the necessary information on to the responsible sales employee and adds notes on the first customer interaction.

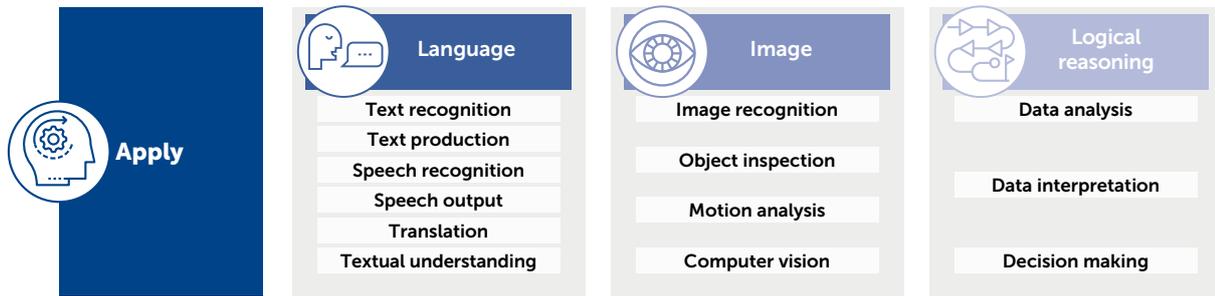


2.2 AI Applications: Language, image, and logical reasoning

For the next ten to 15 years, there is no “one” AI solution that can cover use cases. Today, AI solutions are always implemented specifically for one capability. The capabilities can be divided into three superordinate application

fields: Language, image, and logical reasoning. In many cases, the solutions used consist of a combination of the three applications.

FIG. 7 Overview of artificial intelligence applications



Source: Arthur D. Little, eco e. V.

Language: A new interaction between the human and the machine becomes possible.

Language inputs and outputs have been in use for over 20 years. The benefits have mostly been limited to very specific and isolated areas of application. In many cases, the text captured by speech input was very faulty and the speech output was not very natural. The use of AI has improved

the interaction between the human and the machine in recent years. The best examples are digital assistants like Apple Siri, Amazon Alexa, and Google Assistant.

FIG. 7.1 Artificial intelligence capabilities in the language field of application

Capability		Examples of use cases
Text recognition	Recognize and understand texts	Chatbots in customer service Detect errors in contracts Process invoices
Text production	Formulate texts on the basis of structured data	Chatbots in customer service Automatically edit contracts
Speech recognition	Recognize naturally spoken speech and translate it into a machine readable format	Customer hotline Document maintenance work
Speech output	Output structured data in natural speech	Customer hotline Work instructions
Translation	Translate machine-readable data, taking the context into account	Multilingual functional descriptions Contract contents
Textual understanding	Summarize and derive recommendations based on text or speech input	Knowledge management Rate applicants Identify target customers

Source: Arthur D. Little, eco e. V.



Image: Tangible information becomes meta information.

AI enables the processing of any image/video source in order to obtain meaningful information and to take measures based on this information. In recent years, there have been major breakthroughs in the recognition

of relevant image information. When it comes to facial recognition, AI solutions are already faster and more accurate than humans to a large extent.



FIG. 7.2 Artificial intelligence capabilities in the image field of application

Capability	Examples of use cases
Image recognition	Classify image information Detect obstacles for autonomous means of transport Record and categorize documents
Object inspection	Recognize deviations in image information from the target state Quality inspection in manufacturing Real-time revision in trading
Motion analysis	Capture motion patterns and convert them into structured data in real time Evaluate customer flows Analyze candidates in interviews
Computer vision	Evaluate moving images in a context-dependent manner and derive recommendations Steer autonomous means of transport Monitor security

Source: Arthur D. Little, eco e. V.

Logical reasoning: Machines begin to think (and decide) deductively and logically.

While the language and image capabilities of AI systems attempt to replicate aspects of human senses, logical reasoning represents "thought" and "instinct." Aided by AI, machines are capable of analyzing, comparing, and interpreting large amounts of data and, in particular, real-time data streams, and then deducing recommen-

dations for action. Currently, however, humans still need to assure quality.



FIG. 7.3 Artificial intelligence capabilities in the logical reasoning field of application

Capability	Examples of use cases
Data analysis	Intelligently combine real-time analyses and different data Create financial reports automatically Recommend products Monitor stock
Data interpretation	Interpret and evaluate data and analyses Credit verification and credit scoring Predictive maintenance
Decision making	Perform actions based on defined goals and results of data interpretation Smart building management Optimize product availability

Source: Arthur D. Little, eco e. V.



2.3 Performance today: Most AI capabilities cannot keep up with people

While there are already successful implementations of AI applications for all capabilities today, the performance of these capabilities is, in most cases, not at the same level as a human being in terms of effectiveness and/or efficiency.

Due to technological advances in recent years, AI capabilities for speech and object recognition are at least on a par with those of humans. Translation between strong language pairs such as German and English is also on the same level as that of a human being.

Figure 8 illustrates that capabilities with high potential for supporting business processes are still in their infancy. The performance is incremental or solid. It is, nevertheless, always necessary for people to support and monitor the AI solution.



FIG. 8

Performance potential matrix for artificial intelligence capabilities



¹ In selected/specific fields of application, often through specialized developments.



**Interview with
Dr. Jens Roettig,
Project Manager AI Ethics,
Bayer AG**



Which AI use cases are most important for Bayer?

At Bayer, we use AI to digitally transform the entire value chain of our three divisions Consumer Health, Crop Science, and Pharmaceuticals: from research and development to manufacturing, marketing, and sales. Accordingly, there are use cases for all areas.

Examples in the healthcare sector include the use of AI to improve disease detection (diagnostics), virtual studies, the development of individualized therapies, and digital factories.

In the field of Crop Science, for instance, we have a digital platform that enables farmers to make better decisions, for example on the use of fertilizers and pesticides, based on data analysis of their fields and the environment. But here, too, AI is used in research and development of new seeds, for example, and in production in order to optimize processes.

How are use cases divided into “process improvement” and “product improvement” (e.g. AI-controlled harvesting recommendations)?

We focus on both because we consider the entire value chain. In addition, completely new business models are being developed. In agriculture, for example, it will no longer be a question of maximizing the sale of certain products, but of being able to give farmers certain promises of results in relation to the harvest.

Which quantitatively measurable effects are achieved (or expected) at Bayer with AI?

Each use case, which is part of the strategy of the respective division, is backed up with measurable targets. Measurement is simple in the area of manufacturing – it is more difficult to do with new business models. Research and development are about developing new solutions more efficiently. For example, the development of a new drug currently takes an average of ten years and can cost up to one billion Euros.

What hurdles does Bayer face in introducing AI (use cases)?

The introduction of AI goes hand in hand with the digital transformation of a company. This means massive changes in the way we work together, in the technical platforms, in the way we handle data, and in our corporate culture. In addition, collaborations with external partners such as start-ups and tech companies must also be strengthened. Employees must be offered training, programs such as reverse mentoring are needed, and external talent, especially in the data science field, must be acquired.

This is a comprehensive transformation program that goes beyond individual use cases. To accelerate this process, we have established the Digital Transformation Board at Bayer, a body in which the Management Boards of the three divisions, the Chief Financial Officer, the Chief Information Officer, and the responsible IT managers of the three divisions are represented.

Is AI giving rise to new products or business models at Bayer?

Yes, the goal is also new business models – look at the example in Crop Science, where the business model will change from maximizing revenues through product sales to certain earnings commitments to growers. New solutions are also possible in the healthcare sector that go beyond traditional medicines, such as Digital Therapeutics.

Which ethical questions regarding AI are really important?

AI is a technology that can be used both positively and negatively. There are reservations and fears, and rightly so. The loss of autonomy of people in favor of machines, the curtailing of data protection, the impact on the labor market – these are all real dangers.



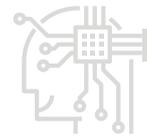
We therefore need guidelines to alleviate this fear and to achieve acceptance of digital technologies such as AI among the population. Bayer is involved in the EU Commission's High Level Expert Group, which is working on these guidelines. On the other hand, however, we must be careful not to shape the framework conditions in the EU in such a way that technical progress takes place outside Europe. The right balance is important. Europe can lead the way in developing an ethical framework for the use of AI.

The guidelines developed by the High Level Expert Group are currently being tested by companies. An assessment list was created for this purpose. Bayer is also participating in the test with a use case. This test phase runs until the end of 2019.

Which message on AI should be heard by more decision-makers?

Digitalization has no end in itself, but it must be close to business realities. Technology should not just be introduced because the decision-makers somehow find this "trendy" and then do great pilot projects. Digitalization and the introduction of AI also go hand in hand with a broad-based transformation program for the entire company. Particular use cases are only the tip of the iceberg.

In everyday life, there is also the danger that digitalization will be less prioritized. This will not enable real transformation. At management level, companies need a good balance between day-to-day business and future business, because the potential of digital projects or new business models will naturally only materialize in the future.



3. Technology: AI and its Building Blocks

3.1 How AI applications develop from data, machine learning, neural networks, and analytical models

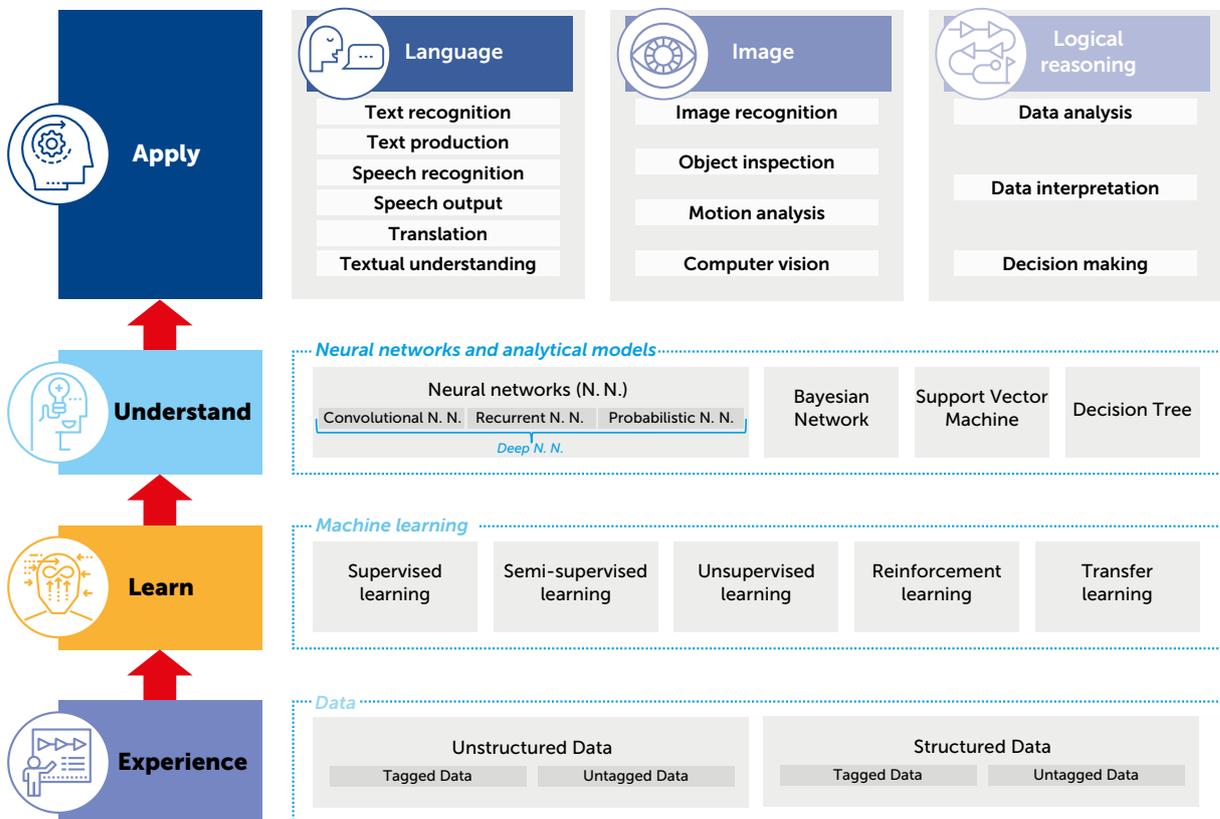
AI is one of the most intensively "researched" fields of technology worldwide. In 2019, an average of over 100 scientific articles were published per day. In addition to scientific research, international and German technology corporations are also investing heavily in this area. The Chinese technology company Tencent initially invested more than ten billion US dollars in research and development of AI for a period of two years, and Amazon employs more than 5,000 people for the development of its voice assistant alone. The Robert Bosch Group aims to quadruple the number of its AI experts from 1,000 to over 4,000 by 2021, and aims to supplement all Bosch products with AI or develop them with the help of AI.

As already described, AI is not a single technology and cannot be represented by a single component. AI solutions and applications always consist of a combination of stored data, machine learning, neural networks, and analytical models. An analogy to human intelligence can be established: Experience – Learn – Understand – Apply (see Figure 9).

The use of object recognition and inspection in tumor detection is described below as an illustration of the structure and functionality of AI applications.

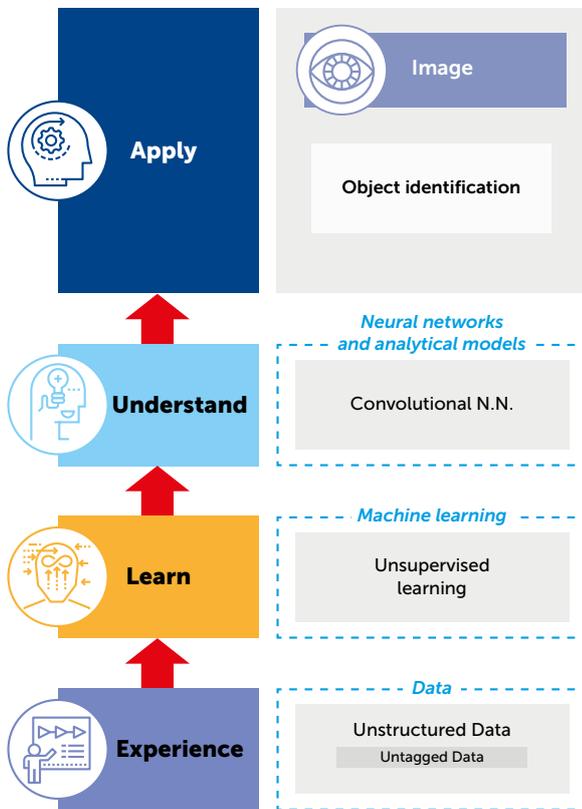


FIG. 9 Artificial intelligence: Machines learn and understand, in order to support humans



Source: Arthur D. Little, eco e. V.

FIG. 10 Example for the application of the AI Framework



Source: Arthur D. Little, eco e. V.

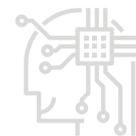
Experience: The foundation of AI is data, and this data is broken down into training and testing data. In the case of cancer cell detection, examples of data include X-ray images (unstructured data). These can be either labeled or unlabeled. In the case of a label, the algorithm is fed with an X-ray image which has been labeled by humans with the adjunct "Here is a tumor." Unlabeled data can also be fed to the machine, so that the software itself detects patterns. In this example, unlabeled data is used because labeling involves a great deal of effort.

Learn: The X-ray images are analyzed through the process of unsupervised learning. In this process, the software "scans" the data and examines it for patterns and "features" (for example, aspects that distinguish one X-ray image with cancer cells from another). The meaning of each pattern is not clear to the machine in advance. Subsequently, a specialist can examine the patterns detected and provide the appropriate diagnoses.

Understand: Neural networks are the thought patterns of machines. Each X-ray image contributes to the machine establishing or breaking down connections in the neural network and thus "learning" which image corresponds to which pattern (e.g. a tumor). Through this "thought pattern," the AI understands the situation and is able to apply its knowledge.

Apply: As soon as the neural network demonstrates strong performance on the testing data (i.e. detects tumors), an object identification AI has been created.

Today, AI has the capacity to possess specific and codifiable capabilities in a quality similar to that of a human being, and to make use of these in applications.



Case study: AI in differential diagnosis and emergency admissions

Project SmartMD – “Smart Medical Doctor – From Data to Decision” of the German Federal Ministry of Economic Affairs and Energy, together with Ada Health GmbH, Beuth University of Applied Sciences Berlin, Charité Universitätsmedizin, and Helios Kliniken GmbH

Unnecessarily high costs arise as a result of mistakes in the triage of patients. These arise primarily due to delayed initiation of the correct therapy, the initiation of incorrect therapy, and the treatment of avoidable complications. This applies in particular to rare diseases, which affect 10 percent of the population over their lifetime.

AI supports the physician in this process in quickly assessing the situation. In the context of differential diagnosis, the AI helps to exclude possible misdiagnoses. Similar cases can be identified from an archive that belongs to the entire association of hospitals, and then

possible diagnostic measures, diagnoses, anomalies, and approaches to therapy can be suggested. This knowledge from the historical diagnoses and assessments of physicians and the already known course of the disease can profoundly support the physician’s assessment. The aim of SmartMD is to transform the case data stored in hospitals into legally usable data products. For this purpose, a platform is being developed that prepares the case data using AI technologies and makes them available in anonymized form.

What is technically distinctive is that, in contrast to search queries in Internet search engines that consist of only a few words, in this case the “search query” of the physician to the AI system includes the complete description of the patient. This includes the textual representation of the patient in the referral letter, as well as additional triage of the patient via medical devices, imaging procedures, and interviews on symptoms via dialogue-based systems. The challenge often lies in the fact that, for many disease patterns, only sparse data (“small data”) is available from the archive.

3.2 Technology radar: AI components continue to develop rapidly

Our AI technology radar shows that most AI devices today still do not have the necessary maturity level to be used universally in AI applications simply and without significant adaptation. Due to the fast development of the industry, we expect most components to be universal and ready to use by 2025. What is important here is simple and “one-click” availability, as is possible today with the familiar services IaaS and PaaS (Platform-as-a-Service).

Universal AI components will not be broadly available until 2025.

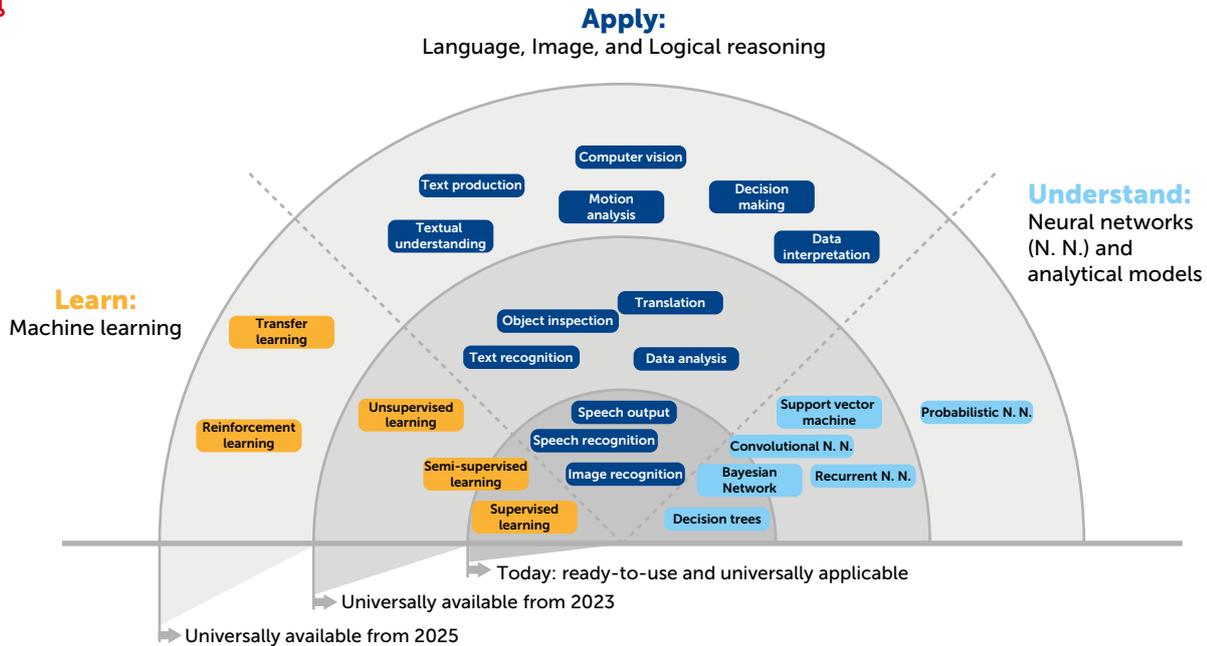
For machine learning, services for supervised learning can already be sourced today from all major cloud providers. The user or developer has the flexibility to use structured or unstructured data. A supervised learning offer can be used for the learning of image information, but also texts and language. Within the framework of supervised learning, the AI is trained by a human. In image recognition, image information used in training is classified by a human. The AI learns from this.

The greatest technological breakthrough since 2016 has been in neural networks and analytical models, i.e. in comprehension. Further developments in deep neural networks have led to the availability of the first universal cloud

offerings for convolutional networks. Classic algorithms such as Bayesian Networks and Decision Trees, which are mainly based on statistics, are mathematically established. However, they are only beginning to be offered through cloud services.

On the application side of AI, image recognition, speech recognition, and speech output are ready-to-use and universally applicable. All three applications of AI are in use today to support business processes. For example, image recognition is used in surveillance cameras to detect unauthorized objects and persons and to inform security personnel. This is already being used, for example, in the security monitoring of company premises and airports.

The broad availability of semi-supervised learning and unsupervised learning makes the training of neural networks significantly more efficient. For example, an improvement by a factor of 30 is expected for how neural networks learn to automatically process invoice information.


FIG. 11 Artificial intelligence technology radar


Source: Arthur D. Little, eco e. V.

In parallel, recurrent neural networks are expected to take the next technological leap. These networks are the basis for AI applications in the context of language, such as text recognition, and logical reasoning, such as decision making.

3.3 Outlook: AI and quantum computers

The current understanding is that the world can be described by quantum physics and within this there is quantum information on which the so-called quantum information theory is based. For some years now, great efforts have been made to develop a computer based on this theory that can process quantum information: The so-called quantum computer uses the possibility of qubits (the bits in the quantum computer) to execute a large number of processes in parallel. Certain algorithms could be executed in certain circumstances at unfathomably greater speed, because they scale polynomially instead of exponentially with the complexity of the problem. This would make quantum computers many times more powerful than classical computer architectures.

The "Quantum Supremacy" first propagated by Google in October 2019 means that for the first time it has been possible to process something faster with a quantum computer than with a classical computer. This is a

great success. However, it does not mean that quantum computers are now able to perform more commercially relevant applications.

The AI field has several intersections with the field of the quantum computer. Many AI algorithms are so computationally-intensive because they make great demands on the parallel execution of processes. This is one of the reasons why experts see great future potential in the combination of the two fields. However, the following must be borne in mind for the combination of quantum computers and AI:

1. There are still great challenges ahead for quantum computers. Completely regardless of AI, they still have a long way to go before they can be used commercially.
2. The potential applications in quantum AI are promising, but – as things stand today – not in a way that they will completely transform the current knowledge and applications of AI.
3. Experimental quantum computers available for purchase today cost tens of millions and are by no means capable of performing commercially relevant tasks significantly faster or more cheaply than (classical) computers.



4. Benefits: Impact of AI on the German Economy in 2025

For the purposes of this study, we have evaluated what the impact of AI will be on the German economy in 2025. 2025 is an appropriate time frame, as a statement on the sustainable and effective application cases can be made with sufficiently high reliability.

In order to find out what impact can be expected from AI in 2025, this study examines the landscape of possible AI application cases in accordance with the various capabilities. Their potential for the various sectors of the German economy is analyzed.

A precise strategic direction is important to determine what should be tackled first, as it is clear that the resources available for AI in most German companies are not enough to handle the development and implementation of all possible forms of use and application options simultaneously. As a result, only the most high-impact use cases are prioritized.

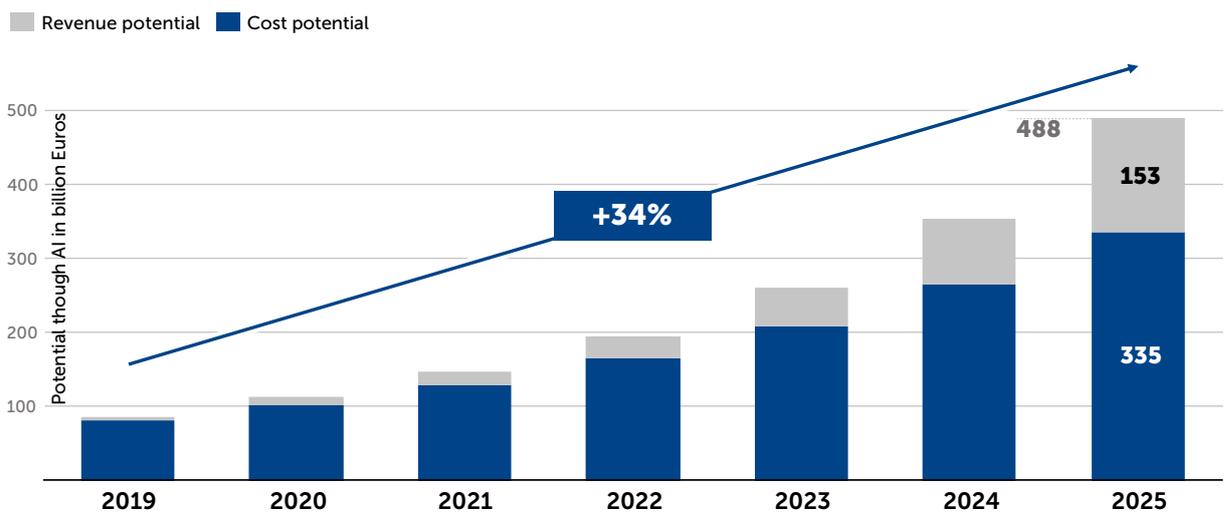
If one projects the potential of the use cases on the sectors of the German economy onto the year 2025 under study, it amounts to a monetary effect of 488 billion Euros. This corresponds to an increase in gross domestic product of

13.3 percent compared with a forecast by the German federal government of just under 2 percent.

The AI impact not only captures the costs, but also leads to a sustainable increase in revenue. The impact on costs amounts to almost 70 percent, the revenue impact to 30 percent. This means an improvement in cost efficiency of 335 billion Euros and additional revenue potential of around 153 billion Euros in 2025.



FIG. 12 Development of the potential of artificial intelligence for German companies 2019–2025, in billions of Euros

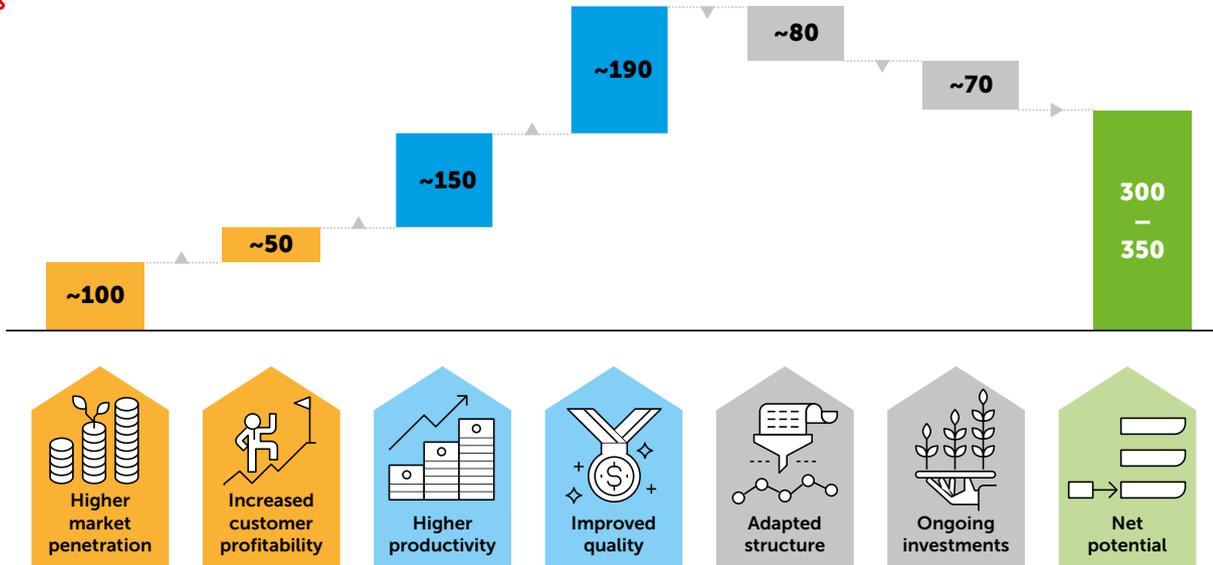


Source: Arthur D. Little, eco e. V.



FIG. 13

Impact of artificial intelligence on the German economy in 2025, in billions of Euros



Source: Arthur D. Little, eco e. V.

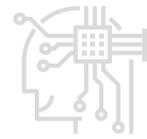
All in all, AI could create immense added value for German companies.

Taking into account the necessary structural adjustments and ongoing investments in AI, we continue to expect a net potential of 300 to 350 billion Euros.

This impact potential suggests that the German economy will face enormous opportunities and changes. German companies and politicians must therefore act quickly and actively invest. Since the substantial investments naturally precede the cost and revenue impact, appropriate measures to safeguard investments and targeted subsidy programs are necessary.

“Move up a gear and implement your plans consistently. Think big, because the international competition thinks big and we do not. Let’s set up our own AI ecosystem here in Germany, consisting of infrastructure, research, support for start-ups, training, so that we don’t fall completely behind the USA and, above all, China; because, at some point, this will influence many other industries – and thus the cornerstones of our economy – in addition to the automotive industry. That means we have to act now, be visionary, think big, and invest.”

Jörg Bienert, President & Founding Member, Bundesverband Künstliche Intelligenz e. V. (the German Federal Association for Artificial Intelligence).



Case study: Automated data categorization in the data factory

Telekom Data Intelligence Hub, Deutsche Telekom AG

A characteristic of machine learning algorithms is the so-called GIGO principle – “Garbage in, Garbage out.” The effectiveness of AI solutions increases with the quality of the data used for training. But even “data gold” is worthless if no one can find it.

Today, data preparation often accounts for more than 80 percent of a data analytics project's time budget. Determining the contents of a data set (metadata) and then its quality are the biggest levers to generate better results in less time.

This is where a micro service of the Telekom Data Intelligence Hub comes in: It categorizes records and generates metadata so that they become searchable – either through a catalog of categories or search engines. One example is the categorization of “open data” from the EU Open Data Portal, a data treasure trove with one million records, but often lacking accurate descriptions. By means of different procedures in the area of Natural Language Processing (NLP), such as “Latent Dirichlet Allocation” (LDA), the data could be assigned to highly automated categories.

The AI-based automation solution can quickly add metadata to tens of thousands of open data records and assign them to categories. The result allows an initial presorting in principal categories such as Manufacturing, Transport & Logistics.

4.1 AI has an impact in all economic dimensions

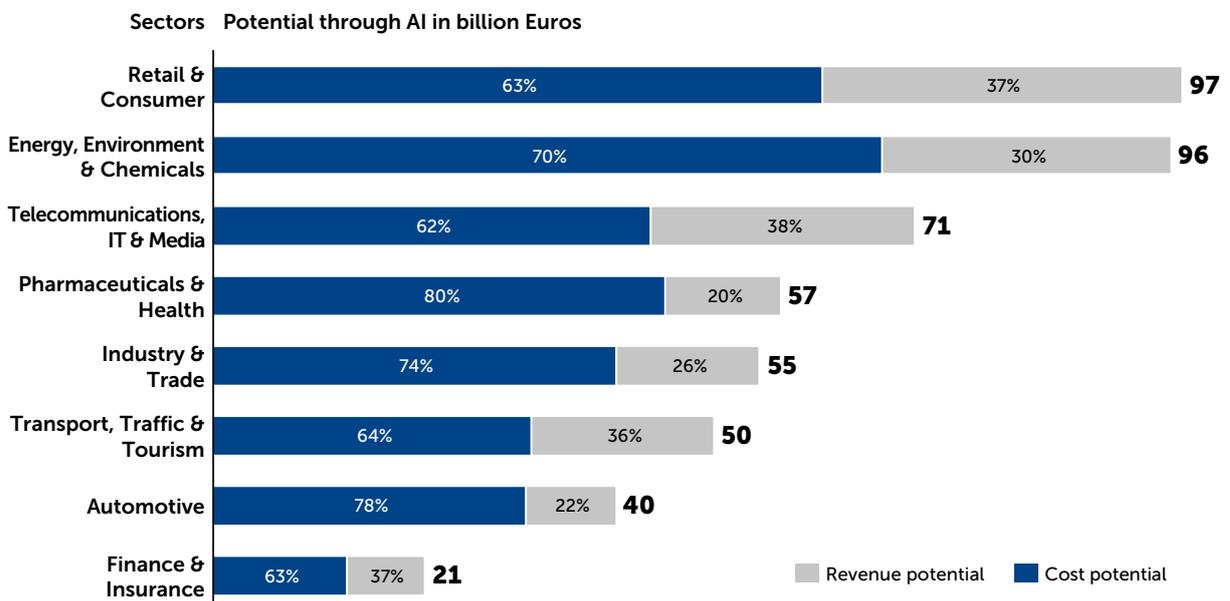
The cases examined were broken down into eight industrial sectors and twelve corporate functions. This makes it possible to estimate how high the impact potential of the individual corporate functions per industry would be. Here you can see where the particular strengths of AI applications can be expected in the coming years. In concrete terms, the results of the study show that the

predicted impact of AI will be discernible in all dimensions of the German economy.

The greatest impact of AI is expected in the Retail & Consumer segment as well as in the Energy, Environment & Chemicals segment. This is hardly surprising given the size of these two sectors in Germany.



FIG. 14 Potential of artificial intelligence for German companies in 2025, according to sector, in billions of Euros



Source: Arthur D. Little, eco e. V. Note: Public Sector and Agriculture not included for the time being



How strong the impact of AI will be will vary in terms of industries. It is to be expected that epicenters of AI effects will develop among the industries. This refers to areas in which the impact of new AI applications will be disproportionately strong and will take effect at an above-average speed.

The most prominent finding is that the Retail sector in particular can benefit from the widespread use of suitable AI solutions.

The use of AI should therefore create elementary added value and competitive advantages, especially in areas with strong, direct end-customer interaction, which is why the potential forecast for other industries with pronounced business-to-consumer (B2C) commercial activity is correspondingly high.

"Deep Learning and NLP are enormously important in retail, marketing, trend analysis, and market influencing. After all, we let ourselves be influenced daily by texts or advertising and communicate our wishes through language. Clinical processes are also an important topic for us; text is ultimately an important modality in doctor-doctor or doctor-patient communication."

Prof. Alexander Löse, Beuth University of Applied Sciences Berlin

Case study: AI evaluation of tens of thousands of customer feedback instances in the retail trade

LINK market research institute and AI start-up Caplena GmbH

How is the waiting time at the checkout perceived? Is the range of products attractive? How do customers rate the friendliness of the sales staff? These are all questions posed by retailers. The answers can be found in customer feedback. The problem is that even medium-sized retailers receive huge amounts of feedback, often without the time and resources to analyze it.

This also applies to Coop, the largest Swiss retailer: "Each quarter, we receive approximately 50,000 instances of feedback, which we cannot possibly go through manually. For this reason, up until now, we have left the analysis of customer feedback up to the individual branch managers. That's why we completely lacked an overview on the 'sales region' and 'retail total levels,'" explains Johanna Mäder, Project Manager for Market Research at Coop.

A tool developed by Caplena was trained with several hundred to thousand manually coded answers. The AI then automatically coded the remaining responses. According to Coop, the automatic categorization is comparable to human accuracy: "We couldn't tell the human coding from the automatic coding; the system really understands our customers' answers." For example, the AI solution recognizes that the word "fresh" in the statement "Bread is always fresh" has a different meaning than in the sentence "It's too fresh for me in the store."

This solution enables LINK to quickly evaluate the feedback from an entire quarter and analyze it together with Coop. "Finally, we can meet a major customer need at a reasonable price and in very good quality," says Laura Colledani, Market Area Manager West & Consumer Goods/Retail at LINK. "With the competent advice provided by LINK, we were able to see from the results of Caplena that, for example, considerably more customers liked the atmosphere in the branches. The



The assessment of the particularly high relevance of AI in business-to-consumer areas raises the question of why German core industries, such as the automotive sector, seem to benefit comparatively little from AI. One part of the answer here is: Appearances can be deceptive. For the automotive industry, for example, it can be said (depending on which industry parameters are used as a basis) that the AI-based impact potential could account for between 10 and 20 percent of the current gross value added. Since the automotive industry is already heavily optimized, this is an immense impact. On the other hand, it is to be expected that AI in certain areas offers particular potential for new business models which have not been included in the present calculations. For example, it can be assumed that AI potential in the automotive sector will really unfold by enabling the development of new business models in the area of autonomous driving.

The field of activity of AI becomes even clearer when looking at corporate functions. Across all industries, the use of AI in Manufacturing and Sales is a significant value driver to realize potential cost savings. This is due to improved productivity and quality. For example, the use of AI in predictive maintenance solutions can reduce maintenance costs by around 8 percent.



FIG. 15

As the example shows, AI is able to reliably categorize customer feedback even if the input is not orthographically or grammatically correct.

increase from 5 to 9 percent was so great that we could categorize the implementation of the new shopfitting concept as a complete success," explains Johanna Mäder from Coop.

The combination of a human understanding of the problem and the efficiency of AI enables insights into customers in a depth that was previously not possible. The AI solution takes over the heavy work, which would otherwise be enormously time-consuming and cost-intensive. But we still need people who know how to use AI efficiently as a tool and who can derive the right conclusions and decision guidelines from the results. AI is giving them the time to do that.

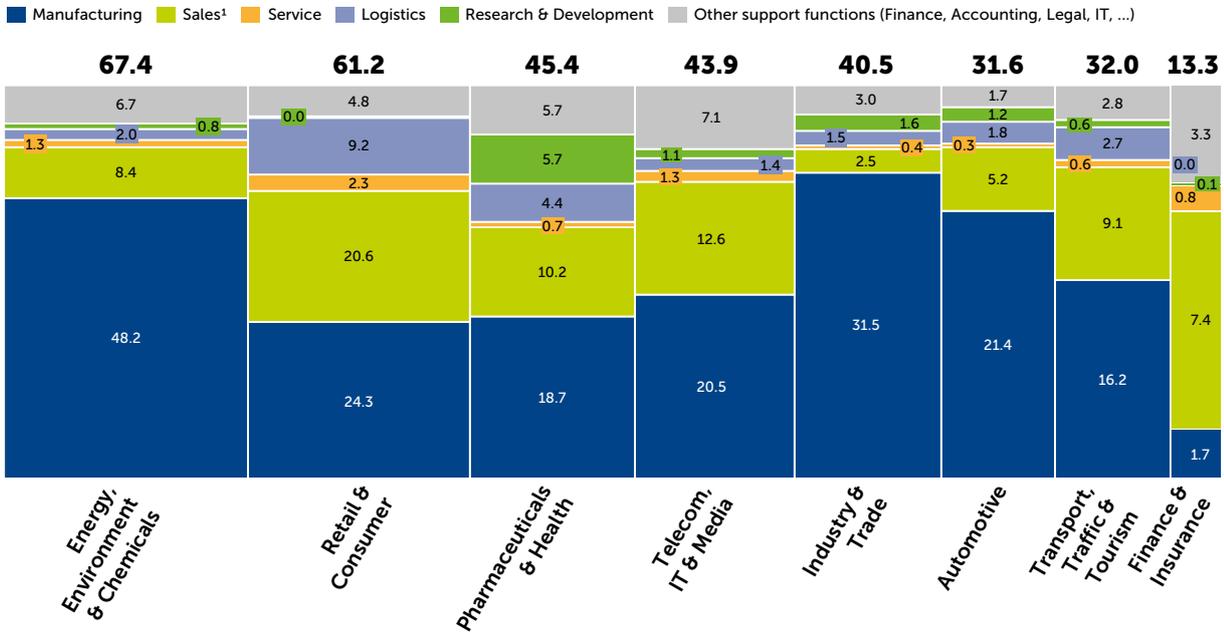
"The store has made a great impression on me what I want I can get too. Unfortunately, I hardly see any staff except in the butchar's and at the cash desk. The white bread is often inedible!"



Source: Caplena GmbH



FIG. 16 Cost savings potential of artificial intelligence by business function and industry in 2025, in billions of Euros



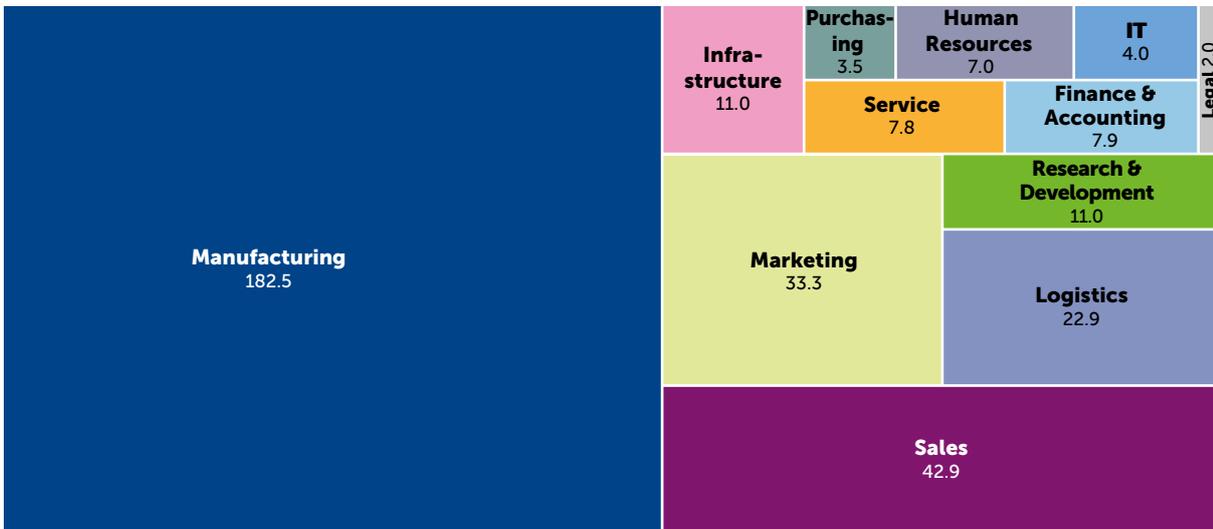
Source: Arthur D. Little, eco e. V. ¹ Sales and Marketing combined

When viewed independently of the focus developments described above, the present results illustrate a fundamental fact:

AI could create substantial added value at every interface of the economic matrix, i.e. in every function of every industry.



FIG. 17 Cost potential by corporate function in 2025, in billions of Euros



Source: Arthur D. Little, eco e. V.



Methodology

Procedure

- Identification of the most likely high-impact AI use cases in companies
- Detailed analysis of 50 prioritized cases from a total of more than 150 cases considered
- Determination of the quantifiable monetary impact potential per case, industry, and function
- Extrapolation to the individual sectors of the German economy in 2025
- Discussion and analysis of the results, derivation of identifiable developments and findings

Assumptions and perimeters

- All cases will be fully established in all potential application areas by 2025.
- Impact potential means attainable monetary effect on revenue and costs.
- Calculation shows the gross potential, i.e. potential without investment costs or operating expenses.
- AI is not used to create new business models, but to optimize existing ones.

We have investigated over 150 use cases – 50 use cases will be established in everyday work by 2025.

Research & Development

1. Requirements evaluation
2. (Re-)Design of products

Purchasing

3. Forecast planning for inventory and supply chain
4. Automation of purchasing
5. Automated supplier analysis

Manufacturing

6. Predictive maintenance
7. Automation of product testing
8. Optimization of energy use
9. Support through smart augmented reality
10. Evaluation of credit scoring (financial industry)
11. Evaluation of credit verification (financial industry)
12. Optimization of distribution network

Sales

13. Voice bots for Sales
14. Evaluation of sales pipeline
15. Active product recommendations
16. Email sales assistant
17. Prediction of product potential
18. Identification of target customers
19. Recommendations for cross-selling and up-selling

Service & Support

20. Chatbots in customer service
21. Voice bots in customer service
22. Automated advertising campaigns
23. Machine translation of information

IT

24. Monitoring of systems

Finance & Accounting

25. Automation of financial figure analysis
26. Automation of financial report generation

Human Resources

27. HR chatbots for employees
28. Chatbots for applicants
29. Identification of candidates
30. Screening of applications
31. Automation of video interviews

Legal

32. Redacting of documents
33. Checking of contracts
34. Drafting of contracts

Marketing

35. Optimization of (re-)targeting
36. Automation of market analysis
37. Channel (hyper-) segmentation
38. Marketing mix
39. Budget decisions
40. Optimization of paid search
41. Website optimization for individual users
42. Topic recommendations & generation of headings
43. Identification of influencers

Logistics

44. Optimization of product availability
45. Supply chain modeling
46. Autonomous warehouse
47. Automation of inventory management

Infrastructure

48. Smart building management

Cross-functional

49. Search Engine Optimization knowledge management
50. Photo expense reports



Selection of important use cases

Holistic optimization of digital marketing

Type: Revenue impact

Potential: 15–20 %

Function: Marketing

From a holistic point of view, digital marketing is a complex interplay of different data, analyses, and evaluations. This means perfect conditions for AI, which can develop correspondingly large potential in this area. AI-based applications can primarily help to (hyper)segment customers and suggest the most effective marketing mix. This includes, among other things, the compilation of contact channels, suggestions for content, paid search, and budget decisions, as well as tailor-made website content per visitor. In addition, AI can help with (re-)targeting and identify and evaluate competitive trends.

Automation in financial accounting

Type: Cost impact

Potential: 20–30 %

Function: Finance & Accounting

In financial accounting, AI bridges the gap between the physical and digital worlds by capturing and interpreting data (including documents), detecting fraud, and allowing automatic booking of entries. Thus the AI applications are not only directly usable for automation in this area. They also enable further automation solutions, for example via robot-controlled process automation (RPA), for instance by capturing data from analog documents.

4.2 Overview of the most high-value use cases

AI as sales generator

As the analysis of the study results thus far have shown, the operational use of AI represents a quantum leap.

For growth in revenue, it is expected that, by 2025, sales through online channels – which account for approximately 8.8 percent of revenue in 2019 – will have increased significantly. However, significant potential can also be realized in offline channels through improved marketing, forecasting, and customer care.

Regardless of the channel used, the logic behind the corresponding applications is impressively simple: People buy what they desire and AI-based systems are able to predict very precisely what people desire. In addition, the systems provide indications as to when and how potential buyers can best be addressed. They suggest what the customer might also like or, in case of doubt, partly take over the contact with the customer. After all, some AI solutions are already very well able to recognize what the customer wants and which form of address seems most suitable. By 2025, it is therefore to be expected that the new technologies will profoundly change the way sales markets function and will essentially optimize and expand the sales opportunities of companies.

“Machine-based processing of large amounts of data has long been a topic at Vodafone. AI can now be used to create models broken right down to the individual customer and thus make real personalization a tangible experience.”

Jörg Knoop, Tribe Lead COPS Innovation & Automation, Vodafone Germany

The supporting functions of the AI applications will play a major role in this. Rather than acting independently, AI applications will change the sales functions by supporting people in their decisions and simple, recurring activities. For example, marketing departments will be able to coordinate automated, individual customer approaches via



different channels. Sales units will be able to focus on a prioritized list of potential customers with automatically generated, relevant customer information. Thus, AI will help to use resources more purposefully, address customers more individually, and thereby dramatically increase the overall effect of available resources.

AI thus offers new solutions for an issue that already existed at the beginning of the last century.

“Half the money I spend on advertising is wasted; the trouble is I don’t know which half.”

John Wanamaker, American department store founder and marketing pioneer

It looks likely that this problem, which has greatly affected the marketing activities of most companies in the past 100 years, will be significantly resolved by AI by 2025. On the one hand, in the future, the new technologies will enable a very precise understanding of which marketing expenditures actually create value. On the other hand, they will deliver approaches for optimally coupling advertising activities with sales activities. AI will thus enable companies to develop a new generation of marketing ecosystems.

In view of these possible applications of AI, the high potential to increase sales and the associated impact on company revenue should come as little surprise. In addition, these findings explain the strong concentration of impact potential in the Marketing and Sales areas and in the Retail & Consumer sector, where the impact of individual, optimized marketing strategies and sales pitches is particularly pronounced.

Selection of important use cases

More accurate forecasts for optimized inventory management

Type: Cost impact
Potential: 12–15 %
Function: Logistics

Some of the occasionally most difficult and – at the same time – most important tasks of supply chain management are forecasting demand, sales, manufacturing, and purchasing. These forecasts are not only complex to make, but they also have a major impact on business continuity and inventory costs. AI applications can simplify, accelerate, and significantly improve the accuracy of such forecasts. Unnecessarily high inventory costs can thus be avoided and operational continuity can be ensured in the long term.

Voice bots and chatbots in the sales process

Type: Revenue impact
Potential: 5–10 %
Function: Sales

Interpersonal interaction is one of the areas in which people still far outperform AI. However, sales departments often only handle very small parts of their sales pipelines because they need to use existing resources as effectively as possible. AI applications can help to fundamentally increase pipeline coverage by handling the less promising part without any waiting time, i.e. reacting immediately when leads occur. This creates opportunities that would otherwise slip by unnoticed.



Selection of important use cases

Prioritization and design in research and development

Type: Cost impact
Potential: 10–20 %
Function: Research & Development

R&D is often so expensive because it is difficult to judge which projects will generate how much return on investment. AI can create data-based forecasts here and thus significantly support the prioritization process. Even beyond simple prioritization, generative AI is currently taking on more and more design tasks. For example, the latest applications can create or optimize digital prototypes.

Forecast of sales probabilities

Type: Revenue impact
Potential: 5–15 %
Function: Sales

Sales divisions are usually confronted with a long pipeline of potential orders. The critical questions are often: “Whom do I sell to, and how?”. The answers to these questions depend on the forecast of how likely it is that a particular potential order can be realized through which activities. On the basis of valid data, for example from Customer Relationship Management (CRM) systems, AI applications can not only accelerate and automate these exact forecasts, but in particular increase their precision considerably.

AI as lever of efficiency

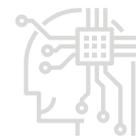
A significant part of AI value creation is due to the ability of applications to enable dramatic efficiency gains in all sectors of the economy. For example, AI applications can optimize existing processes, reduce error rates, and support or completely take over recurring manual activities. The application possibilities of AI are at least as diverse in the area of cost efficiencies as in sales generation.

In this context, AI-based efficiency increases mean that existing structures and processes can be optimized by AI. This frees up resources that can be then used elsewhere to create value. These resources can be of different kinds. This includes relieving the pressure on employees with AI solutions as well as reducing inventory costs through data-driven optimization of the flow of goods.

In order to identify the full extent of these potential increases in efficiency for the individual areas, it is worth doing an analysis that compares the cost-side impact potential of AI with the respective initial values. Figure 16 shows the possible increases in efficiency in the individual industries and corporate functions compared with the status quo.

While the absolute impact is likely to be greatest in Manufacturing areas, the relative influence on these areas is much smaller. Instead, AI will have a particularly substantial impact where analytical tasks and recurring activities can be automated or cost-intensive activities can be optimized through data-based models.

A correspondingly large AI impact can be assumed for areas in which the activity profile offers many leverage points for data-based optimization and automation. The Finance & Accounting areas will benefit by far the most from this in future. In particular, the ability of AI systems to selectively read unstructured data collections, learn from large amounts of data, and deliver summarized result reports will enable companies' financial departments to optimize and fully or partially automate most accounting, transaction, and reporting tasks.



“In accounting, I am surprised by how analog processes still are. Nothing has been automated yet. This is an area with a lot of potential.”

Maurice Gonzenbach, Co-Founder & Machine Learning Engineer, Caplena GmbH

But AI will also enable significant efficiency improvements in other areas. Human Resources and Sales, in particular, will also benefit to a particularly high degree from the potential of the new technologies. On the one hand, benefits will be derived from the aforementioned analytical skills of AI, which can be used, for example, to review job applications.

On the other hand, these two areas will be able to make particular use of the possibilities offered by AI solutions that support and automate employee and customer interaction. In the future, employees will be able to clarify their most urgent queries to the HR department with a chatbot. Another AI-based application can pre-formulate customer-specific emails for Sales staff. Thus, a variety of different possible uses for AI applications can also be seen in the realization of potential efficiencies.

Selection of important use cases

Identification of suitable candidates

Type: Cost impact
Potential: 20–30 %
Function: Human Resources

The recruitment of suitable candidates requires the processing of significant amounts of data in a multitude of standardized processes as well as a subsequent, target-oriented decision-making process. AI-based solutions can offer support here, for example by (semi-)automatically supporting the screening of applicant data and the sourcing process.

Internal HR chatbots

Type: Cost impact
Potential: 10–20 %
Function: Human Resources

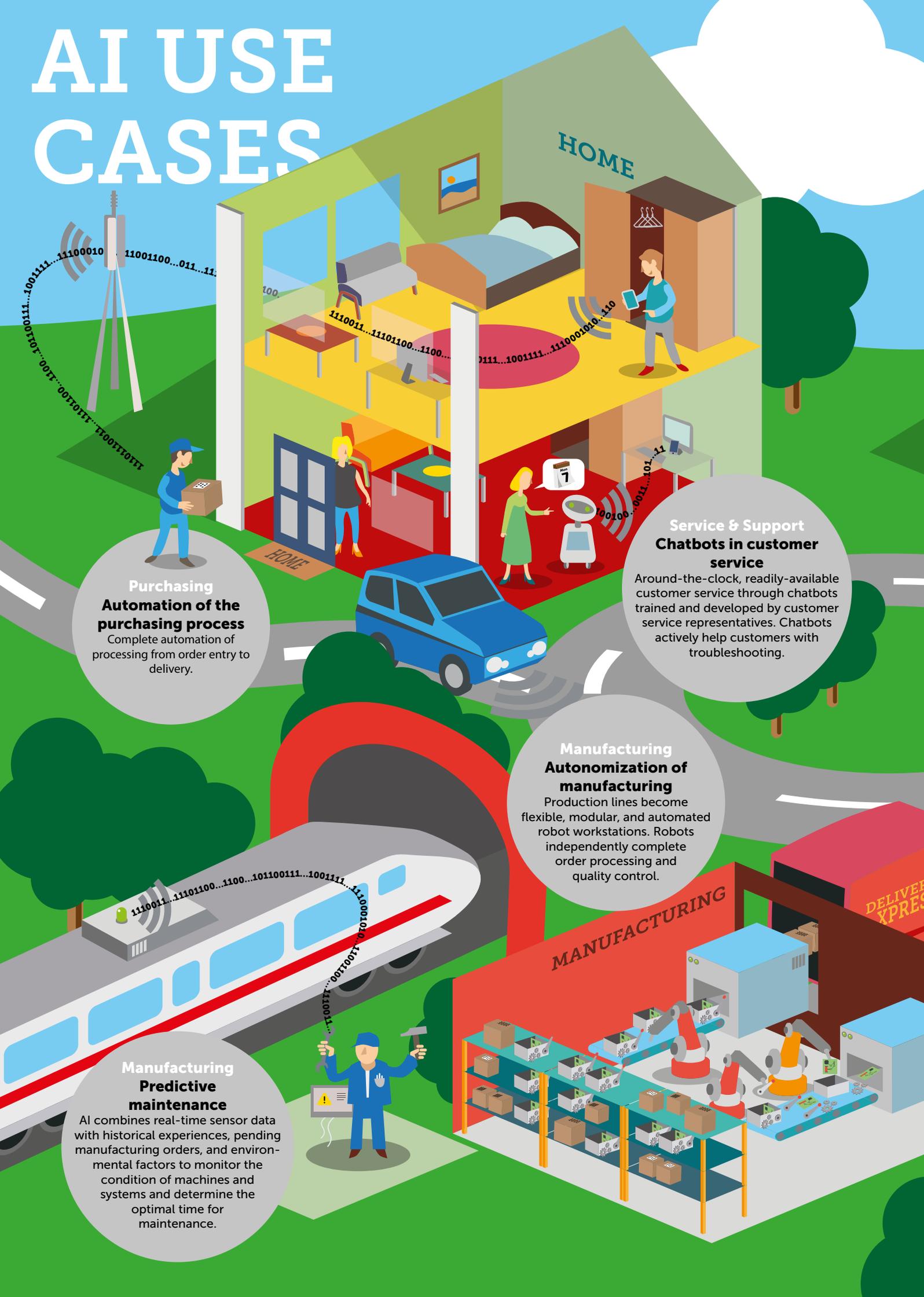
Internal HR processes are traditionally characterized by answering the same or similar employee questions. HR chatbots allow this effort to be significantly minimized and thus provide a simple and well-suited application to relieve HR areas.

Analysis and draft responses for legal documents

Type: Cost impact
Potential: 10–20 %
Function: Legal

More than in almost any other area, the work of legal departments is characterized by textual processing. AI is able to analyze and interpret large parts of legal documents. In addition, the applications can create initial drafts for letters and documents. In this way, the initial effort for each legal document received can be reduced.

AI USE CASES



Purchasing Automation of the purchasing process
Complete automation of processing from order entry to delivery.

Service & Support Chatbots in customer service
Around-the-clock, readily-available customer service through chatbots trained and developed by customer service representatives. Chatbots actively help customers with troubleshooting.

Manufacturing Autonomization of manufacturing
Production lines become flexible, modular, and automated robot workstations. Robots independently complete order processing and quality control.

Manufacturing Predictive maintenance
AI combines real-time sensor data with historical experiences, pending manufacturing orders, and environmental factors to monitor the condition of machines and systems and determine the optimal time for maintenance.

Human Resources
HR chatbots for employees

Individual support for employees around the clock, as AI chatbots can access and respond to individual information (e.g. vacation days, training programs, development opportunities) in response to employee enquiries.

Hello Mr. Smith ...

Legal

Checking of contracts

Automatic review of contracts for admissibility and intention as well as identification of critical points for legal review.

Research & Development

(Re-)design of products

AI analyses current designs, market studies, and customer requirements and defines design criteria, e.g. to minimize weight. In some cases, the AI will develop its own design proposals and simulate them in different environments.

Finance & Accounting

Document digitalization & process automation

Automatic digitalization, processing, and interpretation of paper documents such as contracts, invoices, notices, etc.

Marketing

Topic recommendation & content generation

Real-time identification of popular topics and linking with appropriate communication measures for own products. AI solutions then create an initial communication template based on structured data.

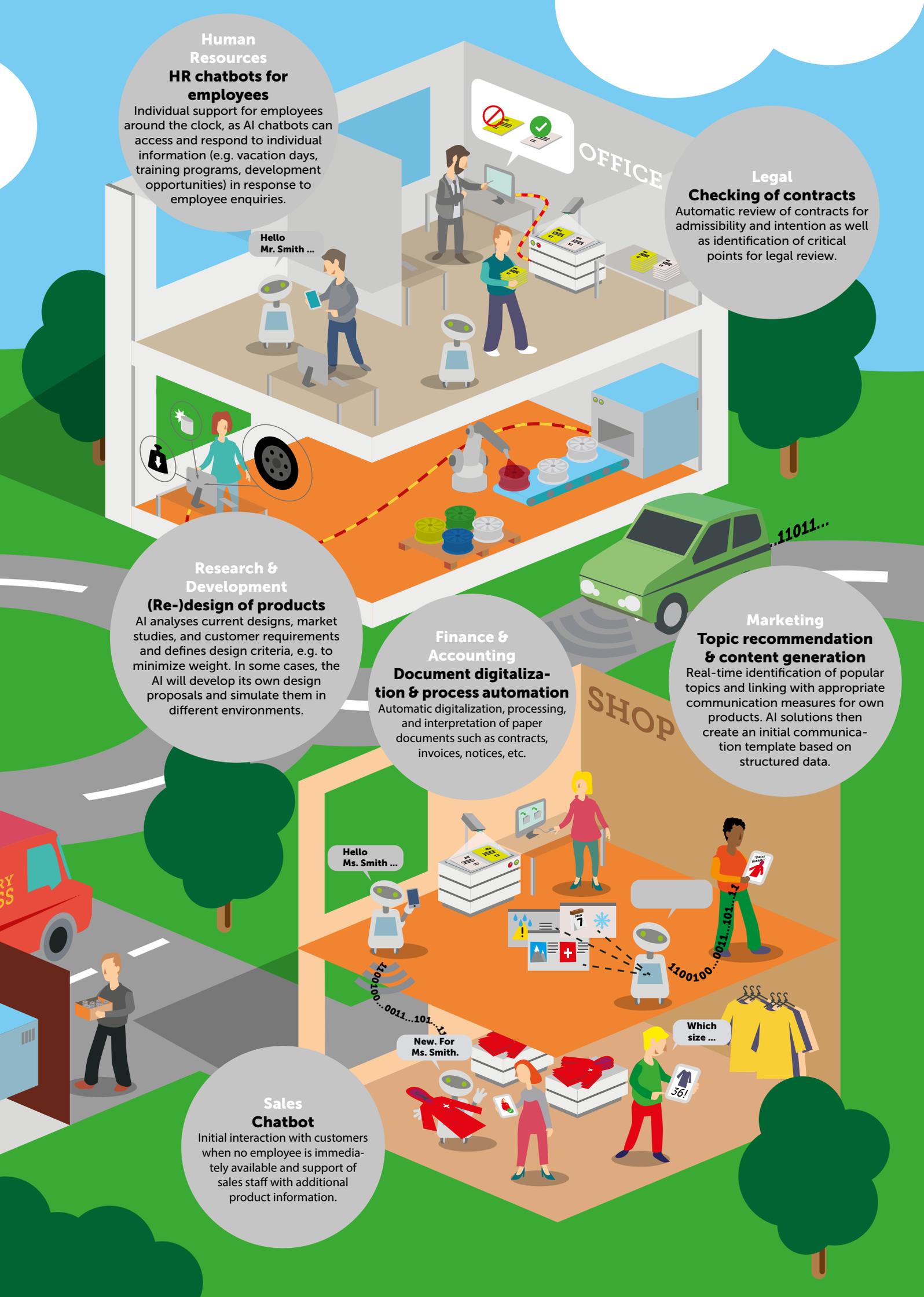
Sales Chatbot

Initial interaction with customers when no employee is immediately available and support of sales staff with additional product information.

Hello Ms. Smith ...

New. For Ms. Smith.

Which size ...





Deep dive: Data, the basic prerequisite for AI

"No intelligence without data!"

Personal comment from Dr. Susan Wagner, VP Data, Artificial Intelligence and Governance, Deutsche Telekom AG

The importance of data for AI can be illustrated along the lines of five facets:

1. Data are in vertical silos: An AI can only be trained with the data for its specific problem. It is true that the aim of the discipline of "transfer learning" is to make an AI trained for one problem usable for another problem. But you can't achieve more than a starting advantage with it (at least today). If you want to train an AI, you need a "silo" full of data for the specific problem you want to solve. For most specific AI applications, data is therefore much rarer than you might think.

"If you feel you have data the competition doesn't have, you should realize that value."

Maurice Gonzenbach, Co-Founder & Machine Learning Engineer, Caplena GmbH

2. Poor data quality = poor AI quality: AI improves with the quality of the data. An AI learns "blindly" off by heart what it takes from the examples given to it. There are many cases in which an AI has thus learned the prejudices of the people from whom the training data originated.

"What we recommend every customer is: Before you overoptimize the software, you should invest in the data. Data is the be-all and end-all."

Maurice Gonzenbach, Co-Founder & Machine Learning Engineer, Caplena GmbH

3. Data must be managed: People, machines, brands etc. These assets are expensive for companies, difficult to build up, and in order to achieve the greatest possible competitive advantage, you have to constantly work on them. Most managers aren't aware of the importance data has for these assets. But data deserves to be more valued, because today it can enable massive competitive advantages.

4. A culture of data must be filled with life: Just because the meaning of data has been understood does not mean that its value has been internalized. If a company wants to benefit fully from AI, it needs a data culture. This means that, when you develop a product or a process, you have to think about the data straight away: How can you automatically generate data while using the product or process, which can then be used for optimization?

This also means that, from the outset, you have to ask yourself whether products and services can be provided via a platform model. Then, at the point of sale, one can measure the demand-supply dynamics, transform them into insights, and thus find out what they mean for the product design and the desired business model. Only when this becomes a habit does a fertile data culture emerge in which there is always a good data basis for AI products.

"[Is data the new oil?] Not only. My observation is that a culture which is data-driven is the game changer for many companies. Only the right culture enables learning from data to be derived from feedback loops and the continuous improvement of data products."

Prof. Alexander Löser, Beuth University of Applied Sciences Berlin



5. AI and data protection: The AI technology wave adds a controversial topic to the data protection debate.

First and foremost, the General Data Protection Regulation (GDPR) has an influence on AI projects. From a societal point of view, the (partial) discord between AI and data protection sets Germany the task of finding a compromise:

- On the one hand, society has a great interest in individual rights, privacy, data protection, and transparency regarding the handling of personal data.
- On the other hand, the USA and China are currently undertaking massively higher investments in AI than the EU. Strict data protection makes progress in the EU even more difficult. This could not only lead to an economic disadvantage for the EU, but could also jeopardize (digital) sovereignty.

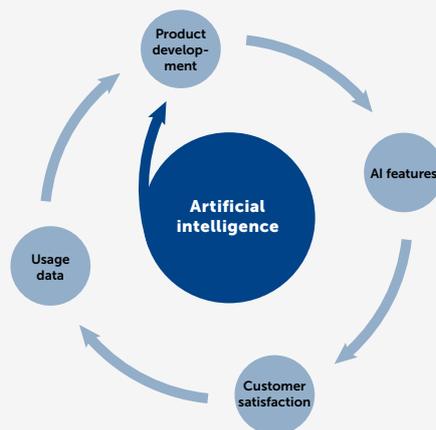
Note: For the sake of completeness, two further points should be mentioned on the subject of data:

1. More and more research is being done to achieve high AI performance with "small data." Breakthroughs in this area can by no means be ruled out. Probabilistic neural networks are already looking quite promising today and are used, for example, in logistics.
2. Reinforcement learning is another form of machine learning with huge potential for the future, with data playing a far smaller role here.

Deep dive: AI flywheel – the impact that rewards early starters



FIG. 18 Examples of the artificial intelligence flywheel



Source: Arthur D. Little, eco e. V.

Examples:

a) Internet search engines: Every time a user enters a keyword into Google Search and then clicks on a link, Google can learn which link appears to be the most relevant for that keyword. Consequently, the more people that use Google Search, the more data Google can collect

and the better Google Search will be. The better Google Search is, the more people use it. And so on ...

Google Search has a worldwide market share of over 90 percent in Internet search engines, with a slight upward trend – effectively a monopoly. The other big Google products like YouTube, Gmail, Google Maps etc. have the same AI feedback loop mechanism with the



same result. Google's parent company, Alphabet, generates 86 percent of its revenues from advertising, mainly with AdWords. In other words: The entire Alphabet Group is supported by a handful of AI feedback loops.

b) Autonomous driving: When an "autopilot" is perfect, there is no longer any reason for a driver to intervene in driving. Every time the driver intervenes during autopilot control, something was wrong; for example, they felt unsafe or the car was driving too slowly. Ergo, the more the autopilot is used, the more training data is generated. The more data is generated, the better the autopilot and the better the autopilot, the more people will use it. And so on ...

The first company to reach a level with its autopilot that is so high that a mass introduction will take place will reap double benefits:

1. Through the mass introduction, a mass of data can be generated. These data will give the quality of the autopilot a further accelerated impetus, making it even more difficult for the competition to catch up.
2. Various extremely promising business models can be rolled out without competition.

"The most prominent example relates to the question surrounding autonomous driving. The one who does this best will dominate the entire industry in the medium and long term and ultimately become the leading company. A central feature of these platform economies is that they often function according to the 'winner takes it all' principle."

Jörg Bienert, President & Founding Member, Bundesverband Künstliche Intelligenz e. V. (the German Federal Association for Artificial Intelligence)

c) Voice assistants: After the PC, the smartphone was the second major computing platform. Now we have the third major computing platform: voice assistants. These systems get better by being trained. The case of Siri has only just made the general public aware that, whenever the voice assistant could not help, the recording of the exchange may be used to further develop the voice assistant. This means that the more it is used, the more data is generated. The more data is generated, the better it gets and the better it gets, the more it is used. And so on ...

This is the reason why all major technology companies are trying to attract users to their assistance systems. They know that whoever succeeds in bringing significantly more momentum into their voice assistant AI feedback loop will have a good chance of becoming the monopoly-holder in that field. Amazon is leading the way. The company did not play a role in the first two computing platforms. It doesn't want to miss out on the third one at any cost.

Unlike other methods or tools, an AI feedback loop cannot be copied because it is always based on proprietary data. What results is very similar to the network effect and leads to a platform economy or "winner takes all" dynamic. In a business where products reinforced with an AI feedback loop can be launched, intensive involvement with AI is of the utmost importance.

"German companies can benefit from the ability to establish feedback loops from customer reactions in order to continuously improve data products. This requires a rethink, away from pipelines and towards a data-driven culture of continuous improvement and learning from mistakes (which the data will tell us about). We already know this culture from the aviation industry, among others."

Prof. Alexander Löser, Beuth University of Applied Sciences Berlin



5. Necessary Change: Strategic Transformation for Lasting Impact

AI offers both potential and opportunities for every company in Germany. Opportunities for sales growth and cost savings extend across all industries and all value creation activities (see Chapter 4).

5.1 Digital shift: Ten forces of strategic change

AI also represents a risk for companies. If they miss the boat when it comes to introducing AI, a competitive disadvantage can quickly arise because the potential of the initial implementations has an immediate impact. As the case study of the digital service assistant TOBi shows, Vodafone experienced immediate improvements in customer service through the use of AI. Individual pilots and uncoupled approaches are a start for companies. In order for them to realize the full potential of AI, the overall impact needs to be considered holistically. Arthur D. Little denotes this as the Digital Shift. To make this shift, companies must take ten dimensions into account. For AI, that means: Forces that necessitate strategic change are operating along ten dimensions.

The seven external forces

1. **Customer Requirements and Flywheel:** Customers expect to be able to use the services of intelligent assistants 24 hours a day, seven days a week, without any waiting time. They also expect products and platforms to be improved automatically and continuously.
2. **Business Models and Added Value for Customers:** AI makes marketing and sales more effective and many tasks more efficient. It enables loss-making business models to suddenly become profitable. But above all, completely new business models arise when entire steps in the value-creation process are eliminated. Opportunities for platform business models and data products are emerging in many places. The "first mover advantage" holds true more than ever with AI.
3. **Processes and Ecosystems:** AI is particularly good at learning human skills and applying them in contexts where tasks can be neatly structured – i.e. in processes. As this study demonstrates, there is no corporate function and no business process that is not affected by AI.

4. **Corporate Management and Governance:** If AI significantly changes value-creation steps and business processes, this also reflects on the organization. In order not to suffer a competitive disadvantage, companies must orient their structures and decision-making processes towards the rapid introduction of innovation. This applies equally to process and product innovation. Nevertheless, companies must find economies of scale in the right areas. For the use of AI, these are, in particular, the availability and usability of data. Platform business models are predestined to achieve economies of scale even faster. Organizations must be ambidextrous – both innovative and efficient.

5. **Employees and Culture:** AI causes tasks to disappear and new ones to emerge. The collection of data is increasing. Consequently, employees demand further training and have concerns regarding data protection.

"Of course, AI is quite automatically designed to be a red rag for workers' councils. Persuasion is required."

Dr. Volker Glaeser, Partner & Managing Director, Reply

6. **Data and Analytics:** With AI, the value of "good" data increases dramatically. Successful data management is becoming a central requirement in companies because, in order to run AI applications, it is necessary that the right information is available in almost real time.
7. **Technology:** The field of AI technology is large, complex, and developing rapidly. The alignment of important potential application areas in the company and the development of technologies places high demands on technology management. Companies must create the freedom to try out new technologies quickly and to react flexibly to technological leaps. It is essential to rigorously avoid lock-in effects.



The three internal forces

- 8. Approach and Roadmap:** Strategic change requires a target vision. This is particularly difficult in an AI world, as the technology is developing further on a daily basis and new possibilities are emerging. It is important to set a course, translate it into a concrete roadmap, and then work through it effectively using an iterative approach.
- 9. Communication and Change:** Compared to digitalization, the changes for people and organizations through AI are more far-reaching. On the one hand, a fundamental skepticism towards AI must be addressed, while on the other hand, the use of AI as a support is transforming the working life of many employees.

It is important to incentivize "cooperation" with AI solutions as helpers. This ensures that innovations are not unnecessarily slowed down. For the skeptics, the initial impact of AI solutions will be reason to refer to the "not particularly good performance of AI," while others see the danger of their own position being cannibalized by AI.

The concerns, challenges, and experiences of introducing AI must be addressed transparently and regularly. Companies will only be able to introduce AI in a lasting way if they themselves become agile and learning organizations. In such organizations, change is not a challenge, but is propelled by the company's own initiative.

10. Control and Steering: How pronounced is the data culture already? How much potential for augmentation has already been realized and how much is yet to be done? How fast and creative is the organization in discovering and verifying data products and platform economies? Transformation can only be effectively steered once these issues can be measured effectively.

5.2 The four strategies for companies for the use of AI

We have identified four strategies for companies, so that the navigation of the tension between the ten forces, as well as that of the strategic change, can take place in a structured way. Depending on the direct relevance of AI for the value creation activities, recommendations for action can be derived for companies.



FIG. 19

Strategic options for the introduction of artificial intelligence

A AI in Sight	B AI Strengthened	C AI Transformed	D AI Player
Anticipating future AI developments and building experience and skills	Strengthening a company's own value creation through process support and automation using AI	Enriching and transforming products, services, and value creation with AI	Transformation to an AI player by building and marketing the company's own AI capabilities (AI technology components)

Source: Arthur D. Little, eco

In terms of implementation, the four strategies differ in the intensity and orientation with which the company is changed and AI is used. By 2025, not all companies need to be "AI Transformed", let alone "AI Players." However, by 2025 all companies should be on track to being "AI Strengthened." "AI in Sight" can be a starting point to achieving this.



A | AI in Sight

This strategy is relevant for companies in which, on the one hand, value creation depends very much on individual and specific activities without major repetition and/or which, on the other hand, require a high degree of creativity and strategic networked thinking. One example of this is manual trades.

For these companies, AI does not represent a structural or lasting transformation in value creation leading up to 2025. Nevertheless, companies should use the next five years to build AI competencies and gain experience in the use of AI.

“Start, at all costs. That’s the most important thing, to really start with cases. So REALLY start with cases.”

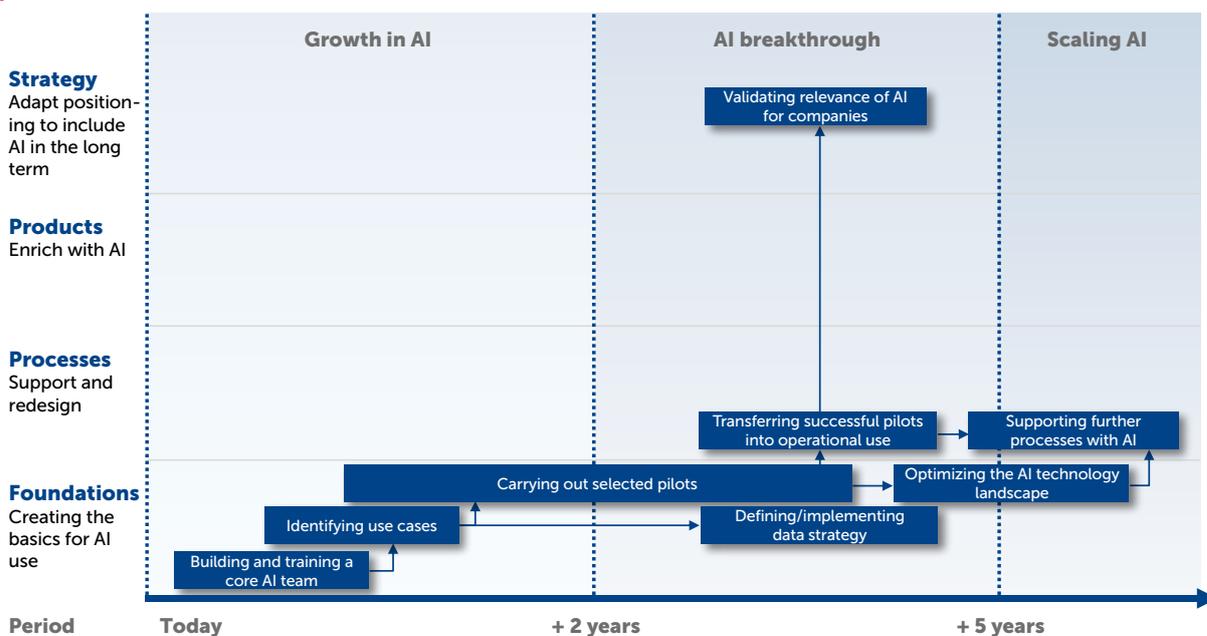
A comment from Dr. Susan Wegner, VP Data, Artificial Intelligence and Governance, Deutsche Telekom AG

Of the ten forces of change presented, (5) Employees and Culture and (7) Technology are particularly relevant. We recommend that companies set up a small core team with at least 20 percent of its capacity to support and build the topic of AI for the company. This includes in particular the establishment of continuous technology screening and the identification of possible fields of application. The objective is to conduct the first AI pilot projects for internal value creation within the year 2020. Through this, the understanding of AI throughout the organization is built up step by step.

Internal activities that are not part of the primary processes are particularly suitable for the first pilots. In particular, the automation of simple support processes is recommended. This does not require any fundamental adjustment of corporate governance and creates a cost savings potential on a small scale. While AI does not require lasting, strategic change by 2025 for companies to remain competitive, companies should start building up initial competencies and gaining experience in pilot projects today.



FIG. 20 A | AI in Sight: Development of competencies and continuous checking of relevance



Source: Arthur D. Little, eco e. V.



B | AI Strengthened

The second strategy is relevant for the majority of companies in Germany. In this, AI will strengthen the company's own value creation in a lasting way. The focus is on realizing cost saving potentials through the use of AI applications. If companies do not consistently implement the strategy, they are at a disadvantage compared to competitors who achieve a quality or cost advantage with the help of AI.

For the successful implementation of the strategy, the following forces in particular must be addressed:

3. Processes and Ecosystems: The aim of the strategy is to use AI to strengthen the company's own value creation. Here, the benefits of AI are as follows:

- AI can be used as a tool to increase the quality of processes through better information, above all due to its strength in forecasting.
- AI can perform process steps automatically.
- AI can enable the automation of tasks that were previously not automatable, such as using information from printed documents. AI acts as an enabler for other process automation, such as Robotic Process Automation (RPA).

4. Corporate Management and Governance: The most important aspect is to enable the organization to exploit the potential of AI. Management is called upon to establish and support AI competencies and decision-making authority. Depending on the corporate structure, this can be done centrally, as a separate unit, or by setting up company-wide responsibilities. Once the responsibilities are established, the existing governance must be adapted so that AI solutions in processes can support decision-making.

5. Employees and Culture: The sustainable development of higher levels of AI expertise requires the establishment of an AI team. In addition, AI awareness and expertise within the currently existing company must be broadened and expanded, and external AI expertise must be brought into the company and absorbed wherever possible.

It is important to offer AI talents a challenging and supportive environment, so that the further development of competences can also take place within the company. For the successful introduction of AI for process support, it is necessary that the right process expertise is combined with the AI expertise. This can take place in the context of individuals and in teams.

6. Data and Analytics: The underlying data is essential if AI is used in processes. For this, companies must implement a data strategy and governance that allows efficient data management.

7. Technologies: In addition to actively following technology developments within and outside of AI, it is important that companies create an appropriate framework for the rapid adoption of AI technologies. In the next two to three years, it will not yet be crucial to be using the right universal technology platform, but rather to create the flexibility to use AI independently of individual technologies.

Only after reaching the point where AI is supporting value creation company-wide will the optimization of the platform and the selection of the right strategic partners prove sensible. This ensures that technology decisions during the introductory phase do not negatively influence the usefulness or feasibility of individual use cases.

8. Approach and Roadmap: For the lasting adoption of AI in the company's own value creation, it is necessary to proceed in a structured manner. For this, it is important to define a target vision for the entire company right from the start. Subsequently, the roadmap for the introduction is then defined and implemented on this basis. The target vision will remain flexible over the next few years and must be validated in particular on the basis of initial experience. The introduction of AI using classical waterfall methodology will be complicated and inefficient. We recommend an agile approach in which sprints are defined and iterations accompany the introduction of AI for all processes.

9. Communication and Change: Extensive communication is necessary to ensure that employees can be optimally supported by AI. To this end, we recommend establishing a change management system that reduces existing hurdles and informs employees transparently about the impact of AI. In addition to communication, it is necessary to create company-wide measures to build AI competencies for employees.



10. Control and Steering: To ensure that AI also creates the desired added value, we recommend testing and managing the introduction of AI applications from the outset, in terms of added-value controlling. Relevant key performance indicators (KPIs) must be defined for processes, and methods must be established for monitoring. A transparent and timely monitoring of the costs and benefits of AI supports the communication measures and the continuous planning of further introductions.

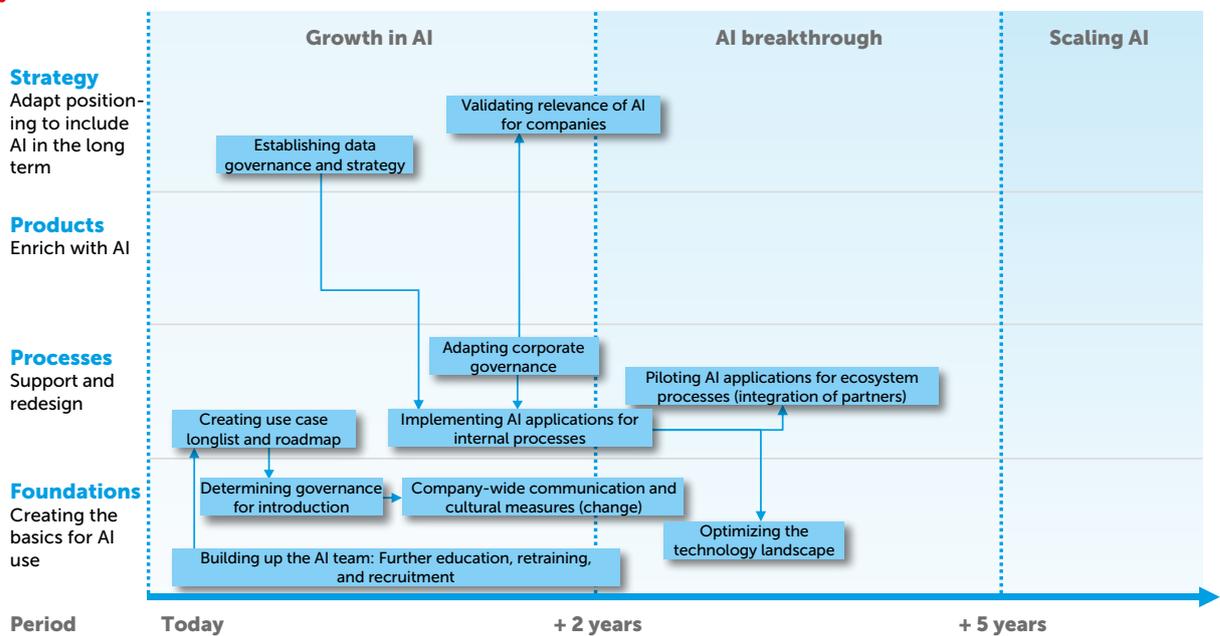
“In the digitalization of customer service, our chatbot TOBi is able to solve more than a third of customer queries individually and in a personalized manner after only one year. With increasing amounts of data and self-learning systems, the potential here is far from exhausted.”

Jörg Knoop, Tribe Lead COPS Innovation & Automation, Vodafone Germany



FIG. 21

B | AI Strengthened: Lasting strengthening of value creation activities using AI



Source: Arthur D. Little, eco e. V.

C | AI Transformed

By 2025 at the latest, 60 to 70 percent of German companies should be pursuing this strategy. Until then, this is particularly relevant for companies that, on the one hand, can lastingly improve their own value creation by the support of AI and/or, on the other hand, can enrich products to achieve greater differentiation with the help of AI. In this context, AI creates three possibilities:

- Products or business models that were previously loss-making, but which, thanks to AI, result in a profitable business case (Example: Uber, as soon as cars can drive autonomously),
- Data products or AI flywheels that generate data during their use, with which they can be further developed (examples: Autopilots, language assistants, search engines, recommendation algorithms etc.),
- Platforms, i.e. "places" where several parties meet as a marketplace. The parties generate valuable data through their interactions on the platform. These can then flow into data products, enable new ones, or turn the marketplace itself into a data product (examples: amazon.com, ebay.com, facebook.com, WeChat etc.).



“If we look at which companies have achieved the largest market capitalization in the last ten years, then these are primarily companies in the platform economy. The platforms create feedback loops with data from their customers, suppliers, products, etc., with which they can improve their data products and make them more attractive for even more customers. This cycle – one should understand it and adapt it to one’s own company.”

Prof. Alexander Löser, Beuth University of Applied Sciences Berlin

In the Digital Shift Framework, this strategy means defining and pursuing a digital target vision for the market, instead of reacting. The most important strategic cornerstones for this are:

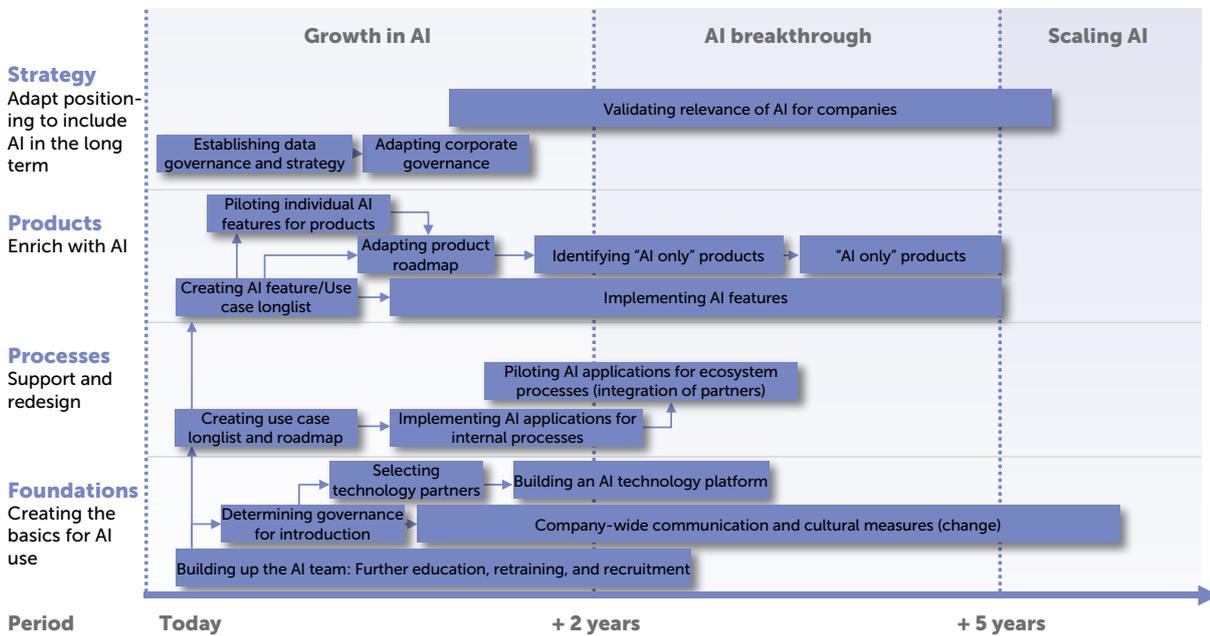
- 1. Flywheel:** An AI flywheel enables companies to capture the strategic relevance (and dependence) of AI, products, processes, business models, and the organization. The aim is to lastingly consolidate the competitive advantage with the help of AI.
- 2. Business Models and Added Value for Customers:** The use of AI in products makes it possible to operate loss-making business models profitably. For example, AI can be used to provide immediate customer service for all customers around the clock. However, the general customer journey is also strengthened with AI, though AI applications making all relevant information available at the points of contact with customers, in order to support employees and systems.

For the strategic forces (3) to (10), the same actions apply as for strategy "B: AI strengthened."



FIG. 22

C | AI Transformed: Strengthening value creation and lasting differentiation with "AI-enriched" products



Source: Arthur D. Little, eco e. V.

D | AI Player

The fourth strategy for using AI is for companies seeking a new business model, new products, and better market positioning with the help of AI. AI not only supports the company's own value creation or existing products, but also becomes a product.

The aim is to achieve market leadership in one of the technology areas and/or application areas of AI. To achieve this, companies build on existing competencies. For the German economy, companies with a high share of manufacturing are particularly suitable for this purpose. As described in Chapter 4, the use of AI in manufacturing in particular creates added value. German technology companies, energy suppliers, and mechanical engineers



can use their leadership to develop and market specific AI applications based on their own experience. The competition is international and comes from both hyperscalers and start-ups.

The transformational dynamics for AI players are fundamentally different from those for the first three strategies. Companies are on the other side of the AI technology wave. For them, AI is not the transformer of their own company, but above all a new sales market. Nevertheless, the ten forces also work here.

1. Flywheel: The positioning, products, and activities must be geared towards creating a new business model and a new market for companies. For industry in Germany, the development of AI applications based on existing competencies – domain-specific knowledge – is an obvious option. It is important that the use of AI applications by customers further develops the company's own wealth of experience and skills. The aim is to create a platform.

2. Business Models and Added Value for Customers: The sale of AI solutions will bring with it a new business model for many companies. For industrial companies in particular, the switch from a hardware-based business to a digital service means a complete realignment of market access and marketing activities. This changes the customer base, the customer interfaces, and also the revenue model. Companies should pay early attention to which aspects of AI applications can be

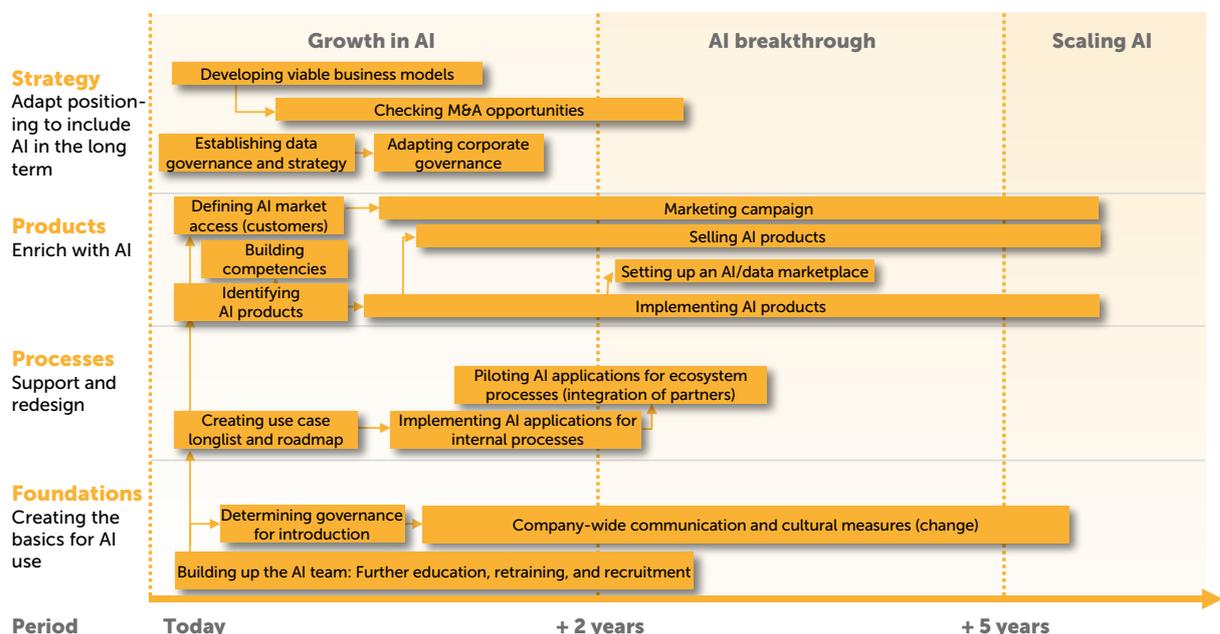
built, operated, and offered as a platform and which components are additional services that operate on the basis of the platform. For example, quality control in mechanical engineering can be offered as a general platform with basic functions and algorithms, while additional services are developed and offered for selected industries, for example visual inspection of surfaces in the finishing of lightweight components. Finally, the development of an AI business model also requires opening up to an ecosystem. As mentioned in Chapter 2, AI applications rarely exist in silos. AI players must therefore start early to build up an appropriate ecosystem with partners, as well as developing the corresponding interfaces, so that these can also be used efficiently by customers.

3. Technology: As a provider of AI solutions, companies package their own expertise in AI applications. They are called upon to set up their own AI infrastructure (for example, by operating high-performance computing in data centers). It is important to define your own vertical range of manufacture at an early stage. Very few companies will develop their own deep neural networks. However, companies must select and retain the right strategic providers to deliver AI components.



FIG. 23

D | AI Player: Development of viable business models as a provider of AI applications for third parties



Source: Arthur D. Little, eco e. V.



6. The Regulation of AI

The field of AI has changed significantly in recent years and has developed rapidly. The result is a growing focus on the possibility of an increased use of such systems and technologies, the handling of AI, and the impact of AI on the state, society, and the economy. Associated with this focus are questions about the political, legal, and societal regulatory framework for AI.

An aim of the present study is to illustrate how governments and intergovernmental organizations approach the issue of AI. The strategies formulated by the respective governments or organizations serve as the baseline information in this respect. Currently, around 25 countries worldwide have developed strategies for dealing with AI or have published comparable papers. Selected documents and strategies are used to investigate the extent to which the relevant actors are active in four fields of action: Data policy, technology regulation, research funding, as well as application development & application areas.

In the field of **data policy**, we investigate the extent to which the actors want to make existing data usable for use in the area of AI. This also includes the balance between the personal right to privacy and the use of data.

The field of **technology regulation** deals with the question of the extent to which the documents of the actors allow conclusions to be drawn about the general handling of

AI and whether they aim for a more restrictive or market-driven handling of AI.

The investigation of the field of **research funding** is intended to explain the extent to which the actors themselves are investing in the development of the fundamentals and application areas of AI and where they are setting research policy priorities for AI.

The examination of the field of **application development & application areas** is intended to determine in more detail in which areas the actors are promoting the design of AI and how they might be dealing with it in regulatory terms.

The baseline information for this investigation includes the AI strategies of the European Union, Germany, and France. Our fundamental findings are compiled and classified on the basis of the four fields of action described above.

In order to better place the observations made here in a global context, reference is also made to the AI strategy of the People's Republic of China. For further reference, corresponding documents from the USA – which has not yet published a coherent AI strategy – have been included in our research.

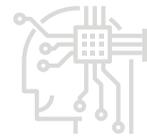
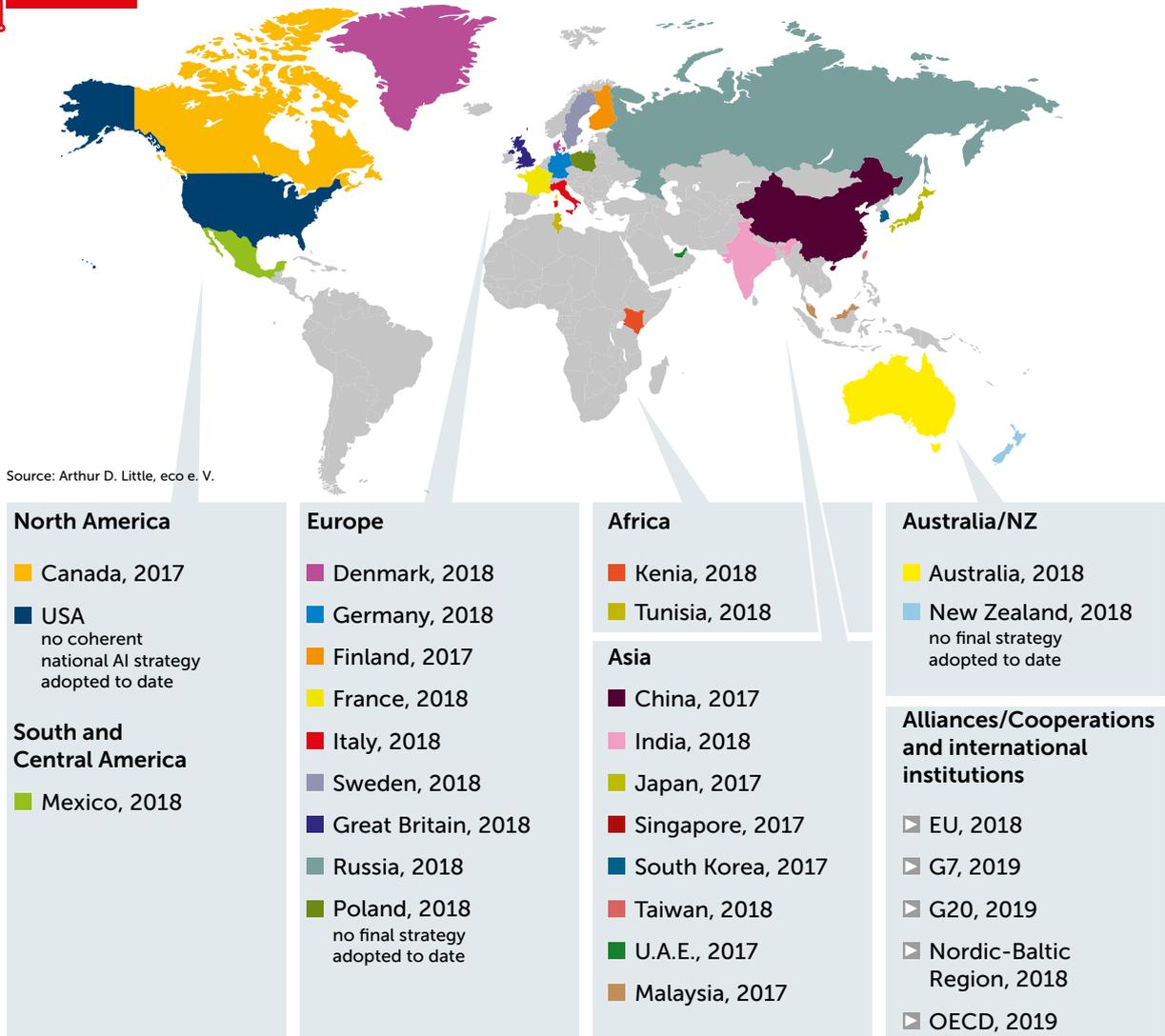


FIG. 24 Globally agreed strategies for artificial intelligence



6.1 The European Union

The European Union (EU) is a unique intergovernmental organization with its own resources (the Commission) and the European Council, which represents the governments of the individual EU Member States. Accordingly, it cannot define its own uniform "European AI strategy" as is done in nation states by the respective governments. Rather, the papers currently published reflect the views of the respective European institutions on the subject. The proposals and recommendations are accordingly evaluated in this context. They are less concrete and provide a more abstract framework within which Member States' national AI strategies should ideally fit. In this sense, the EU does not present a coherent AI strategy, but implements various interrelated policies that constitute a European approach to dealing with AI. For our study, the

Commission's communication on "Artificial Intelligence for Europe" (COM (2018) 237) and the "Coordinated Plan on Artificial Intelligence" (COM (2018) 795) were taken as the main resources. The Staff Working Document on liability for emerging digital technologies (SWD (2018) 137) was also used.

Data policy

The EU documents regard the General Data Protection Regulation (GDPR) as the basis for the regulation of AI and the related data policy and accordingly consider that the provisions of the GDPR should apply to these technologies. The right to information granted to citizens by the GDPR are considered to be central. Furthermore, the hope is expressed that the ePrivacy Regulation (ePR) will establish additional regulation in the area of privacy.



The Cybersecurity Act passed at the beginning of 2019 is intended to promote the security of AI systems. In the context of the EU Charter of Fundamental Rights, which explicitly mentions privacy as a protected good, it is also highlighted that the EU would like to continue to deal in detail with the explainability and transparency of AI. The High Level Expert Group on Artificial Intelligence (AI-HLEG) is to develop ethical guidelines that will be used as recommendations for further regulation.

In addition to data protection, European stakeholders also want to develop a policy on data. The primary focus is on publicly accessible data. As a cornerstone for a European data policy, the revision of the PSI Directive is cited: this was completed in June 2019 and concerns the publication of a large part of geo-information data and other data generated by the EU. Interfaces (APIs) based on the "European Interoperability Framework" are also to be made available. The EU would also like to develop guidance and information on how to provide and share data for AI systems for businesses and set up a support center to advise public and private bodies. In the area of data policy, less emphasis is placed on regulation and further restrictions, as very strict rules already apply in the European context with the GDPR and the forthcoming ePVO.

Technology regulation

In addition to the aforementioned ethical guidelines for AI – the development of which were entrusted to the AI-HLEG expert group set up for this purpose, and which are now available – and the EU Charter of Fundamental Rights, the European institutions are also endeavoring to shape the legal framework for AI. The traceability and transparency of AI are cited as decisive factors for this. However, there is no further definition of how exactly this transparency is to be achieved. The AI-HLEG is making further concrete statements in this area. However, these should not initially be seen as an official regulatory approach by the European Commission, the Council, or Parliament. Liability rules for modern technologies, including AI, are also under discussion. The Staff Working Document on this topic (SWD (2018) 137) points out a possible revision of the European Product Liability Directive, the adaptation of which is already being discussed with reference to the Internet of Things.

Another aspect to which the EU would like to devote more attention is the set of socio-economic challenges posed by AI. However, a direct, imminent regulatory approach cannot be discerned in this area. The Commission is focusing on qualifications in handling AI and on the training of AI specialists. This is to take place within the framework of

the "New Skills Agenda" for Europe, which canonicalizes and records qualification elements. In addition, possible labor market-relevant effects are to be quantified and evaluated by means of technology assessment.

Research funding

For the EU, research funding is a central element with which Europe would like to set its own course in the field of AI. The European Framework Program for Research and Development, "Horizon 2020," will provide 500 million Euros annually for research into AI. In addition, public-private partnerships (PPPs) within the framework of the program are to interlink the research and implementation of AI technologies and applications. This project is also expected to have a leverage effect, with a cumulative annual research volume of 20 billion Euros by the end of 2020, with support from all Member States. In 2020, the European Investment Fund (EIF), together with the funds from Horizon 2020, is to provide around 100 million Euros for research purposes. Research centers for AI will also be established throughout Europe. The focus of these activities is to support basic research and industrial research. The European Innovation Council is to be involved in this work, as is the European Research Council. In addition, centers of excellence are to promote research.

Application development & application areas

When developing applications in the field of AI, European players place a special focus on small and medium-sized enterprises (SMEs). To this end, the 400 hubs that already exist throughout Europe for the development of AI technology applications are to be expanded and upgraded. In addition, an "AI on Demand" concept is to be launched, which will provide assistance specifically for SMEs in the use of AI. Furthermore, the European players see the possibility of offering test fields and experimental spaces for AI products. The focus is on the health sector, the transport and logistics sector, infrastructure inspection and maintenance, agriculture, and the food industry, as well as on agile development and manufacturing. Private investments are to be promoted with the help of venture capital and other instruments and measures that have not yet been specified in more detail. In addition, the Coordinated Plan on Artificial Intelligence identifies optimization potential in the area of the Single Market and cites this as a key challenge.



FIG. 25

Well-intertwined – the German & the European AI Strategies



Source: Arthur D. Little, eco e. V.

6.2 The Federal Republic of Germany

In November 2018, the German federal government adopted an "Artificial Intelligence Strategy." Germany has thus preempted the European Coordinated Plan on Artificial Intelligence, which encourages the development of national AI strategies in the Member States. This national AI strategy summarizes the key activities of the German federal government in the field of AI and places them under a common umbrella. Further developments in Germany arise from parliamentary activities. A study commission is currently working on recommendations for action for AI.

Data policy

In considering the area of data policy from both a regulatory perspective and within the framework of the national AI strategy, reference is made to the GDPR, which can be used as a standardized fundament throughout Europe. In addition, there is a national data protection law in Germany. It should be borne in mind here that the German Data Protection Act contains more concrete requirements, for example in the areas of scoring and lending, than the GDPR. In addition, the German federal government has identified challenges in the application of AI in the field of predictive policing and social media forensics. Here it remains to be seen which activities are developed and to what extent they meet the self-imposed requirements of civil rights and the rule of law.

In addition to regulating data protection, the German federal government would like to improve access to data in particular and thus promote the development of AI. To this end, the German federal government would like to make existing databases accessible and usable, and expand infrastructure for real-time data transmission. The national AI strategy is led by a curated data and computing infrastructure. The German federal government would also like to revise the e-Government Act and restructure it with a view to expanding open data. In addition, the International Data Spaces initiative is referenced as a possible starting point for providing and sharing data.

Technology regulation

In the field of technology regulation, an ethical, human-centered approach is placed in the foreground as a guiding principle for AI. A reference to the debate on the ethical use of AI at European level takes account of the cross-border use of digital technologies. Primarily, the strategy creates the impression that no new cross-sectional regulation of AI is being sought. Rather, the existing regulatory framework is seen to provide a stable basis for the regulation of AI. New laws on a larger scale are therefore not expected for the time being. The restrained regulatory approach of the German federal government is backed up by the plan to create a standardization framework for AI in cooperation with the German Institute for Standardization (DIN).



However, the German government sees a greater need for regulation with regard to the transparency and traceability of AI. The establishment or expansion of public or private bodies is intended to create a control mechanism which can oblige the operators of AI systems to disclose their services and products. These measures are designed in particular to prevent people from being discriminated against through AI. A "Digital Bill of Rights" is also to be developed in line with the legal requirements and ethical guidelines of AI HLEG. This is to deal in particular with the aspects and impact of AI related to the field of work and employment. The strategy emphasizes that a societal and dialogue-oriented approach should be followed. Accordingly, reference is made to legislation already adapted to the German Works Constitution Act (BetrVG) on the inclusion of works councils when using AI in companies.

The strategy also notes that there are already numerous sector-specific regulatory approaches and much preparatory work being done in this area. The human-centered approach is to be tested and monitored with "observatories." In addition, a FinTech Council is advising the German Federal Ministry of Finance on possible regulatory approaches for AI in the financial sector. The Competition Law 4.0 Commission, whose task is to formulate proposals for European competition law, is also expected to deal with issues relating to the use of AI and its impact on competition, and submitted proposals to this end in September 2019.

In the area of employee qualification, the strategy still sees potential for development and cites the Digital Pact for Schools and the German Qualification Opportunities Act, which are intended to create the basis for this.

In addition to the close connection to European regulation, it also states that Germany is striving for close coordination with France in the field of AI. In October 2019, the French and German governments signed an agreement setting out key aspects of a joint approach and common goals in dealing with AI.

Research funding

The AI strategy of the German federal government regards research on AI as constituting a central cornerstone for policy-making. A declared goal of the German federal government is to research and develop AI systems in Germany. The research focus here is on the Internet of Things and Industry 4.0. Not only flagship projects are to be funded. Instead, the path of research funding is to follow a federal approach involving several decentralized competence centers. Nevertheless, a certain amount of pooling of resources is planned – above all through the German Research Center for Artificial Intelligence

(DFKI), whose structure is to be further developed as a public-private partnership and promoted by a national research consortium. Young scientists are also to be supported. The institutional framework for AI research is to be strengthened through innovation clusters and the German Federal Agency for Leading-Edge Innovations.

According to the strategy, research will be carried out in particular in the areas of pattern and speech recognition, machine learning, neural networks, and expert systems. But it is also intended that the transparency of AI continue to be tracked. In order to also do justice in the field of research to the human-centered approach anchored in the strategy, research into consumer-centered AI will be included in the equation. So-called legal tech is mentioned as a design field, while privacy management systems in the field of data protection are also alluded to.

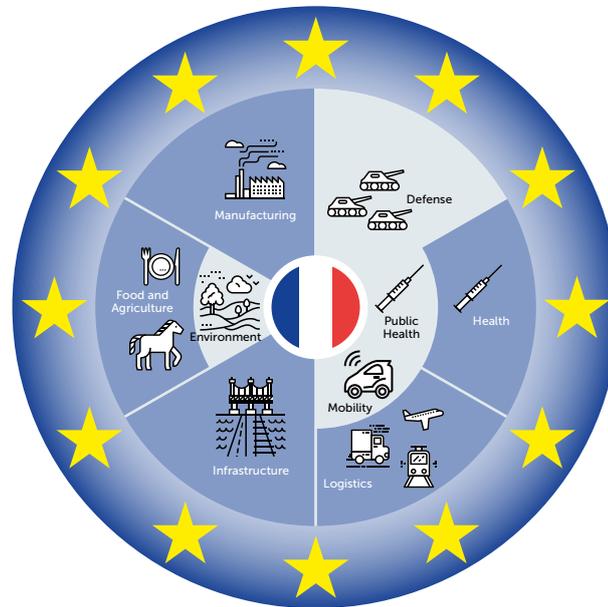
In addition to public research, the German federal government also wants to strengthen private sector research in the field of AI. In addition, corporate research funding for the development of AI systems is being sought. Programs such as the Central Innovation Program for SMEs ("Zentrales Innovationsprogramm Mittelstand" – ZIM), SME 4.0, and the Joint Industrial Research program ("Industrielle Gemeinschaftsforschung" – IGF) are also available to support such research. Here, AI research is built into the existing structures.

Application development & application areas

The AI strategy of the German federal government formulates as an abstract objective a European approach for data-driven business models. The intention is to take a new path, one which is based on high-quality and publicly accessible data. The aim is to achieve technical sovereignty in the field of AI. Mobility, in particular, is cited as an important field of application, with corresponding legislation for the Road Traffic Act already in existence since 2017. The security of IT systems and digital services is also highlighted as an issue. In addition, the need for sustainable development and the achievement of the 17 Sustainable Development Goals of the United Nations is stipulated. Research on and the development of space and geo-information applications is to be stepped up considerably. The health sector is also considered to be of central importance. AI systems are to be used in the treatment of patients to improve care and strengthen prevention. In the field of care, more emphasis is to be placed on robotic applications based on AI. The biotech sector should also benefit from AI technologies. Although applications in the areas of Internet of Things and Industry 4.0 are primarily cited in relation to research, they should also be considered in the area of application development.



FIG. 26 Well-intertwined II – the French & the European AI Strategies



Source: Arthur D. Little, eco e. V.

In addition, the extent to which regulation is conducive to the use of AI is to be examined on a sector-specific basis.

A strengthening in the area of venture capital is also foreseen. The German state bank Kreditanstalt für Wiederaufbau (KfW) will make around 200 million Euros available for this purpose in 2020.

6.3 The French Republic

In spring 2018, French President Emmanuel Macron presented an AI strategy for his term of office. It highlights the importance of AI for French society. The French state sees itself as playing a central role in making AI and its applications a success. The strategy defines the central challenges such as the development of AI ecosystems, the definition of a future-oriented data policy, the implementation of a legal and financial framework conducive to AI, and the answering of ethical questions. In France, an inter-ministerial coordination unit for AI is to be set up in order to enable synergies across society and to benefit from AI development.

Data policy

The French government recognizes that the general regulatory requirements need to be reviewed to enable digital innovation in the future. Numerous projects of the future French data policy, such as the strengthening of open data, are to be regarded in a European context. In order to accelerate the development, implementation, and use

of AI-based applications, the government recommends that a European legal framework for the use of data in general and public data in particular be drawn up. The strategy points out that the French administration has a high volume of data. It is therefore necessary to review potential access to publicly collected data at national and EU levels. At the same time, the future policy on data use must strengthen the sovereignty of France and Europe.


FIG. 27 Key aspects of AI strategies in Germany and France

	DATA POLICY	TECHNOLOGY REGULATION	RESEARCH FUNDING	APPLICATION DEVELOPMENT & APPLICATION AREAS
GER				
FRA				

Source: Arthur D. Little, eco e. V.

The basic premise should apply that all planned measures should be based on and reflect the high standards of the GDPR.

In order to take advantage of the many possibilities offered by AI, the development of a platform for the exchange of public and private data is envisaged, with the aim of supporting research institutions in particular. Technological development is to be promoted through the harmonized interaction of research and companies interested in cooperation. In this context, reference is also made to the amended PSI Directive.

Technology regulation

In the regulation of technology, the French AI strategy pursues an ethical and human-centered approach. An AI Ethics Commission is to be established to provide expert support for the questions of ethics and AI developments that will arise in the future. The aim of the Commission's work will be to define recommendations, including for a benchmark on ethical issues.

The French government wants to ensure that AI and the underlying algorithms are transparent to the population and are not perceived as a black box that could endanger security. Therefore, the algorithms used in public administration should be underpinned with the highest possible transparency and, if necessary, made publicly available. The setting up of an expert group on AI algorithms is planned. The focus of the expert group's work will be the testing of algorithms and their underlying database. Similar to the impact assessment for the GDPR, the French government plans to carry out impact assessments on the potential for discrimination by AI applications. The

results should not only safeguard the country's internal security, but also be used to measure the success of AI developments.

In order for the potential of AI to unfold in the labor market, labor law regulation is to be revised. The quite rigid regulation that has been in place up to now is to be reformed to enable transformation.

Research funding

The French strategy sets out the objective of achieving a visible lead in the development of AI in the coming years in a global comparison. The government therefore plans to invest a total of 1.5 billion Euros in research funding for AI up to 2023. It is intended to expand the establishment and promotion of AI-oriented chairs at French universities and to strengthen these through research projects.

In order for the academic bodies to produce reliable results, the research institutes must be equipped with the necessary IT infrastructure. A task force has recommended the development of a supercomputer that is geared to future AI requirements. The central requirements include storage capacities, computing times, and cloud access options.

It is important for the acceptance and future of France to anchor AI competencies in society as a whole. For this reason, the exchange and teaching of digital skills should be organized in an interdisciplinary manner. In this context, the strategy points to the particular importance of partnerships between research institutes and private partners such as companies. On the basis of the partnerships, AI skills would be imparted to the economy and, in return, previously inaccessible data portfolios would be



developed. It is expected that the use of AI will change the French labor market, and therefore the creation of opportunities to learn digital skills at all stages of life are deemed to be necessary.

Application development & application areas

For the rollout of AI applications, the French government has defined four concrete application areas that will pose major challenges for society as a whole in the coming decades. The central application areas include: Public Health, Environment, Mobility, and Defense.

The use of AI is generally intended to increase sustainability in the above-mentioned areas. In order to precisely define the deployment potential and key challenges of the individual sectors, sector-specific strategies are to be developed. Building on this, the French government is seeking to set up sector-specific platforms. This is intended to pool value-added data from AI applications and to enable new value chains.

The French strategy points out that AI applications can only be developed and used successfully and in a targeted manner if networking between all players in research, education, and industry is strengthened in the future. Only on the basis of good networking can the transfer of knowledge from research results to practical application succeed reliably.

6.4 Placing the strategies in the global context

The AI strategies from France, Germany, and Europe were published over the period of one year and in many places show a close relationship to each other, even if this is not always explicitly formulated. This is due to the time sequence of publication. At the same time, commonalities and also differentiations can be identified, which are explained below. There are also other activities in the field of AI. At present, some 25 states and five intergovernmental institutions have published or are about to publish AI strategies or have produced corresponding documents that can be used instead of an AI strategy. In the public debate, the main actors with regard to the regulation and design of AI systems are usually the People's Republic of China and the USA. Their strategies are drawn on in order to place the German, French and European AI strategies in a global context.

The European approaches to regulating AI should provide a framework for the Member States. The EU wants to promote common goals in Europe through programs and funding. National strategies in Member States such as Germany and France focus on concrete applications and the use of AI in their respective countries. Neither

the European nor the German and French AI strategy approaches exhibit any fundamental contradictions or diverging objectives. Rather, they intertwine at many points and complement each other to form a fairly homogeneous European overall picture, albeit one with occasionally different emphases; with the latter being due to the respective regulatory requirements and legal and institutional traditions. It is in this overall context that the further differentiation should be seen.

The strategies from Germany, France, and Europe share approaches either based on the European harmonized legal framework (GDPR, PSI Directive) or built on it, and use this framework as a guideline for their further action. In terms of transparency, Germany, France, and Europe have a fundamental need for cross-sectional regulation of AI.

In this context, the German AI strategy, with its approach for private or public bodies to monitor services and products that work with AI, offers a more concrete concept than that of the European strategy. The French AI strategy holds out the prospect of a publication obligation for algorithms developed by the public sector. In addition, all strategies are characterized by the guiding principle that the need for regulation must primarily be considered on a sector-specific basis. In contrast to the German federal government, the EU is placing greater emphasis on the aspect of liability rules for the use of AI and would like to address this within the framework of an amendment to the European Product Liability Directive.

A similar sector-specific approach to the regulation of AI can be found in the relevant US government documents. However, the USA is primarily relying on deregulation and market-driven approaches to achieve faster dissemination and application of AI. Although China's AI strategy cites industry as the central field of application, it is much more abstract in terms of the application areas. The data protection aspects play a very minor role. Rather, the Chinese strategy explicitly writes about Big Data and the merging of different data. The American documents mention the protection of privacy, but it is not positioned prominently, which may also be due to the legislative powers of the US government in this area. However, in the USA, approaches to protection against discrimination are certainly highlighted and addressed, which, conversely, may be mentioned in Chinese documents as a marginal note, but are not further concretized.


FIG. 28 Key aspects of AI strategies in the USA, China, and the EU

	DATA POLICY	TECHNOLOGY REGULATION	RESEARCH FUNDING	APPLICATION DEVELOPMENT & APPLICATION AREAS
USA				
CHINA				
EU				

Source: Arthur D. Little, eco e. V.

In addition to the legal standards in the area of data protection and access to public data, the strategies of Germany, France, and Europe demand access for AI in the realm of public data. The question of the extent to which this focus could help companies to develop high-quality services that are also based on user data is left open. What is certain is that AI systems based on such data will face regulation in the European legal area. Access to data held by or generated by the public sector is also highlighted in the relevant documents of the People's Republic of China and the USA. The approach taken by the USA is similar to the European and German approach. In contrast, the Chinese approach appears to focus on a large central data infrastructure that is designed as an open source platform for AI. This is intended to provide a basis for various applications and systems that can build on it.

The question of how people will interact with AI in the future, and the extent to which the use of AI can also become relevant to employment – and therefore needs to be regulated – is addressed by the European, German, and French AI strategies. In Germany, the issue is subject to more strict regulation due to the additional inclusion and participation rights of works councils. France is planning to reorganize its labor law under the auspices of AI. The People's Republic of China would like to play a determining role in this area, above all through the qualification and transparency of all those involved. In

the US documents, the role of employees and the shaping of the world of work are central aspects.

The European and national AI strategies of Germany and France all focus strongly on AI research and development. The differences in the field of research are mainly due to the fact that the German AI strategy identifies more application areas for research. This can also be observed in the area of application development: Here, the EU is pursuing a rather sectoral and abstract approach, while the AI strategy of the German federal government specifically identifies sectors and application areas that are to be developed. It is particularly noteworthy here that France, contrary to the German and European approach, explicitly states the military development of AI as an objective.

A positive point worth emphasizing is that the German and European AI strategies in particular want to support a more dialogue-oriented approach to standardization and the necessary dialogue with society as a whole. This is important to promote the acceptance of AI in society. The relevant French documents also indicate that the acceptance of AI plays a central role and that open approaches to solutions could be arrived at, for example through a joint platform of industry and science. Only if there is a societal consensus on the use of AI will politics and industry be able to use these technologies in Germany and Europe. The teaching of skills in dealing



with AI, which is also listed in the European strategies, is considered to be a central component for the success of the dialogue with society as a whole.

The opportunities for researching AI technologies are currently favorable. All actors considered here intend to allocate significant budgetary resources to AI research. The research funding projects in the EU, Germany, and the People's Republic of China do not focus exclusively on application-oriented projects – basic research is also to be simultaneously carried out and funded. In Germany and Europe, the focus is on theoretical basic research in particular. In the individual fields of application, this is then further described and, in some cases, restricted on the basis of legal regulation and ethical principles. Chinese basic research, on the other hand, is intended to increasingly work towards the Chinese AI platform, which the State Council has defined as an objective. In its "Summary of the 2018 White House Summit on AI," the USA mentions an explicitly market-driven approach to AI research.

In the area of application development, the Chinese objective seems to be most concretely defined. A clear focus is on industrial and robotic applications based on an open central platform on which the various services can be built. The more market-oriented strategies of the EU as well as Germany, France, and the USA are less precise at this point, although the French government's approach of a common "data platform" for business and science could turn out to be quite concrete. In addition, further approaches can also be found in Germany, France, and the EU, both with regard to the digitalization of administration (e-government) and the support and monitoring of economic developments, for example through the EU's "AI on Demand" platform. The close intertwining of the strategies is also underlined by the German-French AI agreement.

In particular, the handling of data protection could be a key feature of differentiation. Concrete approaches to data protection are currently not found in the Chinese AI strategy. The handling of data will therefore be subject to much fewer restrictions, which could, in particular, facilitate the handling and processing of personal data. Conversely, Germany and Europe, where consumer markets are also paying more attention to the issue, could benefit from data protection rules. Awareness of the importance of avoiding discrimination could be another factor that has a positive impact on AI investment in the European Economic Area. It remains open at this point as to what extent these developments will continue. The "Beijing Principles on AI" were published at the beginning of 2019 in China, which underlines that ethical aspects in the use of AI are also becoming increasingly important there.

6.5 Summary and outlook for AI regulation

In Europe, in the EU Member States, and in international comparison, political actors have recognized the groundbreaking importance of AI for positive societal and economic development. Political considerations and approaches focus on the handling of data, the relationship between people and technology, the responsibility of AI developers and operators, and meaningful promotion and further research into the topic. The strategic importance attached to the AI technology field and the technological competence in this segment is obvious. AI is regarded by all actors as an important economic and location factor.

Europe and the EU Member States are aiming to dissolve the previous bipolarity of an apparent US and Chinese dominance in this field of technology by means of a coordinated European approach and to set their own accents. Europe and the EU Member States have recognized the opportunities and potential of developing algorithms, AI systems, and applications according to high ethical and data protection standards as an original European strategic factor in the international context. However, the strategies apply a lower level of focus on the challenges for existing business models through disruption and AI and the societal dialogue concerning these challenges.

In order to develop the societal and economic potential of AI, a responsible data policy is needed that provides access to a high-quality database and also to public data. The EU, France, and Germany take a rather conservative approach in the economic context and discuss the use of AI against the background of their previous economic and industrial priorities.

Respect for human and civil rights plays a central role, as is usual in liberal democracies. Therefore, transparency, traceability, and trust in a reasonable and appropriate use of AI are of great importance. They are ultimately also decisive for their societal acceptance. This also includes examining and identifying potential effects on the labor market so that unintended impacts can be cushioned at an early stage.

In addition to basic research at universities and research institutions, transfer to industry is also important and must be encouraged. Political actors around the world face the challenge of providing a reliable and appropriate framework for the use of AI. This should be based on innovation-friendly and market-driven regulatory mechanisms and should support and encourage the use and testing of AI in different sectors of the economy.



7. AI in the eco Association: Topic Evaluation and Measures

AI is a key technology for tomorrow's digital markets, and at the same time an important interdisciplinary issue. As the largest association of the Internet industry in Europe, eco aims to promote the acceptance of AI by examining, discussing, and communicating organizational, technical, legal, and ethical issues. In its Guidelines for the Handling of Artificial Intelligence, eco calls for, among other things, AI to become a core competence of German industry.

Under the title Service-Meister, a consortium led by the eco Association is developing a platform that supports service processes with AI. The issue of security must be considered throughout, and there is a great need to use data collectively and establish fair mechanisms for this.

The value creation network around AI-based processes is becoming increasingly extensive and digital infrastructures are an essential part of this consideration. eco pools the competences for this and is a decisive support for industry in the use of digital services with and from the Internet.

7.1 A simple trick is what helps us get started



Harald A. Summa, CEO, eco – Association of the Internet Industry

How important is AI for our economy? A simple question to which there seems to be no easy answer. This may be because, on the one hand, the topic is so complex, so multi-layered, and visionary that not even experts would claim to have understood it. On the other hand, AI is also an issue that easily triggers opinions: Be it the opinion that the problems artificial intelligence is dealing with are only of interest to geeks – or, on the other side, that people will urgently need to search for pursuits that will still be relevant even after the singularity has occurred.

But it may also be quite simply due to the term. "Artificial intelligence": Who can visualize anything in response to this term? And who has the overview and the imagination to envision working in cooperation with artificial intelligence in their own place of work? I suspect that many cannot do this.

What might help us on the way is one simple trick: Let's talk about the objective rather than the tool. Let us simply replace the term "artificial intelligence" with terms with which we are all much more familiar, because they have been drivers of innovation and competition since the beginning of industrialization. Instead of talking about AI, let's talk about improving efficiency, minimizing



down time, and managing supply and value chains more precisely. Let's talk about automation.

So, about exactly those topics that are – thanks to intelligent technical solutions – already on the agenda in every company today, at least those that want to survive in the market tomorrow. How important is AI for the industry? Anyone asking this question must be prepared for many different opinions. But for anyone who asks about the importance for the economy of efficient and smooth operational processes, the unanimous answer will be: "They are indispensable."

Especially given that new data-based business models have been emerging for some time. And in these, the former product – a valve, a measuring device, a car or even the entire factory – is seen as the producer of a new raw material: data. Therein lies yet another new source of money.

Who will run this data-based business in the future? That's not settled yet. There is no guarantee that those who provide the hardware will get their hands on the data. But what is pretty certain is that anyone who does not appreciate the value of this data, or does not know what to do with it, will miss a great opportunity.

And one thing is definitely certain: Anyone who wants to make the most of this opportunity will be unable to avoid the new planning, control, efficiency, process optimization and automation possibilities that run under the term AI. AI is therefore not only already enormously important for our economy today – it's also continuing to get even more important.

7.2 Digital ethics in the AI era



Alexander Rabe, Managing Director, eco – Association of the Internet Industry

Unfortunately, the term "artificial intelligence" is, in public and political discussions, all too often associated with calls for regulations and prohibitions. This may among other things be due to the large number of dystopian science fiction novels and films produced in the last millennium, which certainly were not conducive to a positive connotation of the term. Since then, "THE" artificial intelligence has often been perceived as a danger to humanity and the "singularity" described as a future horror scenario and the next logical evolutionary step. Humanity becomes replaceable – laws are needed to prevent this from happening.

But does this attitude help Europe to position itself in the international competition for the brightest minds in AI development? Does this perspective encourage innovative entrepreneurial spirit for AI start-ups that, as game changers, are turning the international markets upside down? Hardly.

Anyone who wants to try out something new will therefore primarily be drawn to a culture that is more open to this new technology and also promotes it. In the meantime, the USA and China have, in global comparison, positioned themselves at the frontline in terms of AI promotion and are strengthening competition-friendly framework conditions in the field of AI development.

Europe has set out to catch up in the race for the best brains and the most innovative ideas and technologies. Alongside the provision of appropriate funding, in 2018/2019, the EU Member States also had ethical guidelines for dealing with AI formulated by an interdisciplinary committee of experts.



This is a good signal for all those who want to carry out research and found companies in this field in Germany and Europe.

Of course, decisions that can have significant consequences for the community or for individuals must not be left to algorithmic black boxes alone. But where exactly are the limits of such a classification? At what point must laws take effect and penalties be imposed? And at what points do we need other measures instead of rigid guidelines?

When dealing with new AI-based business models and technological approaches, we therefore need – before rigid regulations and laws are enacted – ethical lines of action, responsible users, informed and competent decision-makers in politics and business, and a target scenario for digital transformation.

Digital Germany 2040 and a completed European digital single market are ultimately such target scenarios.

Without these consensus goals, it is all the more difficult to formulate and adhere to ethical guidelines in the field of AI. Due to a lack of basic IT skills in large parts of Europe, however, digital literacy is de facto impossible to achieve. We still have whole cohorts of school and university graduates who complete their training without any basic understanding of IT and go on to become active players in business, science, society, and politics. This is where we have to start in order to enable ethical action in a digitally networked world in times of AI and to keep Germany and Europe competitive as a business location with sustainable digital innovations.

Then AI can also find a home in Germany and Europe.

7.3 AI and cyber security



Prof. Dr. Norbert Pohlmann, Board Member for IT Security, eco – Association of the Internet Industry

In the future, cyber security systems that actively use AI will help to detect significantly better intelligent hackers and their attacks, prevent damage, and minimize risks in the desired digitalization process.

Higher detection rate of attacks

With the help of AI, the detection rate of attacks in the network and in ubiquitous IT end devices (smartphones, laptops, servers, Internet of Things devices, etc.) can be significantly increased. In other words, the detection rates of IT systems that do not use any form of AI cannot be maintained at the same level of security and protection in the long term, when attackers are also using AI methods to attack IT systems.

AI thus has an increasing impact on the cyber security situation, which must be shown by current situation reports.

Support/relief of cyber security experts

A further major challenge for the defenders is the question of which of the very many recognized security-relevant events additionally require human analysts. Not all events can be processed by specialists, because the number of events pushes the processing ability and capacity of human analysts to their limits. Attackers can take advantage of this fact and distract the defenders in a targeted manner in order to penetrate the IT system unnoticed.

AI can help to analyze events in real time and to decide whether human intervention is still necessary. This can also compensate for the lack of cyber security experts. In other application scenarios, where partial autonomy is not technically possible and human involvement is mandatory, the use of AI can significantly support human tasks and activities. This will allow a more targeted use of existing resources and increase the overall level of cyber security. In this context, "situation-specific" means that



classical methods based on signatures are only used in a supporting role and new, behavior-based methods – such as advanced anomaly detection or predictive analysis – are being introduced. The use of AI makes such procedures possible and can bring about significant progress in cyber security.

Improvements to existing cyber security solutions

In addition, identity and access management systems benefit from the automatic evaluation of users' transaction data to ensure that only authorized users are granted access to IT systems and applications. However, the collection, processing, and storage of personal data must be in compliance with the provisions of data protection law (e.g. the General Data Protection Regulation (GDPR)). It should be noted that data protection compliance can represent an asymmetry in attack scenarios between defender and attacker.

Novel passive identification and authentication methods can make a contribution and result in increased resilience and robustness of IT systems. Due to the lack of active user interaction in this form of identification and authentication, for example by evaluating sensor data in smartphones, IT systems can be made more secure very easily. But also in the field of risk-based and adaptive authentication, AI will help to implement appropriate cyber security depending on the situation, thus significantly minimizing the damage. Other approaches in the field of AI and cyber security include the detection of malware, spam, and fake news as well as secure software development, IT forensics, threat intelligence, and many more.

Security and trustworthiness of AI applications

Apart from AI for cyber security, the security and trustworthiness of AI applications play a very important role for future success. Trust is understood as the subjective conviction of the correctness of a statement and of actions. Therefore, an AI system is considered trustworthy by users if it always behaves in the expected way for the intended purpose. This trustworthiness can be established in AI systems if the input data for the AI is of high quality for the specific application and if the IT application and the AI system used have been designed by AI and application experts and have been implemented in a tamper-proof and trustworthy manner. In addition, AI systems must allow results to be tracked and ethical principles to be respected. Trustworthiness will lead to a higher acceptance of AI. Therefore, security and trustworthiness of AI applications are an important area for the future success of AI.

7.4 AI in the new working world



Lucia Falkenberg, Chief People Officer, eco – Association of the Internet Industry

The use of AI in the new world of work is currently causing uncertainty and doubt in many places and raises many questions: Will a machine do my work in the future? Will decisions that are crucial for me, such as those concerning the allocation of work, soon be made by algorithms? And is human work becoming increasingly worthless? As justified as these worries are, fear and ignorance are the worst conceivable advisors, when more than ever the will to create and the striving for continuous development of one's own abilities are in demand.

One thing is certain at present: The world of work will undergo massive changes in the course of digitalization; work will not disappear, but change and lifelong learning will become a basic prerequisite for future professional success. It can be assumed that almost every job will be affected by digitalization and speculation about how many and which jobs will be lost in the future varies.

In fact, the world of work has not only been undergoing change since the Industrial Revolution, but has always been characterized by progress and constant change. Never before, however, has the potential to shape things been as great as in the digital world of work, and rarely before has it been possible – at least in the industrialized nations – to afford to discuss the value of work from an ethical point of view and against the background of economic prosperity. For example, a basic income is currently being considered as a starting point for societal participation, the courage to implement innovative entrepreneurial ideas, and a self-determined life.

Even pessimistic forecasts assume that digitalization will create a large number of new jobs, that completely new job profiles will develop and that digitalization will remain the most important job engine of the German economy. The task now is to create the framework conditions for



as many companies and their employees as possible to benefit from the economic potential of the digital working world and to make use of the existing scope for creativity.

Qualified specialists more important than ever

Digitalization offers great opportunities for a more flexible and efficient working world and will increasingly be able to integrate groups of applicants who previously had poorer conditions on the labor market due to physical limitations, cultural differences, or non-work obligations.

Demographic change alone is already causing a considerable shortage of skilled workers and is fueling the development towards an applicant market in which employers and employees meet at eye level and considerable efforts are made to attract suitable applicants to companies. The use of digital technology and AI is already taken for granted and desired by younger groups of applicants, because it eliminates physically demanding, repetitive, and meaningless activities in favor of creative and communicative tasks.

Thus, the use of AI already enables the analysis of large amounts of data and thus creates the prerequisites for valid decisions based on structured information – but the decision is made by humans.

A good example of this is algorithms that evaluate digital applicant data and ideally provide more unbiased results than the human colleague, unless the person who programmed the algorithm has transferred their own thought patterns. But who ultimately becomes part of the team is not decided by the AI or the increasingly popular recruiting chatbots, but by the future human colleagues.

The fact that this decision-making sovereignty will remain with humankind in the future is – in addition to the demand for maximum transparency – one of the core requirements of a working world determined by ethical standards and a sense of responsibility, in which AI is increasingly becoming the norm.

Efficiency and freedom in the AI-supported working environment

At the same time, digitalization enables people to work independently of time and place, thus creating new scope for a better work-life balance and a life-phase oriented organization of professional development. Algorithms complement and support human work and open up new possibilities for self-determined work, new types of employment models, and diverse career paths. The further development of the corporate culture towards agility,

flexibility, and participative models plays a decisive role in this process.

Continuous qualification as a basic requirement

The growing need for new skills such as programming and self-motivated learning ensures that the world of work is becoming more democratic and a new understanding of leadership is being established. Employees and employers jointly accept the challenge of reacting agilely to constantly changing markets. The striving of individuals to develop their own skills throughout life and the necessary continuous training are of immense importance.

Not only companies, but also politics and society are facing major challenges in this area. The requests to political decision-makers to adapt the legal provisions to the conditions of the digital working world, to facilitate the influx of urgently needed skilled workers, and to establish a national further training strategy are finally being heard. Their implementation is still taking too long. Especially the development of digital skills at all levels of the education system is increasingly determining the employability of German employees.

Shared responsibility in the digital working world

The topic of "corporate responsibility" is also becoming increasingly important in this context. In the future, it will encompass much more than the question of the psychological and physical integrity of employees and a cosmetic facet of employer attractiveness. The race for the most talented specialists will be won by those companies that are already looking closely into the question of what strategy and goals the use of AI should serve, what qualification requirements it entails, and how to give their own employees the greatest possible opportunity to participate.

The social partners and especially the trade unions are called upon to take up this challenge together, beyond outdated ideological trench warfare, and together to create the conditions for Germany to sensibly implement opportunities for innovation and to shape the digitalization of the world of work for the benefit of all concerned.



7.5 FAST.FORWARD.FUTURE – designing the Internet of the future with AI



Andreas Weiss, Head of Digital Business Models, eco – Association of the Internet Industry

The field of AI has changed a lot in recent years and has developed rapidly. Dynamic learning systems in particular are currently being used more and more frequently, opening up new areas of application that were previously unknown in this form.

AI-based applications and digital assistants are already part of everyday life for many people and have also found their way into the private sphere. These systems are used in homes, offices, but also in the automotive sector, with the aim of creating smart homes or smart buildings and enabling autonomous driving.

Nearly all future concepts are based on the collection of data and provision of AI functions and services via the Internet. A survey within the eco Association competence areas showed relevant functional areas for the use of AI. The Internet of Things and Industry 4.0 are growing ever closer together thanks to AI-based processes. Retailers, both stationary and online, are also intensively testing the new possibilities, especially with regard to target group-oriented communication. In all areas, risk minimization measures and the issue of security through AI are particularly relevant. In this context, the question also arises of how new value-added processes and business models can be developed with the help of AI.

AI and industry

We are now reaching the phase in which classic business models are being challenged by the digital services available via the Internet. In concrete terms, the eco Association is accompanying this change with the project Service-Meister, which was successful at the AI innovation competition of the German Federal Ministry for Economic Affairs and Energy (BMWi) and is now being implemented from 2020 to 2022 (www.servicemeister.org).

The cross-plant, cross-departmental, and cross-company service platform is tailored specifically to the challenges facing German SMEs. An important sub-goal is to enable less educated professionals to provide complex services with the help of digital guides such as AI-based service bots and smart services. The second sub-goal is a platform for digitalized service knowledge to enable cross-company scalability of services. This should create a service ecosystem that counteracts the shortage of skilled workers in Germany and make German SMEs competitive in the long term.

Specifically, the aim is to digitalize maintenance processes, keep systems available, and market internal service knowledge externally – all this with the use of processes from the AI sector to make innovations easily accessible to SMEs. Service-Meister will create an open AI platform for all maintenance processes. The project relies on tandems of application companies and implementation partners to develop AI functions.



The project under the leadership of the eco Association not only provides the industry with a decisive technology component for further digitalization; it also provides answers to the many questions that arise with regard to the opening market for services.



8. Conclusion

The aim of this study was to identify and assess the potential of AI for the German economy up until 2025.

The factual evidence allows just one conclusion to be drawn: AI offers a very high level of potential for the German economy. If AI is used on a nationwide basis, GDP growth of more than 13 percent between 2019 and 2025 is realistic. In addition, it offers the opportunity for established German companies to transfer domain-specific knowledge into the digital world and into AI, because the necessary data is available due to many years of industrial expertise, as well as the wide distribution of German machines, systems, and processes designed here. German companies can package these in AI applications for their own industry, based on their own competencies. This creates a new business model for the digital world.

However, potential is also always associated with risk. If Germany sleeps through the introduction of AI in all areas of the economy, we run the risk of being at a disadvantage compared to international competitors – and this applies not just to the core industries that are internationally important for Germany, such as Mechanical Engineering, Automotive, and Chemicals; but also to industries that affect the everyday life of all German citizens, such as Trade, Energy & Environment, and Transport.

We strongly recommend that companies in Germany act promptly, because the introduction of AI goes far beyond the introduction of a new technology. As our analysis of use cases shows, AI supports people first and foremost, and changes processes and value-added activities in a sustainable way. Strategic change is essential for companies: This ranges from the ten strategic forces of business model, customer interface, management, employees and culture, data and technology to a new system for performance measurement and performance metrics. This change cannot take place within two years in 2025, but requires structural interventions in the cornerstones of companies: People, vision, culture, and processes. This also includes the willingness to use data in a cooperative manner. The more data available, the better and more effective AI procedures will be.

Policy-makers and society are called upon to create suitable framework conditions and prerequisites for the successful introduction of AI. The principles of high level data protection must not be changed. Rather, it requires an active, reflected, and coordinated approach by policymakers to ensure that the AI ecosystem in Germany is

specifically promoted and further developed. The state has the opportunity to facilitate academia, innovation, and the taking of entrepreneurial risks in the field of AI.

The aim must be to expand today's ecosystem of academia and large corporations to include innovative start-ups and medium-sized companies and venture capitalists. This is the only way to ensure that innovations are tested and introduced across sectors and that Germany uses the next five years to ensure that in 2025 AI is present in all companies, in all sectors, and in all corporate functions.



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About eco

eco shapes the Internet

With more than 1,100 member companies from over 70 countries, eco is the largest association of the Internet industry in Europe. Since 1995, we have played a decisive role in shaping the Internet, fostering new technologies, creating framework conditions and representing the interests of our members in politics and in international bodies.

Together with our members, we are committed to a free, technology-neutral, network-neutral, and high-performance Internet. We thereby want to promote the security and reliability of the Internet as well as build trust in it. Our goal is to shape the digital transformation of society and the economy in the best possible way so that successful economic action can be brought to fruition on the basis of our democratic values. As the voice of the Internet industry, we assume social responsibility for ethically oriented digitalization.



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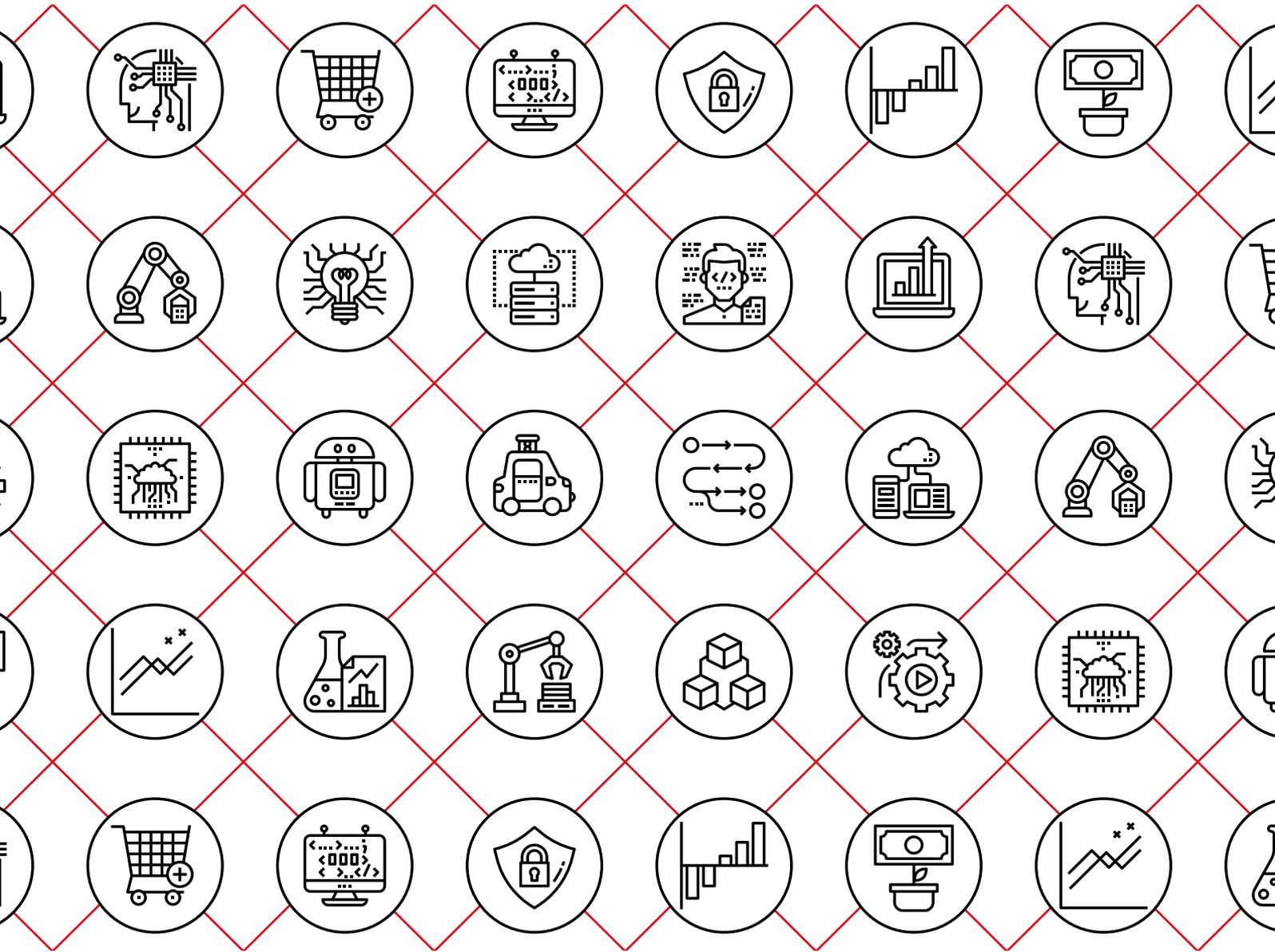
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