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Federal Ministry of Education and Research

Lernende Systeme
GERMANY'S PLATFORM FOR ARTIFICIAL INTELLIGENCE

Progress Report of Plattform Lernende Systeme

Designing Artificial Intelligence for the benefit of society

Potentials and challenges for the research and application of AI

About the Plattform Lernende Systeme

To design self-learning systems in the interest of society – this was the aim of Plattform Lernende Systeme, which was initiated in 2017 by the Federal Ministry of Education and Research (BMBF) at the suggestion of the Autonomous Systems Forum of the High-Tech Forum and acatech – National Academy of Science and Engineering. The platform bundles the existing expertise in the field of Artificial Intelligence and supports Germany's further path to becoming an internationally leading technology provider. The approximately 200 members of the platform are organized in working groups and a steering committee. They demonstrate the personal, social and economic benefits of self-learning systems and identify challenges and design options.

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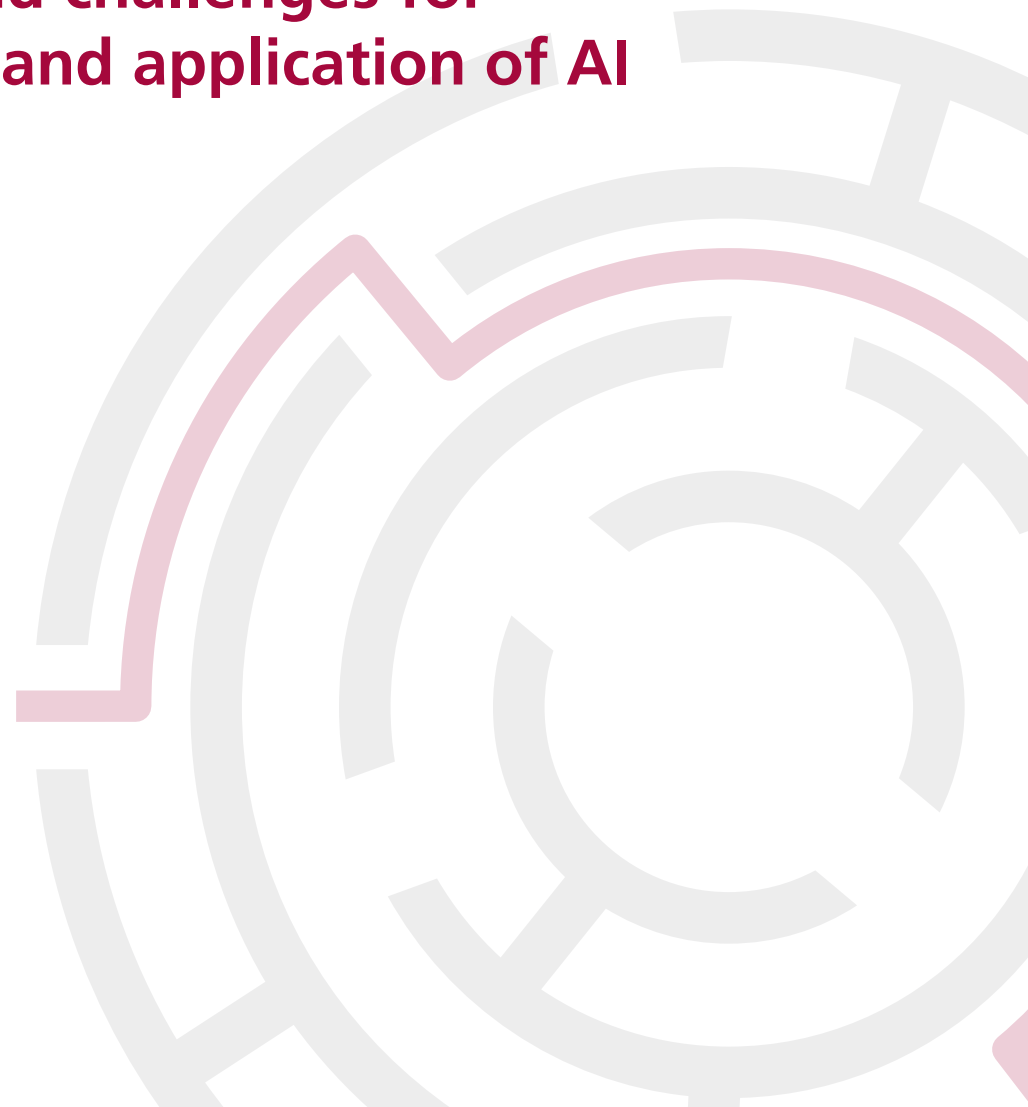
Potentials and challenges for the research and application of AI



Anja Karliczek
Federal Minister of Education and Research and Co-Chair of Plattform Lernende Systeme

The Corona pandemic confronts the world with unprecedented challenges. People in politics and science are in demand, as are doctors and nurses in the hospital, as well as employees in the supermarket or bus drivers. We need their intelligence, their competence, their resilience in the common fight against the pandemic. Artificial Intelligence can also make an important contribution, in containing the spread of COVID-19. It can help to rapidly diagnose diseases or find active agents against the pathogen.

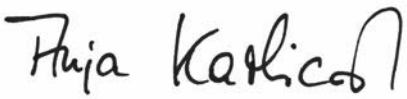
Back in November 2018, the German government adopted the Artificial Intelligence (AI) Strategy to massively promote research, development, and application of AI. We will now continue this strategy. In doing so, we want to respond to current developments, focus our measures and further expand the diverse research funding on AI – both at the cutting edge and across the board. We will further strengthen Germany's leading role in AI research based on our European values: for example, by promoting the AI centres of excellence as a unique research network or by supporting small and medium-sized enterprises for an immediate transfer into application.

Particularly important to us is our focus on the needs of people. For AI research, people must be at the center, it must reach and serve people. That's why the Federal Ministry of Education and Research launched the Plattform Lernende Systeme – the platform for Artificial Intelligence – in 2017. It promotes exchange between experts from science, industry, and civil society organizations. Questions of ethics, law and sustainability are to be discussed here just as much as technological innovations. After all, AI is intended to improve our lives, make our work easier and help and help us to use our creative potential for the common good.

With its diverse contributions, the Plattform Lernende Systeme illustrates the opportunities and challenges of AI in all its breadth: for example, the contribution that self-learning systems can make to healthcare or mobility, or how the introduction of AI in companies can succeed and open up new business models. Or how AI systems can be used reliably, trustworthily, and safely.

I would like to thank the members of Plattform Lernende Systeme for their work and their voluntary commitment.

I hope you enjoy and find inspiration in reading the progress report.



Member of the German Bundestag
Federal Ministry of Education and Research

Karl-Heinz Streibich
President of acatech – National Academy of Science and Engineering and Co-Chair of Plattform Lernende Systeme

Designing Artificial Intelligence for the benefit of society – with this claim, Plattform Lernende Systeme has been organizing exchanges between science, business, and civil society on this topic of the future since 2017. The focus is on the question of how we in Germany and Europe want to use Artificial Intelligence (AI) for the benefit of people.

AI technologies make an important contribution to ensuring the future viability of the economy and society in times of rapid technological developments. However, the relevance of new technologies only comes into play if people can assess the opportunities and risks so that they can accept and shape their use individually and socially. To this end, it is necessary to involve society in early and competent opinion-forming when shaping new fields of technology and to discuss the potential and risks of technologies in a balanced way.

In the course of this discourse, Plattform Lernende Systeme has repeatedly clarified in its contributions how AI can serve humans, for example, in the industrial environment, in education and training or in medical diagnostics, and how trust can arise from the responsible development and application of AI. This is associated with opportunities, challenges, and unanswered questions: For example, the use of AI can improve medical diagnoses, but a solid database is needed to train the AI systems. Patients, however, will only provide their information if they are convinced of the security of their personal data and the added value of medical AI applications for their health. Only through trust in and societal acceptance of AI technologies can the potential societal benefits be exploited safely and oriented toward the common good.

The current progress report summarizes the main topics addressed to date as well as the key results of the of Plattform Lernende Systeme. It also presents key areas of national and international AI research as well as practical application examples from various industries that show how AI can already support us in our everyday lives. How we use Artificial Intelligence and what changes we want to accept for it must continue to be discussed in a broad social dialog. Plattform Lernende Systeme will continue to provide impetus for the AI discourse in this regard. It will continue to highlight the personal, societal, and economic benefits of self-learning systems as well as the challenges that still exist and identify options for shaping AI. To all members of the platform, I would like to take this opportunity to express my sincere thanks to all members of the platform who have volunteered their time for this dialog.

We wish you an inspiring read!

President of acatech – National Academy of Science and Engineering

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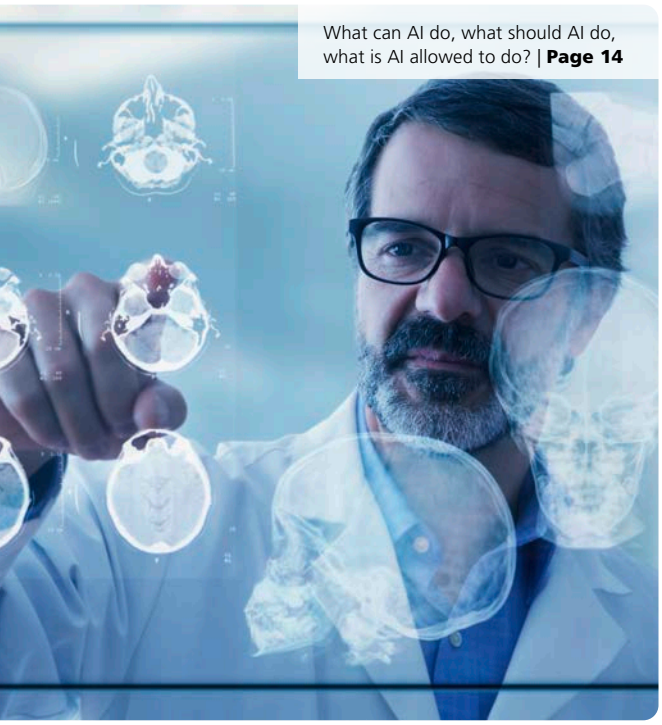
Exploring AI



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At the workshop with the management of the working groups in February 2020, the the main topics of the working groups were discussed. The results of the working groups | **Page 29**

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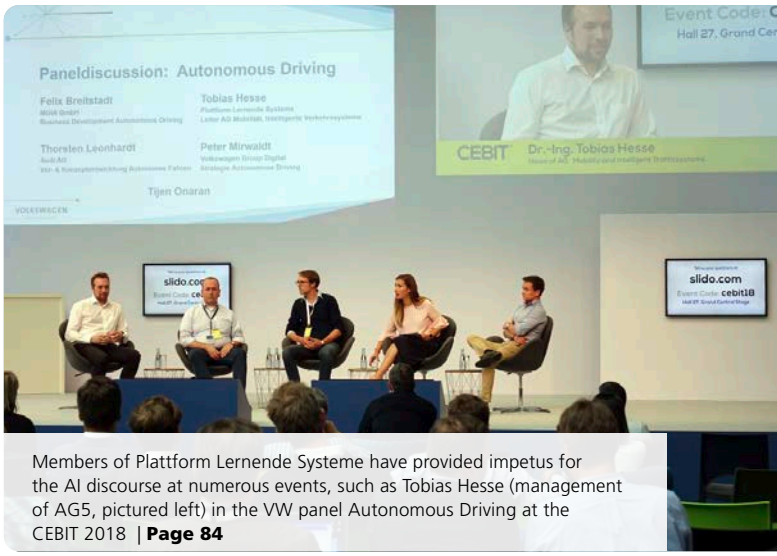


Members of Plattform Lernende Systeme have provided impetus for the AI discourse at numerous events, such as Tobias Hesse (management of AG5, pictured left) in the VW panel Autonomous Driving at the CEBIT 2018 | **Page 84**

I. Designing AI

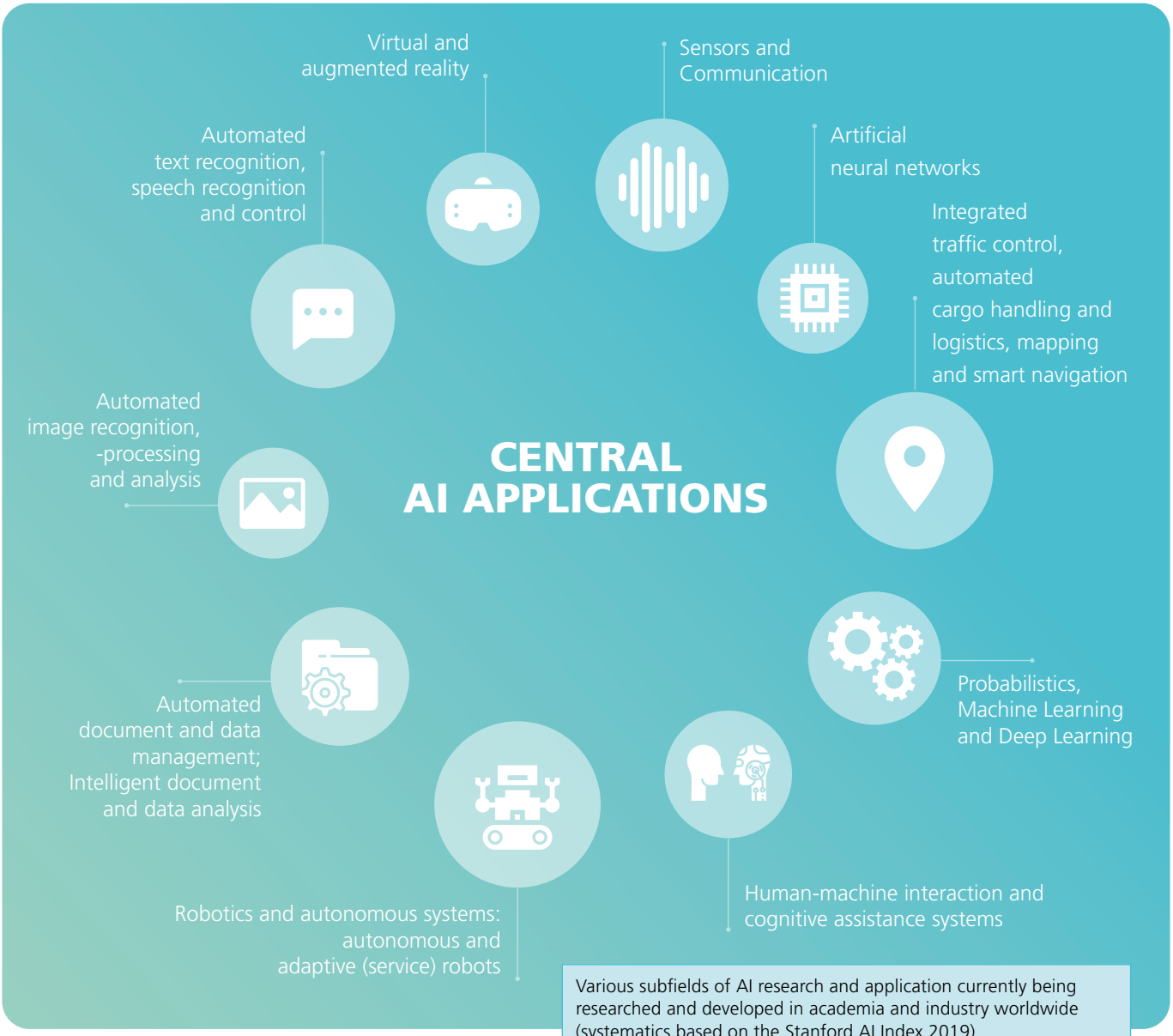
The contribution of Plattform Lernende Systeme to the socio-political AI discourse

What is Artificial Intelligence? Which subfields of AI research are currently being explored and translated into applications? Where do we come up against technical, ethical and legal limits with AI?

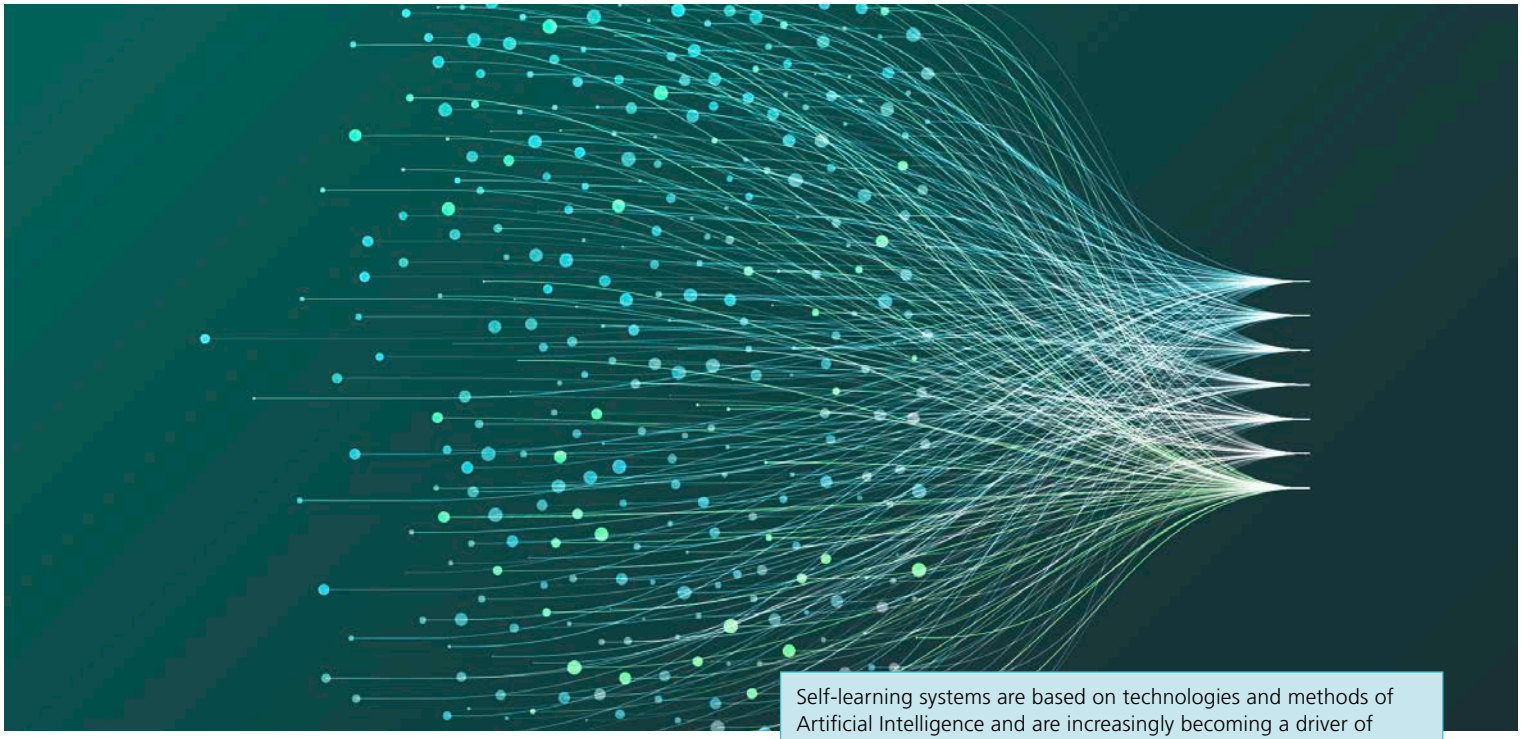
The chapter provides an overview of the central AI applications, of fundamental potentials and challenges in the research and application of AI systems, as well as of the topics, self-image and objectives of Plattform Lernende Systeme.

What can AI do? – Overview of central applications

AI as a colleague in industrial manufacturing and an assistant to doctors? Artificial Intelligence is the buzzword on everyone's lips. But what exactly can AI already do today, where are AI systems used and what for? The following is an overview of the most important AI applications currently being researched in science and industry worldwide.



Various subfields of AI research and application currently being researched and developed in academia and industry worldwide (systematics based on the Stanford AI Index 2019).



Self-learning systems are based on technologies and methods of Artificial Intelligence and are increasingly becoming a driver of digitalisation in business and society

Artificial Intelligence (AI) and Self-learning Systems

As a branch of computer science, Artificial Intelligence attempts to realise cognitive abilities such as learning, planning or problem solving in computer systems. At the same time, the term AI stands for systems whose capabilities generally presuppose human intelligence. Since the concept of intelligence is not clearly defined, however, the understanding of AI changes depending on the state of the art. The goal of research is to enable modern self-learning systems, such as machines, robots and software systems, to process and solve abstract tasks and problems independently, even under changed conditions, so that no human needs to programme an explicit solution path. With the help of self-learning procedures, such systems can continue to learn during operation: they improve the previously trained models, expand their knowledge base and their skills. All AI systems that can be technically implemented today enable problem solving in limited contexts (e.g. speech or image recognition) and thus belong to the so-called weak AI.

What are Self-learning systems?

Self-learning systems are increasingly becoming the driver of digitalisation in the economy and society. They are based on Artificial Intelligence technologies and methods in which great progress is currently being made in terms of their performance. Self-learning systems, such as robots and software systems in general, which independently complete abstractly described tasks based on data that serve them as a basis for learning, without each step being specifically programmed.

Self-learning systems are becoming more widespread and are increasingly supporting people in their work and everyday lives. They can help improve the quality of life in many areas, but also fundamentally change the interaction between humans and machines.

Opportunities and challenges of AI

The economic potential of self-learning systems is enormous: already today, completely new data-based business models are emerging in individual sectors that are drastically changing traditional value chains. This offers opportunities for new companies but can also become a threat to established market leaders if they do not react in time. The development of self-learning systems requires special key competencies. These must be developed in a targeted manner so that Germany can take on a pioneering role here. Decisive here is education and training in schools, universities, and companies. The use of self-learning systems also raises social, legal, ethical and security-related questions – for example with regard to data protection, liability and transparency. These challenges must be discussed at an early stage in a broad-based dialogue.

Plattform Lernende Systeme
Topics, self-image, and objectives

Topics of Plattform Lernende Systeme

Self-learning systems permeate all areas of our working world and our everyday lives. They can, for example, enable autonomous traffic systems and improved medical diagnostics or support rescue forces in disaster areas. They can help improve the quality of life in many areas. They solve given tasks independently and react to their environment. The relationship between man and machine is thus changing fundamentally – and must be designed in the interests of humans in all areas of application. Today, robots, assistance and software systems already handle complex problems and adapt to a wide variety of situations. Self-learning systems are based on Artificial Intelligence methods such as machine learning. These methods mark a paradigm shift: programmers no longer code every step of a system but self-learning methods. They teach machines to learn from data. As a result, self-learning systems recognise the structure of the environment, constantly expand their knowledge based on experience and can perform activities in a complex environment.

Plattform Lernende Systeme deals with a wide range of issues that arise around the development and use of AI

Technological Enablers and Data Science: Artificial Intelligence and data science are the basis of self-learning systems and a prerequisite for their design: from data collection and analysis to the development of key technologies.

IT Security: AI can make many processes more efficient, more convenient for humans and more secure. Provided the technology is reliable and robust against attacks and disruptions.

Work/Qualification, Human-Machine Interaction: Machines and digital devices have become companions in private and professional everyday life. Their design must focus on the benefits for people.

Law and Ethics: Like almost all technical innovations, self-learning systems raise new questions that need to be publicly discussed and framed in a legal framework.

Work and Skilling: Self-learning systems are changing the world of work profoundly: Artificial Intelligence will support and relieve humans in many areas in the future.

Business Models: Artificial Intelligence and self-learning systems process data into knowledge. Exponentially growing amounts of data can thus be made usable for products and services.

Members of the platform provide important impetus to current debates: Here, Jessica Heesen, co-head of the working group IT Security, Privacy, Legal and Ethical Framework, discussed in September 2020 at the Politische Akademie Tutzing on the challenges of digitalisation in in Corona times.

Self-conception of Plattform Lernende Systeme: Bundling knowledge, showing perspectives

The development and introduction of self-learning systems require special key competencies that must be built up in a targeted manner so that Germany can take on a pioneering role here. The use of self-learning systems also raises numerous social, legal, ethical and security-related questions – for example with regard to data protection or liability, but also responsibility and transparency. These questions must be discussed at an early stage in a broad-based dialogue. Designing Artificial Intelligence for the benefit of society – this is the aim of Plattform Lernende Systeme, which was initiated by the Federal Ministry of Education and Research (BMBF) in 2017 at the suggestion of the Expert Panel Autonomous System and acatech – National Academy of Science and Engineering. Germany is one of the pioneers in the fields of self-learning systems and Artificial Intelligence. The Plattform Lernende Systeme is intended to help design them for the benefit of individuals and society. Self-learning systems should improve people's quality of life, strengthen good work, ensure growth and prosperity, and promote the sustainability of the economy, transport, and energy supply.

The Plattform Lernende Systeme brings together expertise from science, business, and society to position Germany internationally as a technology leader for self-learning systems. It sees itself as a place of exchange and cooperation and supports Germany's further path to becoming an internationally leading technology provider. The work of Plattform Lernende Systeme is coordinated by a managing office based at acatech. A steering committee chaired by Federal Minister Anja Karliczek and acatech President Karl-Heinz Streibich decides on the strategic and content-related orientation of the platform. The Platform's approximately 200 members are organised in seven interdisciplinary and cross-sectoral working groups; these working groups form the core of the Platform. In the respective thematically specialised working groups, the members discuss the opportunities, challenges and framework conditions for the development and responsible use of self-learning systems. From the results, they derive scenarios, recommendations, design options or roadmaps.

Mobility: Tomorrow's mobility is characterised by self-learning systems of different kinds: modes of transport on land, on water and in the air are reaching ever higher levels of automation.

Medicine and Care: The intelligent linking of data promises great progress in medical research, diagnosis, and prevention. Important prerequisites are acceptance and security.

Hostile-to-Life Environments: The deep sea, outer space, contaminated environments, crisis zones: Self-learning systems can take on tasks in places that are dangerous, pose unreasonable hardship for humans or are harmful to their health.

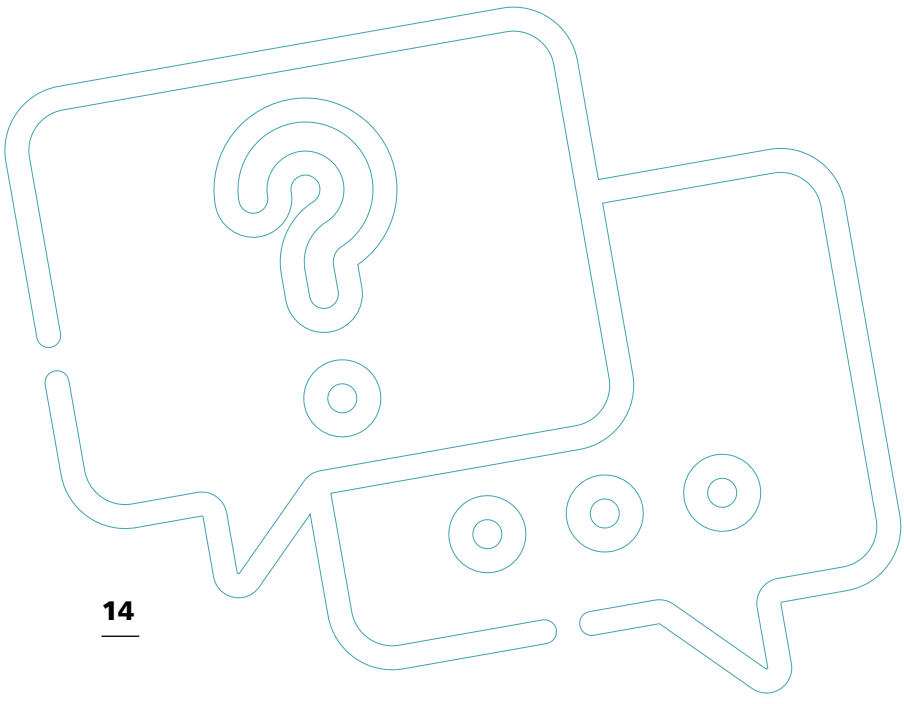
With its work, Plattform Lernende Systeme aims to

- shape in the sense of a good, just and responsible social coexistence,
- strengthen competences for the development and handling of self-learning systems,
- bundle different perspectives as an independent broker,
- promote social dialogue on the topic of Artificial Intelligence,
- develop target images and scenarios for the application of self-learning systems,
- stimulate cooperation in research and development.

Tanja Rückert and Wolfgang Wahlster

What can AI do, what should AI do, what is AI allowed to do?

Artificial Intelligence offers enormous potential for the personal and professional everyday life of many people. At the same time, technological innovation also presents our society with some challenges, for example regarding compliance with data protection regulations and human self-determination. **Tanja Rückert**, Head of the Building Technologies Division at Bosch, and **Wolfgang Wahlster**, Chief Executive Advisor (CEA) of the German Research Center for Artificial Intelligence (DFKI), discuss the current priorities in AI research as well as the scientific and economic potential of AI in this interview. The two members of the steering committee of Plattform Lernende Systeme also debate about ethical challenges of AI innovations and the importance of societal values as a basis for technology policy objectives.



Every day, new AI innovations are announced around the world: Where are the greatest technological leaps forward in AI currently taking place? Where do the boundaries (still) remain?

Wolfgang Wahlster: In recent years, the performance of automatic pattern recognition through machine learning, for example in speech recognition or image classification, has increased enormously. We now achieve recognition rates that are in the range we expect from humans. There are even individual classification tasks for which AI systems with multi-layer neural networks already deliver somewhat better results than experts, for example dentists in the recognition of caries on X-ray images. However, when it comes to purely statistical learning from mass data, there are also limits. Humans combine what they learn from data with the knowledge they have acquired in addition or during their education. In AI research, we therefore distinguish between model-free and model-based learning. AI research is currently working feverishly on hybrid systems in which proven model representations are combined with statistical learning results. In interactive learning, an additional attempt is made to have the learning AI system acquire the necessary domain knowledge in a targeted and task-specific manner in dialogue with a human subject matter expert. In the next generation of AI systems, it is no longer a matter of merely analysing data, but also of drawing conclusions from the data situation that ultimately lead to concrete action planning by the system.

AI can have a positive effects on our everyday life.

Tanja Rückert
Head of the Building Technologies Division at Bosch and member of the steering committee of Plattform Lernende Systeme

Tanja Rückert: First, AI means "learning". The more you feed computers with data, the more intelligent they become. However, when we feed our computers with images, we very often use the same images. In road traffic, for example, there are millions of images of cars. What is often missing, however, are special cases, for example construction machinery. One of the challenges for AI development is to ensure that, over time, the vehicles or means of transport that do not occur so frequently are also integrated into the AI systems that are to process this data. An important step towards this is for AI systems to learn using a combination of data

From the perspective of science and business, the use of AI, for instance in healthcare, promises great potential for the everyday lives of many people

from different sensors. By using data from different sensors and applying different algorithms, it is possible to ensure, for example, that special cases – and not just 80 percent of cases – are also recognised. The limits of AI also clearly lie in emotion, empathy, and social intelligence. There are a lot of research efforts on this, but overall, it is not yet usable.

Where do you see the greatest benefit of AI?

Wahlster: Most AI applications make social and economic sense. One example is the healthcare sector, because AI can already help there in practical work today. Medical staff currently spend too much of their working time documenting their own activities. Here, there are already initial AI approaches that digitally record all the individual work steps of doctors and nurses on an ongoing basis, so that they only must check and confirm the automated protocol. AI can thus relieve the medical and nursing staff, leaving more time for dialogue with the patient.

Rückert: AI systems can have positive effects on our everyday lives in many areas. They contribute to climate protection by enabling us to better regulate and reduce energy consumption for machines, to detect deviations in energy consumption more quickly or to dynamically adjust energy consumption between summer and winter. They can also better protect people from danger, for example through video-based fire detection, which we have developed at Bosch (see p. 66–67). The intelligent algorithm detects flames and smoke particularly quickly and reliably based on their physical behaviour. There are now numerous other practical examples: Whether it is the detection of wrong-way drivers in road traffic, the identification of parts on runways at the airport or the analysis of parking data. AI systems offer humans support in selecting holiday photos, voice recognition and music track recommendations. In many examples, which have become very commonplace, people often no longer even think that Artificial Intelligence is behind them, and it is increasingly accepted that these systems are part of everyday life.

Germany is considered one of the most important innovation locations worldwide: Are companies recognising the potential of AI for the German economy?

Wahlster: Overall, we see a certain sense of optimism in the German economy to actively design the second wave of digitalisation, which is characterised by AI. In Germany, we have weak points in the field of AI in the B2C sector, for example in the use of AI on platforms for online trade, which is dominated internationally by companies like Amazon or Alibaba. In my opinion, it is no longer worth investing intensively in this area because we can no longer catch up with the hyperscaler, at least on a global level. Therefore, we should concentrate economically and scientifically on our strengths. In Germany, these lie firstly in industrial AI – in other words, the use of AI for the next stage of Industry 4.0, for example in production control and planning as well as the use of robots and worker assistance systems. We are the global leader in this area and have a lead of two to three years over China and the USA. Secondly, Germany is also a leader in

intelligent business software, for example through companies like SAP or Software AG. They have invested a lot in AI, and their solutions are now being taken up by medium-sized companies. Thirdly, we are the world leader in collaborative robotics – that is, the development of robots that directly support humans in their work process and work hand in hand with employees or in teams (team robotics). Many large German corporations and medium-sized companies are now investing specifically in AI and some operate their own AI labs. One medium-sized company that could be mentioned here as an example is CEWE, a manufacturer of photo products, which also operates its own AI lab.

AI systems can help to reduce transport costs costs and make a contribution contribute to sustainable logistics.

Rückert: Many companies in Germany have recognised the potential of AI, but investments are very differentiated and not every company is getting into the new technology. There are certainly also SMEs that cannot afford to invest here now – the Covid 19 pandemic and its economic consequences are probably exacerbating this. It is therefore important to bring together precisely these small and medium-sized enterprises (SMEs) to evaluate where forces can be combined, or projects can be advanced together with larger corporations. Germany has a great strength in the Industry 4.0 environment and in analysing complex systems, so together we are naturally stronger. The Plattform Lernende Systeme certainly makes an important contribution to this coordinated approach – together with other initiatives of the Federal Government.

Is Germany setting the right course to exploit the potential of AI in research and development?

Wahlster: Yes, I think so, because it is very important in AI research to link it to the development of concrete applications. Therefore, tandem projects with industry must be conceived at the same time as basic research. In terms of financial support for AI research in Germany, we are also in a good position in international comparison. In the future, it would be conceivable that in government tenders – for example on the topic of urban mobility – the most innovative project, rather than the cheapest offer, would be awarded the contract. Procurement authorities in the USA and China already do this, and often innovative AI start-ups are awarded the contract. This requires more willingness on the part of the state to take risks now and then to quickly bring innovation into use, for example in the administrative sector or energy supply.

What about transfer and application? Are the right accents being set here?

Rückert: The regulatory framework in Germany and Europe must find a balance between promoting AI innovations and protecting people at the same time. In the national funding programmes for AI, it is important that the funding is used in a targeted manner and that, for example, the German strengths of the industry are supported in a targeted manner. These lie in the manufacture of complex physical products, the digital combination of machine and product data, and the establishment of ecosystems between start-ups, science, SMEs, and large-scale industry. Finally, when setting the political course, it must also be examined whether the various funding initiatives could be more closely coordinated with each other to bundle forces and use funding funds efficiently.

How can citizens be convinced of the benefits of AI? How can AI certification contribute to this?

Wahlster: The successful use of AI systems always requires the trust of people. We can only achieve this through self-explanatory systems that are able to make a decision proposal comprehensible. The ability to explain and the transparency of the AI systems are therefore quite decisive. In addition, the data used for learning must be free of

errors and bias and come from trustworthy sources. Since there is stricter product liability, certification of AI systems is important not only for customers, but also for the industry, so that they cannot be legally prosecuted for faulty systems. For this reason, the industry is also making great efforts to establish standards and norms that can then lead to the certification of AI products. In addition, whoever sets the standards in this area will later also dominate the market. That is why we are now the first country to have drawn up a standardisation roadmap for AI on behalf of the Federal Government.

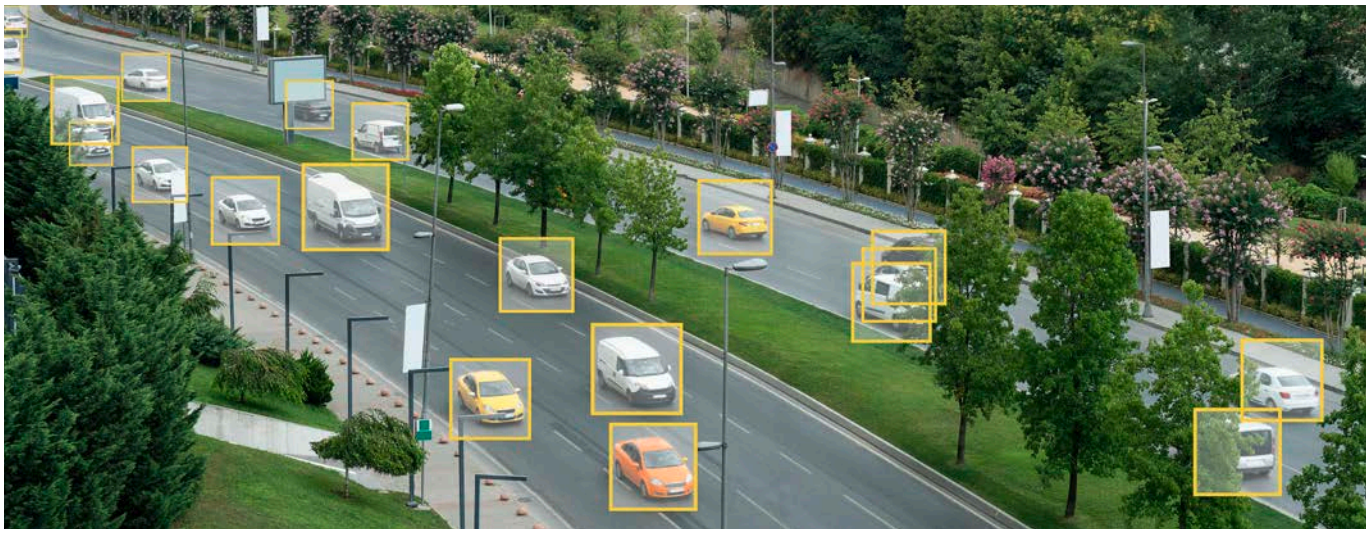
How do you evaluate the certification of AI from a company perspective?

Rückert: Each company must assess this individually. At Bosch, the topic of ethics and AI has a very high priority, and an AI code has been developed that defines guidelines. Every AI product must comply with these guidelines. In addition, certain legal requirements and ethical principles must be considered during product development: AI should serve humans as a tool. These guidelines have now also become part of the software development process. We thus combine a value-based approach with technical excellence – while the latter evolves, the value base remains the same. However, there is also a red line: Artificial Intelligence cannot weigh up the interests of individuals or groups.

> **Over-regulation would be wrong, as it makes no sense to certify every chatbot that recommends cooking recipes.**
>
> **Wolfgang Wahlster**
> CEA of the German Research Center for Artificial Intelligence and member of the steering committee of Plattform Lernende Systeme

Machines and robots have become useful supporters in research and and industry.

The mobility of tomorrow is characterised by self-learning systems of different kinds: transport modes are achieving ever increasingly higher levels of automation and vehicles are becoming more and more interconnected.



These red lines are currently drawn differently at different companies. At Bosch, we draw this line somewhat more conservatively and focus on quality and reliability.

Other companies interpret these red lines differently. Is there therefore a need for a binding AI seal to provide consumers with orientation regarding the safety of the systems?

Rückert: For the individual consumer, it helps, of course, to have a neutral body that provides guidelines that companies must follow when developing or manufacturing AI products. A working group within Plattform Lernende Systeme has also dealt with this topic and published an impulse paper on the certification of AI systems in spring 2020 (Heesen et al. 2020). It discusses in detail how the certification of AI systems can lead to more trust in this technology.

Wahlster: Civil society is calling for certificates for risky AI products and services. However, overregulation would be wrong because it makes no sense to certify every chatbot that recommends cooking recipes. But we must pay attention to red lines, and these are defined in Germany and Europe by common fundamental values. These include human dignity and self-determination. The various possible uses of AI can be classified in a risk pyramid: At the top of the pyramid are processes that are absolutely forbidden. These include, for example, brain-to-brain communication or the stimulation of a brain to make a human perform involuntary actions outside of a purely medical application. Autonomous weapon systems based on AI systems that select their own victims are also unethical according to our principles. At the bottom of the pyramid are applications such as the chatbots for cooking recipes. Here, regulation should be avoided as far as possible, as otherwise innovations are made more difficult. It is therefore necessary to assess risks to then arrive at an appropriate regulation that does not inhibit innovation.

How do the principles of AI development and use differ internationally?

Rückert: In an international comparison, Germany is certainly on the more conservative, risk-averse side when it comes to AI. In China, for example, it is much easier to get hold of data, which of course makes it easier for an AI to learn. In the US, too, the regulations – especially in the consumer sector – are not so tightly defined. That means we are certainly more critical here in Germany. Conversely, high standards of data protection and privacy for an AI "made in Germany" can become a unique selling point and seal of quality worldwide, if

the pendulum does not swing towards overregulation.

What contribution do initiatives like Plattform Lernende Systeme make to advancing AI research and application?

Rückert: The worst thing that can happen when it comes to AI is silos: industry pushes ahead, start-ups and science pull in different directions and politics tries to catch up. The ecosystem of industry, start-ups, science, and politics – as tedious as it sometimes is – is essential so that we can move forward with one voice on the topic of AI. Plattform Lernende Systeme – together with other initiatives of the Federal Government – makes an important contribution to this coordinated approach, as it brings together science, industry, and politics. Plattform Lernende Systeme can also make a major contribution to the acceptance of this technology and broaden the social debate on the topic of AI: We have very good publications with concise examples and the AI map illustrates the positive potential uses of Artificial Intelligence with more and more application examples. This creates trust among citizens.

Wahlster: I would like to underline that: The strength of Plattform Lernende Systeme lies in the mixed composition of members from politics, science, companies, and associations. I also find it very important that the Plattform Lernende Systeme tries to spread knowledge about AI broadly, especially among small and medium-sized enterprises, and also specifically supports solid training in AI for the general population with initiatives such as the AI Campus. We must continue to strengthen this, so that entrepreneurs and SMEs can also inform themselves about the topic of AI and receive support to successfully establish new AI-based solutions in the market.

ABOUT THE INTERVIEW PARTNERS |

Dr. Tanja Rückert is heading the Bosch Building Technologies division, a leading international company in the security and building technology sector, in the Bosch Group since August 2018. Prior, she worked for many years at SAP, where she was most recently responsible for the IoT & Digital Supply Chain division and thus for all SAP solutions in the areas of production, supply chain management, asset management, IoT and Industry 4.0. Tanja Rückert is a board member of the Munich Circle, she is a member of the University Council of the Karlsruhe University of Applied Sciences and a member of the steering committee of Plattform Lernende Systeme.

Prof. Dr. Dr. h.c. mult. Wolfgang Wahlster advises the German Research Centre for Artificial Intelligence (DFKI) – the world's largest research institution in this field with over 800 scientists – as Chief Executive Advisor. Until the beginning of 2019, he headed the DFKI and held the first German Chair for Artificial Intelligence (AI) in Germany for over 30 years. His work has received many awards, including the Future Prize of the Federal President, the Order of Merit of the Federal Republic of Germany and three honorary doctorates. Wolfgang Wahlster was President of the World Association and the European Association for AI. He was inducted onto the Wall and Hall of Fame as a pioneer of AI as well as into the Nobel Prize Academy and is a member of the steering committee of Plattform Lernende Systeme.

Plattform Lernende Systeme
Steering Committee

The executive steering committee decides the strategic and content-related focus of the platform and provides the impetus for its work. Its members from science, research and industry represent critical topics, disciplines, industries and businesses of various sizes in the field of self-learning systems. The members were appointed by the Federal Ministry of Education and Research (BMBF).

Anja Karliczek
Federal Minister of Education and Research

Karl Heinz Streibich
President of acatech – National Academy of Science and Engineering

Dirk Abendroth
Chief Technology Officer (CTO) at Continental Automotive

Holger Hanselka
President of the Karlsruhe Institute of Technology (KIT) and Vice President for the Research Field Energy of the Helmholtz Gemeinschaft

Jürgen Müller
Member of the Executive Board of SAP SE, Head of the devision Technology and Innovation

Frank Riemensperger
Chairman of the Accenture Country Group Germany, Austria, Switzerland

Regina Ammicht Quinn
Spokesperson of the International Center for Ethics in the Sciences and Humanities (IZEW) of the University of Tübingen

Ralf Klinkenberg
Founder and research director of the predictive analytics software provider RapidMiner GmbH

Reimund Neugebauer
President of the Fraunhofer-Gesellschaft e. V.

Tanja Rückert
Head of the division Bosch Building Technologies in the Bosch Group

Andreas Goppelt
Head of the Research & Development at Ottobock as Chief Technology Officer (CTO)

Hanna Köpcke
Founder of Webdata Solutions GmbH

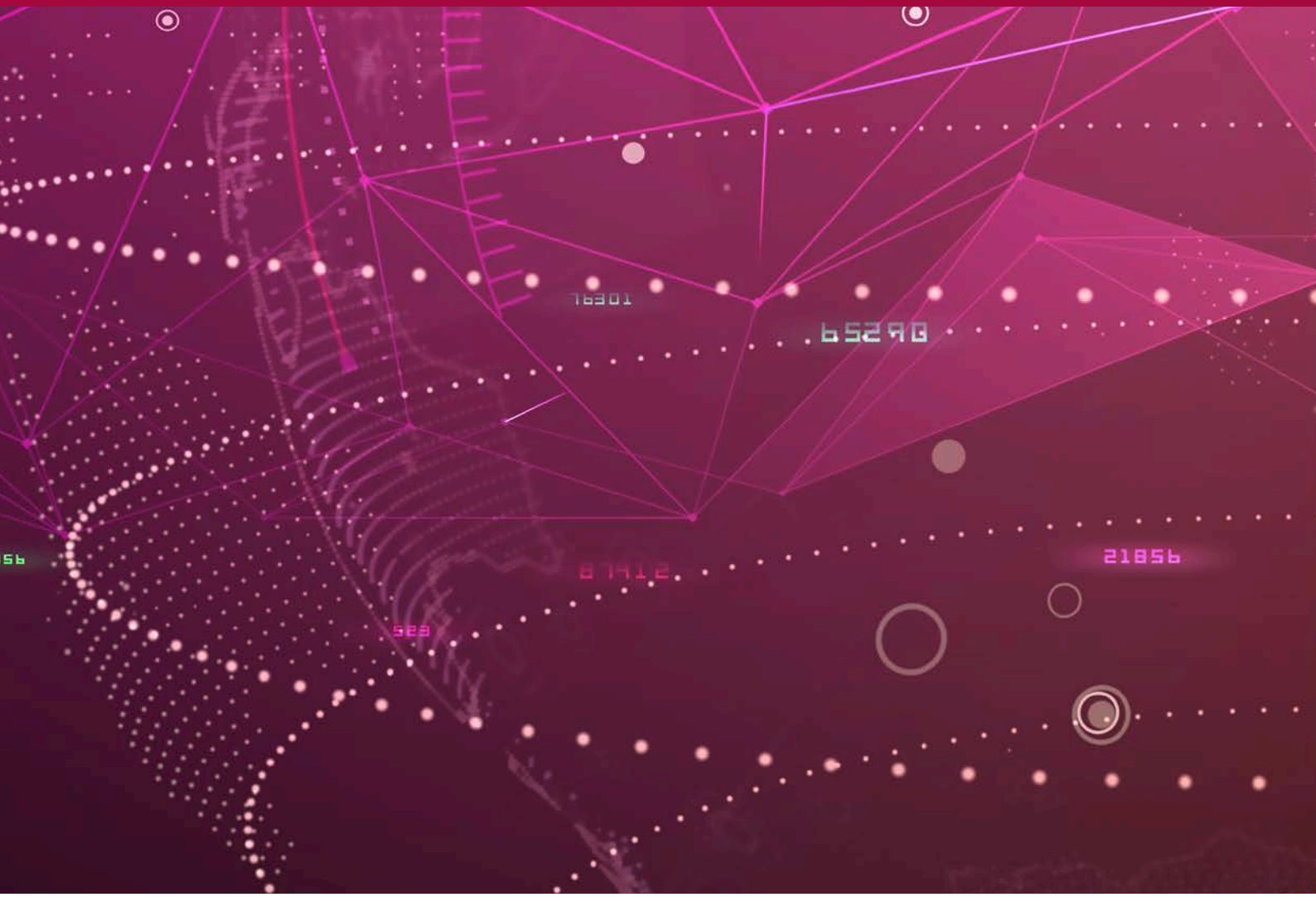
Reinhard Ploss
Chairman of the Management Board of Infineon Technologies AG

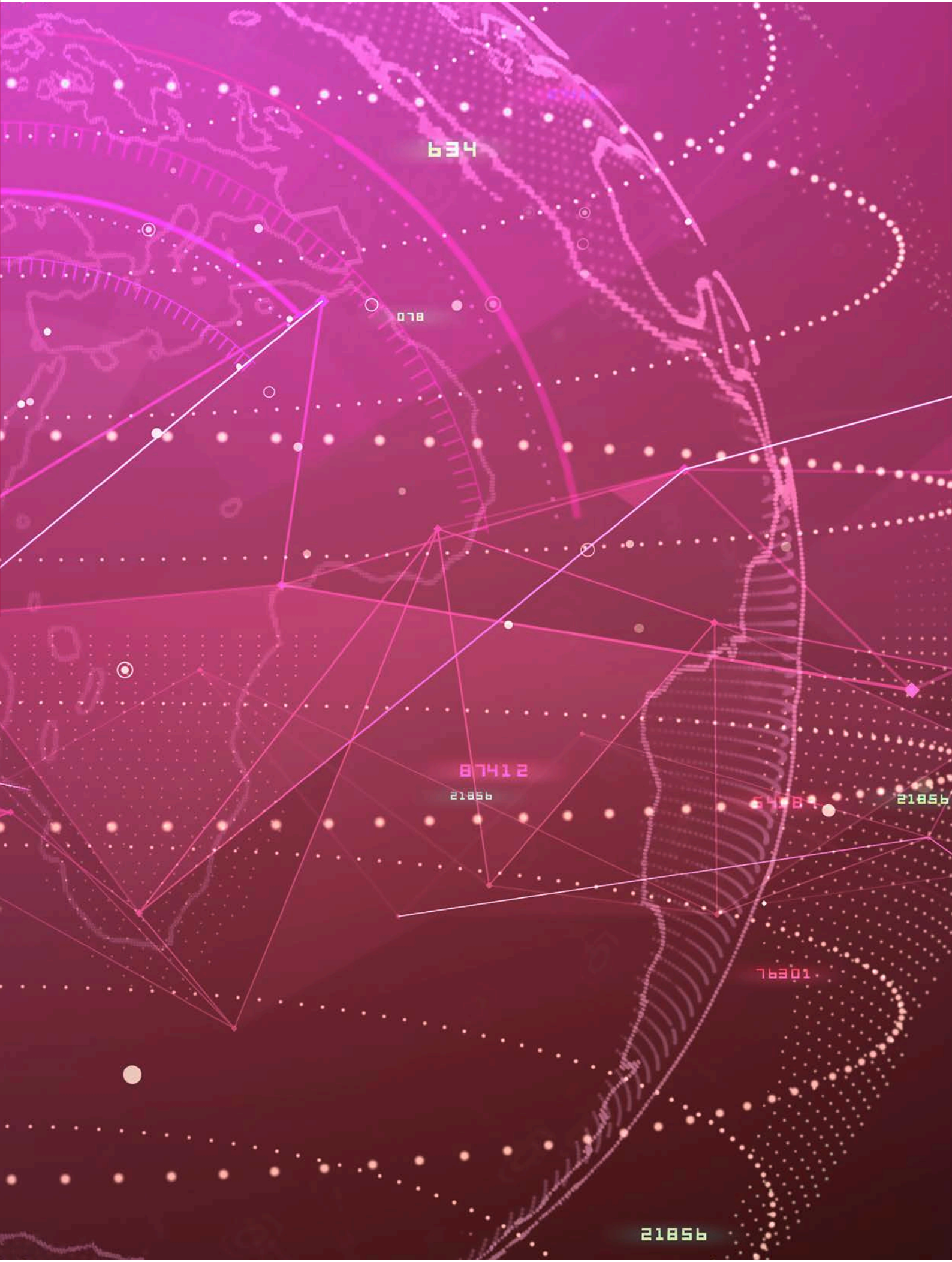
Wolfgang Wahlster
Chief Executive Advisor of the German Research Center for Artificial Intelligence (DFKI)

II. Exploring AI

National and international AI research and results of Plattform Lernende Systeme

Where are the focal points of current AI research and what differences exist regarding the various AI strategies in an international comparison? The chapter provides an overview of the central results of the various working groups of Plattform Lernende Systeme as well as the research focus and AI strategies in different countries.

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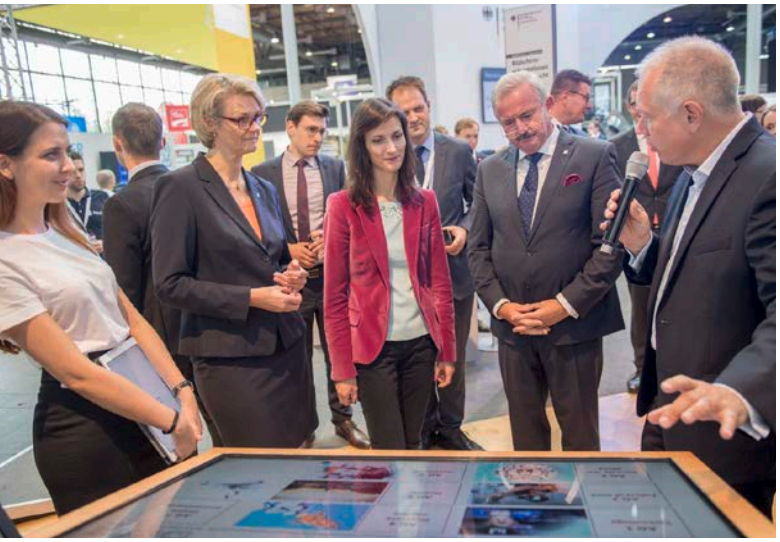
AI research in Germany
National Strategy for "AI Made in Germany"

AI is a **key technology** that promises great potential for **economic growth** and **productivity gains**. With the **national AI strategy**, the Federal Government wants to use the advances in the field of Artificial Intelligence for the **benefit of society**. At the same time, the goal is to make Germany a **leading location** for the **development and application** of AI technologies and to secure its global **competitiveness**.



EU Commissioner Mariya Gabriel (3rd from left), Anja Karliczek (Federal Minister of Research) (2nd from left), Reimund Neugebauer (2nd from right) and Frank Riemensperger (right in picture) (members of the steering committee) at the booth of Plattform Lernende Systeme at CEBIT 2018.

With its national AI strategy adopted in 2018, the Federal Government developed a framework for action and adopted measures to promote and utilise the potential of AI for the benefit of people and the environment in a responsible and public welfare-oriented manner. Following on from this, an update of the strategy was adopted by the cabinet in December 2020. The Federal Government's AI Strategy aims to establish "AI Made in Germany" as an international trademark for modern, safe, and public welfare-oriented AI applications based on the European canon of values. The update of the AI Strategy is a response to new developments and needs that have emerged since the publication of the AI Strategy 2018. Up to and including 2025, the federal government's investments in AI will be increased from three to five billion euros using funds from the economic stimulus and future packages. This is also intended to strengthen Germany in the fight against the COVID 19 pandemic and lay important foundations for competitiveness after the crisis.

The national AI strategy focuses on the areas of research, transfer, social dialogue, technology assessment, qualification, and data availability. Particular emphasis is placed on the transfer from research to practice and on social dialogue. In the update of the AI Strategy, the focus is on the fields of action research, minds and expertise, transfer and application, regulatory framework, and society. In terms of content,

Presentation and handover of new platform publications by the working group leaders at the Annual Conference of Plattform Lernende Systeme 2019 to the co-chairs of the platform, Anja Karliczek, Federal Minister of Education and Research, and Karl-Heinz Streibich, President of acatech – National Academy of Science and Engineering (center).

the areas of sustainability, environmental and climate protection, pandemic control, and international and European networking will be at the centre of new initiatives in the future.

For an "AI Made in Europe", constant networking at European and international level is being strived for. Based on common European values, the exchange and cooperation with other countries should be further expanded. This includes, for example, Franco-German cooperation in AI research, for which a joint AI roadmap was signed in 2019.

Political goals

Starting from a good research base, Germany is to become a leading global location for the research, development, and application of Artificial Intelligence.

- Technological leadership and "AI Made in Germany" quality seal
- Germany and Europe are to become leading AI locations and thus contribute to securing future competitiveness
- Responsible and public good-oriented development and use of AI
- Broad social dialogue and active policy shaping

Guest contribution by Katharina Morik

Status quo of AI research in Germany

What is our current position with AI research in international comparison and how can Germany move forward in the global race for technology leadership in Artificial Intelligence? **Katharina Morik**, Professor of Artificial Intelligence at TU Dortmund University, and member of Plattform Lernende Systeme, coordinates the cooperation of the AI competence centres in Germany and France on the German side. The guest contribution shows where the focus of German AI research currently lies and illustrates why Germany and France need to join forces in AI research.

The objective of AI research must always be the implementation in practical AI applications.

German AI research – especially basic research – is broadly positioned overall, even by international standards. This is reflected in the fact that very many different subfields of AI are taught and researched at German universities. Therefore, Germany is also well positioned in the field of AI in an international comparison: according to SCIMAGOjr (SCI-mago Journal Rank), Germany was ranked 6th in a country comparison for the number of AI publications, both on average from 1996– 2018 and alone in 2018. In terms of the number of citations, Germany was even ranked 3rd after the USA and UK. Although there was early work on machine learning (ML) in Berlin and St. Augustin (Morik, Wrobel, Kietz & Emde 1993), which addressed knowledge- and data-based modelling in interaction, German AI research initially focused on classical problem solving. In the meantime, the special importance of machine learning is generally recognised. On the one hand, intelligence without the ability to learn is inconceivable; on the other hand, scientific and economic data of all kinds cannot be utilised without curation, learning pre-processing and analyses. Machine learning optimises many different systems, for example in production, traffic coordination, logistics or healthcare. Moreover, ML is the driving force behind many AI applications in research, for example in physics, medicine, or agricultural science.

As early as 1988, the Federal Ministry of Education and Research (BMBF) set a visible focus in AI research with the establishment of the German Research Centre for Artificial Intelligence (DFKI). Together with the research institutes of the Fraunhofer-Gesellschaft, the Max Planck Society and the Leibniz and Helmholz Associations, Germany has a powerful science and research landscape in the field of AI that is closely linked to industry through participation

and cooperation. Thanks to the sustained funding of these institutions, German research was able to take a leading position early on. Collaborative Research Centres of the German Research Foundation (DFG) also offer AI scientists a longer-term perspective, bring together many PhD students through concerted projects and integrated Research Training Groups, and thus lead to outstanding research. Start-ups such as DeepL (see p. 70–71) or RapidMiner show how short the path from research to successful practice can be.

Expansion of training programmes and research competence

Teaching and training at universities and colleges has a crucial role to play in promoting AI research and competence. Professors not only train the next generation of scientists, but also those who use AI in companies and the teachers and trainers who pass on AI knowledge. The need for experts with knowledge and skills in the field of machine learning is considerable in science and business. Therefore, the further development and expansion of training programmes is necessary at all levels, from schools to vocational training, universities of applied sciences and universities.

In November 2018, the German government adopted the Artificial Intelligence Strategy to make Germany and Europe a leading location for the development and application of AI technologies and to secure Germany's future competitiveness (see p. 24–25). However, since there were only a few professorships for machine learning in Germany and a certain number of researchers in one place is a condition for scientific progress, the idea arose to bundle and expand competence in some places. Such competence centres should radiate into the surrounding area, cooperate with other universities, universities of applied sciences and companies, network with each other and train young researchers. The Federal Ministry of Education and Research has established five competence centres in the field of Big Data and Machine Learning, namely in Berlin, Munich, Dresden/Leipzig, Tübingen and Dortmund/Bonn, in addition to the German Research Centre for AI[1], which has existed since 1988. Originally, around 64 million euros were earmarked for funding from 2019 to 2022. Federal Minister Anja Karliczek, co-chair of Plattform Lernende Systeme, announced that funding for the competence centres would be doubled. At the competence centres, the cooperation of a critical mass of excellent scientists is to be achieved so that these centres are also internationally attractive. It is important to expand research and teaching capacity, i.e. to establish professorships. The development work of the competence centres serves the goal of establishing machine learning at almost all universities and colleges in the long term, as has already been achieved for classical AI with its many subfields. Visiting national and international scientists, summer schools and networking events involve many and promote the community of researchers. Each centre has a transfer environment of application areas and companies, start-ups,

The need for experts with knowledge and skills in machine learning is significant in science and industry.

Katharina Morik
Professor of Artificial Intelligence, Technical University Dortmund, and Co-Head of the working group Technological Enabler and Data Science

1 The German AI competence centers include: Berlin Institute for the Foundations of Learning and Data (BIFOLD), Tübingen AI Center – Competence Center for Machine Learning, MCML – Munich Center for Machine Learning, ML2R – Competence Center Machine Learning Rhine-Ruhr, ScaDS.AI – Competence Center for Scalable Data Services and Solutions Dresden/Leipzig, German Research Center for Artificial Intelligence (DFKI).

and small research institutes, so that the ecosystem of application and development is also promoted. In addition, the competence centres network with each other.

Objectives of Franco-German research cooperation

Science is always international and so German researchers are involved in the international research community. The European Conference on Machine Learning (ECML) was shaped from a Franco-German cooperation into one of the most important conferences within the discipline. There is a tradition of cooperation in the Franco-German border area, such as the Franco-German University in Saarbrücken or the agreement between DFKI and the French National Institute for Information Technology (INRIA). When it comes to national AI strategies, Germany and France share the same goals: AI should support people as well as achieve a sustainable economy in Europe. This requires strong research that quickly transfers the results from science into practice. The joint AI roadmap ("Toulouse Declaration"), which France and Germany signed in October 2019 for stronger cooperation on the topic of AI, envisages the establishment of a joint AI ecosystem, as well as intensifying existing research collaborations and realising new cooperation projects. In the meantime, we are shaping close cooperation with France here, also through the AI competence centres in the two countries. Activities include the exchange of scientists, the discussion of curricula in AI and data science as well as joint efforts for transfer into applications and support for suitable computing capacity. Stronger networking between German and French economic actors is also planned. Furthermore, the roadmap announces a joint approach to a secure, sovereign infrastructure for data storage and exchange, a coordinated approach to AI standardisation, a joint approach to legal issues on AI, and a discourse on leapfrog innovation projects.

Outlook: Further investment in cutting-edge research needed

With regard to further research into AI technology, Germany faces the challenge of developing trustworthy and people-oriented AI research that combines basic research with solid transfer into practice – this is considered a special profile of European AI research and can become a competitive advantage (see pp. 56–59). In order to compete with China and the USA, however, we must not stop at temporary project funding, but rather invest in research, teaching and training in Artificial Intelligence in the European countries in a sustainable and coordinated manner. AI research requires a critical mass of excellent scientists in one place. For this reason, it is important for the further expansion of AI research in Germany that important research centres are further developed that are internationally attractive and can radiate to educational institutions and business enterprises in the surrounding area. AI research as an achievement of individuals is no longer purposeful.

ABOUT THE AUTHOR |

Prof. Dr. Katharina Morik holds the Chair of Artificial Intelligence at TU Dortmund University, which she established in 1991, with a focus on machine learning. She is the spokesperson of the Collaborative Research Center "Information Retrieval by Analysis under Resource Constraints" and heads the Competence Center for Machine Learning Rhine-Ruhr (ML2R), which was established in August 2018, together with Prof. Dr. Stefan Wrobel. She also coordinates the German AI competence centers and their collaboration with French partners. She is a Fellow of the German Informatics Society, a member of the Academy of Science and Engineering and the North Rhine-Westphalian Academy of Sciences and Arts. She is co-head of the working group Technological Enablers and Data Science at Plattform Lernende Systeme.

Plattform Lernende Systeme
Results and main topics of the working groups

Self-learning systems are the next step in digitalisation. They solve predefined tasks independently and react to their environment. For society and the economy this promises a great deal of potential.

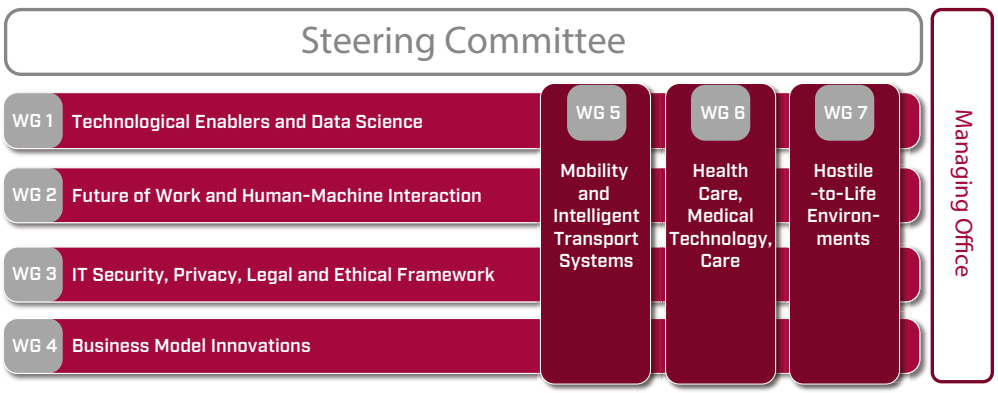
The members of Plattform Lernende Systeme from science, business and society develop discussion papers, application scenarios, guidelines, and recommendations for action. In doing so, the working groups illustrate the potential benefits that self-learning systems promise for people and society by means of concrete and everyday application scenarios. They also identify open questions and challenges as well as technical, legal, and ethical limits associated with the use of Artificial Intelligence. The individual working groups regularly exchange views on it and thus combine their thematic expertise. In joint positions, they identify needs for action, present roadmaps and derive recommendations for action as well as goals for the implementation of self-learning systems – for example, regarding research, technology development and legal and social framework conditions.

Four working groups deal with technological, economic, and social cross-cutting issues that affect all applications of self-learning systems:

- Technological Enablers and Data Science
- Future of Work and Human-Machine Interaction
- IT Security, Privacy, Legal and Ethical Framework
- Business Model Innovations

Three further working groups are investigating concrete fields of application for self-learning systems and are developing scenarios for the application and design of Artificial Intelligence in different fields of application:

- Mobility and Intelligent Transport Systems
- Health Care, Medical Technology, Care
- Hostile-to-Life Environments



Plattform Lernende Systeme
The seven working groups

Seven interdisciplinary and cross-sectoral working groups (WG) form the core of Plattform Lernende Systeme. Around 200 experts (for an overview of members, see pp. 92–96) from science, companies of various sizes, politics and civil society discuss technological, economic, and social issues associated with the development and introduction of learning systems and Artificial Intelligence in a regular exchange. They present their results to the public together with recommendations for implementation.

Working Group 1

Katharina Morik
Chairholder for Artificial Intelligence at TU Dortmund University, coordinator of the German AI Competence Centers and their cooperation with French partners

Volker Markl
Head of the Department of Database Systems and Information Management (DIMA) at the TU Berlin and Co-Director of the Berlin Institute for the Foundations of Learning and Data (BIFOLD)

Technological Enablers and Data Science

Working Group 2

Elisabeth André
Chairholder for Human-Centered Artificial Intelligence at the Institue of Computer Science at Universität Augsburg

Wilhelm Bauer
Managing Director of the Fraunhofer Institute for Industrial Engineering IAO, Stuttgart

Future of Work and Human-Machine Interaction

Working Group 3

Jessica Heesen
Head of the research focus Media Ethics and Information Ethics at the International Center for Ethics in the Sciences and Humanities (IZEW) at University of Tübingen

Jörn Müller-Quade
Chair of Cryptography and Security at the Karlsruhe Institute of Technology (KIT) and Director at the Karlsruhe Research Center for Computer Science (FZI)

IT Security, Privacy, Legal and Ethical Framework

Working Group 4

Susanne Boll-Westermann
Professor for Media Informatics and Multimedia Systems at the Carl von Ossietzky University Oldenburg and member of the board of the Oldenburg Institute for Computer Science (OFFIS)

Wolfgang Faisst
Co-Founder and CEO of Value-Works GmbH; Prior, head of S/4 Next – Next Generation Business Processes & Practices at SAP SE

Business Model Innovations

Working Group 6

Karsten Hiltawsky
Head of the Technology and Intellectual Property at Drägerwerk AG & Co. KGaA

Klemens Budde
Senior Physician of the Medical Clinic with focus on Nephrology and Internal Intensive Care Medicine at the Charité University Medicine Berlin

Health Care, Medical Technology, Care

Working Group 5

Tobias Hesse
Head of Department Function Development of Vehicles and Systems at German Aerospace Center (DLR)

Christoph Peylo
Head of the Bosch Center for Artificial Intelligence (BCAI) with locations in in Palo Alto, Bangalore and Renningen near Stuttgart

Mobility and Intelligent Transport Systems

Working Group 7

Jürgen Beyerer
Professor at the Chair for Interactive Real-Time Systems at the Faculty of Computer Science at the Karlsruhe Institute of Technology (KIT) and Director of the Fraunhofer Institute of Optronics, System Technologies and Image Exploitation IOSB in Karlsruhe

Frank Kirchner
Chair of Robotics at the University of Bremen, Scientific Director of the Robotics Innovation Center at the Bremen location of the German Research Center for Artificial Intelligence (DFKI)

Hostile-to-Life Environments

Working group 1

Technological Enablers and Data Sciencee

Machine learning and **data science** are considered the foundation of the digital transformation. In many areas of science and business, they have become a decisive factor for competition. The working group deals with the **technological foundations** and enablers of Artificial Intelligence. This involves, for example, the requirements for research, the training of AI specialists or the **transfer** of research results into successful **applications**. The working group assumes a cross-sectional function within Plattform Lernende Systeme and provides impulses to all other working groups.

The working group is mainly concerned with three main topics: research, education, and knowledge transfer. The research topic focuses on identifying the most important research fields regarding Artificial Intelligence, machine learning and data science and what potential these research fields have for disruptive applications. Excellent higher education and continuing education programmes are central to being able to maintain a strong position in the various research fields in the future and to be able to meet the demand for AI expertise in the economy and society with highly qualified specialists. For this reason, the working group is also dedicated to the topic of training researchers and specialists in machine learning and data science at universities. To transfer knowledge on Artificial Intelligence and data science from research to application, strategies and measures for knowledge transfer are necessary. In this context, it is important to determine which competences are in demand in the application and which competences are necessary to further advance machine learning. In addition, obstacles, and success factors for a fast and successful application of machine learning and data science should be identified. The central guiding questions of the working group include:

- What are the most important fields of research in Artificial Intelligence, machine learning and data science? What potential do they have for disruptive applications?
- What are the strengths and weaknesses of AI research in Germany?
- How can the training of researchers and specialists in machine learning and data science at universities be further improved?
- What skills from AI research are in demand in application?
- What factors favour or inhibit the rapid and successful application of machine learning and data science?
- What will be the enablers of self-learning systems in the future and what competences will be needed?

Much of the challenge and cost is in the processing of data, e.g., in the preparation of training data or the or the management of the learned models – also regarding reproducibility, traceability and transparency. The technologies along the data value chain (information extraction, integration, model building, scalable data management) are therefore an important enabler for self-learning systems.

Volker Markl
Head of the Department of Database Systems and Information Management at the TU Berlin, co-director of the Berlin Big Data Center and co-head of the working group

Results and contribution of the working group

Artificial Intelligence offers enormous potential benefits to improve our everyday lives and strengthen Germany as a business location. To exploit this potential, high-quality education of future AI specialists is just as necessary as a strong AI infrastructure and AI research. With its activities and publications to date, the working group has been able to make a valuable contribution to the discussion on how AI can be advanced in Germany. With the white paper "Machine and Deep Learning", the working group has created a broad overview of the fields of expertise that should be strengthened in order to advance machine learning as a branch of research, but also to bring AI into application. For example, research with a view to hardware – such as AI accelerators – should be further promoted, as should expertise in the fundamentals of machine learning and in various subfields of deep learning. However, the discussion about AI often loses sight of the fact that data management is a foundation for AI because data must first be made accessible for analysis. → P. 34

The lack of AI experts is seen as an obstacle to bringing AI into use. High-quality education and training in colleges and universities is essential here. The German Informatics Society (GI), in cooperation with Plattform Lernende Systeme, has compiled recommendations for teaching and training content for data science degree programmes and continuing education in a working paper. In doing so, different study programme and further education variants were addressed to consider the different personal backgrounds of those interested in education and further education. → P. 34

The certification of AI systems is considered a key prerequisite for advancing the use of AI systems in various economic and life areas such as health or in companies. Together with the working group IT Security, Privacy, Legal and Ethical Framework, the working group has published an impulse paper on the certification of AI systems. → P. 41

Together with the working group IT Security, Privacy, Legal and Ethical Framework, the working group continued to coordinate the cross-working group activities on the topic of certification. A white paper by both working groups discussed the question of how the certification of AI systems can succeed.

Outlook: future issues

In the future, the working group will deal intensively with the conditions for the transfer of AI knowledge into practice, define situation descriptions for the individual conditions and work out design options on this basis. The focus will be on the relationships between the individual conditions to develop a strategy for the transfer of AI knowledge as a joint design task of politics, industry and research institutions and universities as well as research and educational institutions.

Machine Learning and Deep Learning

The engine for "AI made in Germany" (July 2019)

The greatest advances in the field of Artificial Intelligence are currently on machine learning methods. To maintain Germany's innovative strength, research in this field must be expanded and the transfer to industry must be intensified. The working group has published a white paper the necessary competencies and structural measures for successful "AI made in Germany".

Data Science: Learning and training content

(December 2019)

Data science is considered a key discipline of our time, both in business and in science. In a joint working paper, the German Informatics Society (GI), with the cooperation of Plattform Lernende Systeme, identified the skills needed to collect, process, prepare and analyse large amounts of data. It provides orientation for the further development of teaching at colleges and universities as well as in training and further education.

From Data to AI –

Intelligent Data Management as the Basis for Data Science and the use of self-learning systems (November 2020)

Whether satellite images as data sources for navigation systems or holiday photos on social media platforms – unimaginably large amounts of new data are generated every day. Data has become a central raw material in our increasingly digitalised world and forms the basis for AI applications. Data science – the management and analysis of data – is therefore considered a key discipline. The white paper discusses the potential benefits of this discipline, gives examples of applications and highlights process chains of data science applications.

Working group 2

Future of Work and Human-Machine Interaction

Self-learning systems will support people in **many areas of work** in the future – from production to services to social professions. The working group is dedicated to the human-centred design of the future world of work as well as questions of **human-machine interaction**. It examines potentials and challenges that arise from the use of Artificial Intelligence in the world of work and life. The focus is on questions of transformation and the development of humane working conditions. It also analyses requirements and options for **qualification** as well as starting points for the design of human-machine interaction.

The working group focuses on three central priority topics: The design of human-machine interaction, the requirements for qualification and competence development for Artificial Intelligence, and the design of transformation in companies. Artificial Intelligence can support humans in many areas – the decisive factor is the design of the changing relationship between humans and machines: It is important to focus on the needs of humans in the development of AI systems and to design AI technologies for a liveable future and for human-friendly working environments.

A key factor for the use and acceptance of AI systems is education and training in schools, universities, and companies. Competence development and lifelong learning are important to empower citizens for the digital transformation and the application of AI technologies, and to create a sovereign, responsible use, but also to secure the innovative capacity of the location.

The use of AI technologies in companies is an interdisciplinary design task: early consideration of the goals of AI use, the framework conditions for the introduction of AI and the consequences for work design is a central element for the change towards Artificial Intelligence in companies. Here, the social partners have a joint shaping function. The central guiding questions of the working group include:

Work/Qualification

- What are the benefits of self-learning systems for employees and companies?
- What impact do they have on the working environment (e.g. labour market, work intensification, job profiles)?
- Which sectors or activities are particularly affected by change?
- What new competences do self-learning systems require from employees? Which qualification approaches result from this?

Thanks to improved learning capabilities, machines are already relieving humans of extensive tasks and important decisions. On the other hand, the increasing degree of autonomy is not always accompanied by the necessary self-explanatory capability of systems. An algorithm may deliver correct results. How these come about often remains unclear. Developers are confronted with entirely new challenges here, such as how to make technical systems trustworthy and transparent for users.

Elisabeth André
Chairholder for Human-Centered Artificial Intelligence at the Institue of Computer Science at Universität Augsburg and Co-Head of the working group

- What does "good" and humane work look like in the AI age?
- How can the transformation towards the digital world of work be shaped?

Human-machine interaction

- How can the distribution of roles between man and machine be designed in the sense of human self-determination?
- Which principles of human-machine interaction are necessary/desirable for this (keyword human-centred design/interfaces)?
- How can transparency, controllability, explainability, privacy and maintainability of self-learning systems be ensured?
- Where is the journey heading in the development of human-machine interfaces?

Results and contribution of the working group

The working group brings together different perspectives from research, companies, and trade unions. In this way, a dialogue can be conducted between different interests and perspectives regarding the requirements for AI design. The dialogue is of immense importance for the societal AI debate, the design of the future working world and the relationship between humans and technology. The central results of the working group were put up for discussion in numerous com-

(from left to right): Wilhelm Bauer (Fraunhofer IAO), co-head of the working group Future of Work and Human-Machine Interaction, moderated a panel discussion at Cebit 2018 with Elisabeth André (University of Augsburg), Michael Heistmann (BIBB), Michael Gustmann (Kerntechnischer Hilfsdienst).

mittees and events and communicated to different target groups. For example, the cooperation with the Platform Industrie 4.0 or the use of multipliers should be highlighted.

The working group has already developed approaches as well as criteria for the human-friendly design of human-machine interaction, which, starting from questions of safety and robustness, focuses above all on issues of transparency, explainability and data protection. At the same time, this also defines requirements for the development of AI systems, which flow into various standardisation processes and outline framework conditions for the use of AI systems. → P. 38

The working group also contributes to the participation-oriented introduction of Artificial Intelligence in companies. The main focus is on the design of AI change processes that link the requirements of co-determination with the dynamics and specifics of AI technologies – for example, to enable agile introduction processes in the face of shorter innovation cycles and at the same time ensure employee participation. → P. 38

The working group relates the criteria and orientation aids to concrete application scenarios to establish practical relevance and to illustrate the handouts for developers, employees, and decision-makers in companies – especially SMEs – with plausible examples. The scenarios – the information butler for the office and the adaptive robot tools for assembly – refer to different AI technologies and operational areas to illustrate the benefits, challenges and solution approaches of Artificial Intelligence. → P. 38

Outlook: future issues

The topic of training and competence development is key to the successful development, implementation, and introduction of Artificial Intelligence. The basis for education and training, including the development of suitable curricula, is the identification of the competence needs and the competence profiles that will be required in the future – especially for everyday professional life. Therefore, the working group will identify competence needs in a practice-oriented way and develop exemplary competence profiles for different fields of activity. Important steps in competence development are not only necessary in the professional expertise of employees, but also in other fields of competence – such as process know-how, social and communication competences, decision-making and leadership skills or reflection, adaptation, and problem-solving competences. The aim is also to assess which competences are changing and to what extent.

In addition, the development of an application scenario on the topic of care is planned together with the working groups Business Model Innovations and Health Care, Medical Technology, Care. The scenario should demonstrate the use of Artificial Intelligence in home and inpatient care – and the associated benefits and challenges for all involved. The working group can contribute expertise on human-machine interaction issues from research and companies and thus contribute to a socially important issue, namely the use of Artificial Intelligence in healthcare.

Publications WG2

Work, Training, and Human-Machine Interaction –

approaches to designing Artificial Intelligence for the world of work (July 2019)

AI is changing the demands on employees and their skills. It shapes job profiles, workplaces, and the organisation of work in companies. AI is also changing the relationship between humans and machines and enabling new forms of collaboration. The working group analysed this change in a white paper that shows how learning assistance systems could support employees in factual work and production in the future.

Criteria for Human-Machine-Interaction with AI –

Approaches to human-centered design in the working environment (June 2020)

The increasing collaboration between humans and technology makes it necessary to readjust the distribution of tasks when using AI. The white paper presents a catalogue of criteria for human-machine interaction in the work context. The criteria aim at a sustainable, future-oriented, and human-centred design of human-machine interaction and are directed at actors from the planning, development, and implementation of self-learning systems.

Introduction of AI systems in companies

Design approaches for change management (November 2020)

The introduction of AI in companies offers opportunities and potential for both employees and companies. At the same time, the challenges in the use of AI systems must be solved and the change in the companies must be shaped together. To this end, the working group has defined requirements for change management in AI in a white paper to provide orientation for the practical implementation of the introduction in the various phases of the change process.

Application Scenario: Information butler for the office (July 2019)

Intelligent voice assistants that can answer simple questions or execute simple commands can be found today in smartphones, tablets, and millions of households. These systems are not yet capable of handling the complex day-to-day work, for example in administration or counselling. The application scenario outlines how self-learning assistance systems can support knowledge workers in their daily tasks in a few years.

Application scenario: Robotic tool with learning capability in assembly (July 2019)

Manufacturing companies are already using different robot systems that automate processes in the factory and relieve people of assembly line work – from gripper arms to lightweight robots. The application scenario shows how people will guide robots in the factory in the future and teach them new skills in the production process depending on current needs.

Working group 3

IT Security, Privacy, Legal and Ethical Framework

Self-learning systems can support us in our everyday lives, but they must function reliably and be securely protected against attacks. New legal issues, such as **liability or the handling of personal data**, must be put into a legal framework. In two sub-working groups, the working group addresses questions of security, reliability, and the handling of **privacy** in the development and application of self-learning systems as well as related legal and **ethical requirements**.

Self-learning systems have the potential to make many processes more efficient, convenient, and secure. For this to succeed, however, they must be trustworthy (expert opinion of the High-Level Expert Group, 2019) and developed and used based on ethical criteria (ethics by, in and for design). It is also important that self-learning systems always function reliably, securely and in accordance with privacy. How trustworthy, reliable, and secure AI systems must be designed is a current debate, which the working group IT Security, Privacy, Law and Ethics also ties in with. In connection with this, a possible regulation of AI systems (cf. Report of the Data Ethics Commission, 2019) must also be discussed. To this end, it must be clarified which AI systems in which areas of application must be regulated and how, and in which cases regulation may be superfluous. The working group also deals with the transfer of these results into legal requirements. The focus here is, for example, on the challenges that need to be considered in self-learning systems with regard to liability and criminal responsibility and whether the current legal system needs to be adapted in this regard. The central guiding questions of the working group include:

IT Security and Privacy

- How can AI be used to protect IT systems?
- What new threats emerge when attackers use AI?
- What can happen when AI systems are attacked and how can they be protected?
- How can a more flexible handling of (personal) data for AI applications be made possible and at the same time the right to informational self-determination be preserved?

Legal and Ethical Framework

- What challenges do self-learning systems pose in terms of liability, criminal responsibility, and basic legal and ethical issues?
- How must they be designed to safeguard human autonomy and fundamental rights, ensure equal opportunities, and avoid discrimination?
- Does it make sense to introduce a right to data ownership?
- How can society take part in the implementation of self-learning systems in the sense of participation?

Results and contribution of the working group

The working group has already addressed these central issues in several publications and events. A workshop on the topic of regulation and certification was co-organised at the annual conference of Plattform Lernende Systeme in 2019. In addition, a round table on the topic of certification was organised in March 2020 together with the working group Technological Enablers and Data Science. At this event, representatives from science, industry and associations were able to discuss together what needs to be considered on the way to a successful certification of AI systems. The results were incorporated into the impulse paper on the certification of AI systems, which was coordinated together with the working group Technological Enablers and Data Science. → P. 41

Following on from this, the working group, discussed together with the working group Technological Enablers and Data Science, in a white paper how the certification of AI systems can succeed. The white paper provides an overview of the criteria that should guide this certification and how an efficient infrastructure should be designed.

Systematic engineering instead of an arms race: IT security must also stand up to intelligent attackers. Attacks with AI support exacerbate this. The response should not be an arms race, but rather systematic engineering. In cryptography, very successful are clearly defined security objectives, explicit security assumptions and proofs that any successful attacker must violate a security assumption. As AI systems become more powerful, we should approach wherever possible.

Jörn Müller-Quade
Professor for IT Security at the Karlsruhe Institute of Technology (KIT) and Co-Head of the working group

The question of how safe and reliable self-learning systems in medicine must be designed has been examined by the working group together with the working group Health Care, Medical Technology, Care in a white paper. With the white paper on "Ethics Briefing", the working group has developed a guideline for a responsible technology development and application process. This publication directly follows the debate on the topic of trustworthy AI systems and makes a significant contribution to the operationalisation of these values.

Outlook: future issues

The question of when AI systems need to be regulated (and: when regulation is not necessary) will be discussed in a white paper on criticality classification, use and application of AI systems in different application areas. How the security of AI systems in intelligent networked mobility can be established is being investigated by the working group together with the working group Mobility and Intelligent Transport Systems. The aim is to define conditions for success for the use of an intelligent travel assistant. Whether the existing legal system is designed for the use of self-learning systems or whether adjustments are needed will be examined with the help of a fictitious court case.

Publications WG3

Artificial Intelligence and IT Security

Stocktaking and approaches to solutions (April 2019)

AI will improve the security of IT systems in the future. In the hands of cyber criminals, however, it also opens the door to new threats to IT security. The AI systems themselves must also be protected against manipulation. The dynamics between IT security and AI were analysed in a white paper by the working group.

Artificial Intelligence and Discrimination

Challenges and solutions (July 2019)

Decisions made by computer programmes appear to be fact-based, objective, and neutral. In fact, however, Artificial Intelligence repeatedly makes problematic or discriminatory decisions – for example, when people of different ethnic origins receive different prognoses when determining the likelihood of offenders recidivation. The white paper analyses the causes and forms of discrimination and shows possible solutions.

Certification of AI systems (April 2020)

Trust in AI systems is considered a necessary condition to be able to exploit the societal benefit potential of AI in a safe and public welfare-oriented way. A possible key prerequisite for this is the certification of AI systems. The working group presented the potentials and challenges of the certification of AI systems in an impulse paper. This was coordinated together with the working group Technological Enablers and Data Science.

Secure and safe AI Systems in Medicine

Data management and IT security in the cancer treatment of the future (April 2020)

AI can improve people's healthcare. Intelligent assistance systems support doctors in prevention, diagnosis, and therapy decisions. Prerequisite: the protection of patient data and the security of the AI systems is guaranteed. With the support of the working group Health Care, Medical Technology, Care, the working group has analysed data management and IT security in the use of AI in medicine in a white paper and identified essential conditions for success for the application of AI in healthcare.

Ethics briefing – Guidance for responsible development and use of AI systems (October 2020)

Self-determination, justice and the protection of privacy and personality – these ethical values are central to the development and application of AI systems. Members of the working group have defined concrete criteria for the responsible development and use of AI systems. The criteria are intended to serve as orientation for developers, providers, users and affected parties of AI systems. The white paper also presents best practice examples for responsible technology development and application processes in selected companies.

Working group 4

Business Model Innovations

Digitalisation has been changing the **business models** of companies for several years. The increasing use of Artificial Intelligence is ushering in a new phase: in future, products and services can be adapted to the **individual wishes** of customers. This will be possible through the intelligent use and **linking of data**. This raises fundamental questions: What framework conditions must be created so that society can benefit from this transformation of the economy? The working group presents case studies, guidelines, and design options.

Self-learning systems process data into knowledge – and thus make the exponentially growing amount of data usable for products and services. This enables completely new business models, for example for digital platforms, via which numerous companies of all sizes and industries will cooperate in the future. Using concrete case studies from the AI map and with the help of application scenarios in the areas of mobility and health, the working group is investigating how self-learning systems change cost structures in companies and the economy and which revenue structures arise from new types of customer loyalty and value creation in smart products and services. The members of the working group discuss how AI-based business models can be developed successfully and for the benefit of society. The central guiding questions of the working group include:

- How do self-learning systems change cost structures in companies and the economy (e.g. skilled workers, know-how, efficiency, and information advantages)?
- How do revenue structures change due to new types of customer loyalty and value creation with smart products and services?
- What new opportunities are emerging for the business models of small and large companies?
- What new forms of cooperation are becoming possible and necessary (e.g. platforms and ecosystems)?

Results and contribution of the working group

Since 2018, the working group has been an important voice in the German-language discourse on AI business models and their economic and social impact. Chairpersons and members of the working group have been able to provide important content-related impulses for the debate on innovative business models with AI at events of Plattform Lernende Systeme and other high-profile events such as CEBIT 2018, the Digital Summits 2018 and 2019, as well as at events of the Plattform Industrie 4.0. In addition, the

For small and medium-sized enterprises it is important to get to grips with the topic of digitalisation – of which AI is part of today. According to our observation, this is not yet sufficiently the case. SMEs need to understand which products they can improve they can improve through AI methods.

Susanne Boll-Westermann
Professor for Media Informatics and Multimedia Systems at the Carl von Ossietzky University Oldenburg and
Co-Head of the working group

working group participated in the development and continuation of the AI map, which shows application examples for the use of self-learning systems in business and science. Furthermore, in-depth analyses of individual case studies of AI applications and business models as well as a vision for the successful and ethically beneficial use of AI in Germany in 2030, agreed with various stakeholders, were presented in a working group report. Together with the working group Mobility and Intelligent Transport Systems, a white paper on AI-based business models in intelligent networked mobility was also developed. It outlines how self-learning systems are changing business models and which technical and non-technical prerequisites are necessary for this change.

Outlook: future issues

The focus of the current and future work of the working group is on AI business models and data ecosystems in specific sectors. Together with the working group Health Care, Medical Technology, Care, a white paper on AI-based business models in health is to be published. For this purpose, changes in business models as well as necessary technical and non-technical prerequisites for this change will be discussed. In addition, the impact of the new technological possibilities on society will be considered – for example, as a contribution of self-learning systems to more sustainability. Individual entrepreneurs and small and medium-sized enterprises should find their role in an AI platform ecosystem without becoming an interchangeable executor, as can be observed today for some retailers at Amazon or drivers at Uber. For smaller companies, data sourcing and preparation is a large part of the overall effort. Larger companies can provide data in exchange for a share or other compensation through platforms, drastically reducing the research and development costs of a smaller company. The working group wants to outline how company alliances and platforms can be built that offer data and services – to the benefit of all involved. It will also investigate how German or European infrastructure providers of IaaS solutions can be promoted, including alliances or joint ventures of data centre operators who today face each other as competitors in their core business. Initiatives such as the International Data Spaces and GAIA-X can make a valuable contribution here.

Publications WG4

New Business Models using Artificial Intelligence

Visions, case studies and design options (October 2019)

Through the intelligent use and linking of data, products and services can be adapted to the individual wishes of customers in the future. This raises fundamental questions: How can companies adapt their business or develop new AI-based business models? The working group has presented case studies, guidelines, and design options in a working group report.

Working group 5

Mobility and Intelligent Transport Systems

Tomorrow's mobility is characterised by self-learning systems of various kinds: modes of transport on land, on water and in the air are reaching ever **higher levels of automation**. Vehicles are networked with each other, as are road and rail systems. Used intelligently, they can increase road safety and optimise traffic flows. The working group is developing design options for **intelligent mobility systems**, for example on technological solutions and infrastructures, safety issues and legal framework conditions.

Artificial Intelligence can make an important contribution to enabling safer, more flexible, and more cost-effective travel by road, rail, or water. This is because AI-based assistance systems contribute to making transport systems smarter, more resilient and fit for the future. This is made possible by the interaction of sensors, cameras and intelligent infrastructures and platforms that record, manage, and share traffic data. Increasingly powerful machine learning methods are used to process the collected data and derive actions from it, which are implemented either by humans or by the systems themselves.

However, the development towards intelligently networked transport systems is also associated with challenges – for example, the design of human-machine interaction and the safety of the AI applications used. The working group is therefore developing design options for intelligent mobility systems, for example on technological solutions and infrastructures, safety issues and legal framework conditions. The central guiding questions of the working group include:

- How are self-learning systems changing our mobility structures?
- What characteristics must they have to achieve the greatest benefit for the individual and society (e.g. anticipatory vs. adaptive)?
- How must infrastructures and system architectures in the mobility sector be further developed to integrate self-learning systems in a meaningful way?
- What is the optimal balance between individual or local intelligence and central control?
- How can self-learning systems be secured and tested in the mobility sector?
- Which knowledge representations are necessary (e.g. for knowledge exchange and control)?

Results and contribution of the working group

In their report, the representatives from science and industry of the working group discussed the opportunities and challenges of self-learning systems for different modes of transport. For its first report, the working group identified five fields of action that science, business, politics, and society

should address to specifically advance AI-based mobility and intelligent, sustainable and demand-oriented transport systems. These fields of action are:

- Safety in intelligent transport systems
- Networking and interaction of systems
- Availability of transport fleets and infrastructures
- Human-machine interaction (MMI) in the mobility space
- Societal aspects

For all fields of action, the report outlines potentials, challenges and necessary prerequisites for the development and implementation of self-learning AI-based systems in the mobility space. From this, measures were derived that research and development, business, politics, and society should take on the path to an intelligent mobility space. → P. 46

With the help of stakeholder interviews, the working group also identified goals and core problems in the use of AI in mobility. Experts from the working group also investigate the near future: In application scenarios, they show how mobility and logistics can change in a few years with the help of Artificial Intelligence. The environment scenario, consisting of "Carla's journey" and "Ordered? Delivered!", describes how AI can support people in the future and which challenges still need to be addressed. In this context, it is also proposed to create an overarching mobility platform in which the mobility offers of different service providers as well as transport and infrastructure information are integrated, orchestrated, and made available to target groups. → P. 46

Together with the working group Business Model Innovations, a white paper on options for AI-based business models in an intelligently networked mobility space was also developed. In the process, possible business models for the various economic actors were outlined based on application scenarios already created by the working group.

Outlook: future issues

Currently, the members of the working group are identifying requirements and goals for a collaborative mobility platform to exchange feature updates to improve vehicles and local behaviour with a focus on "fleet learning" – self-learning from edge/corner cases. Highly automated driving is already being tested, but still requires further progress to guarantee safe use. The experts are therefore addressing the use case that highly automated vehicles "experience" so-called corner cases that have not yet been covered in development and testing because they occur very rarely. The working group is currently investigating what such a platform concept should look like to support cross-industry fleet learning and which requirements and functions must be fulfilled for this.

Together with the working group IT Security, Privacy, Legal and Ethical Framework, a publication will identify and analyse relevant IT security aspects in intelligent networked mobility along the application scenario "Carla's journey". The paper focuses on the IT security of an intelligent travel assistant with which a journey in the future will not only be faster and more resource-efficient but will also be able to better meet personal needs in a multimodal mobility.

Intelligently networked: Traveling differently means being able to use all modes of transport conveniently and easily in the future. It will be possible to switch from one mode of transport to another without much preparation and without losing time. Road traffic, too, is to be emission-, accident- and stress-free. This vision will only possible through efficient learning and adaptive systems – i.e., using Artificial Intelligence – will become reality. This technology must be easy to use, robust and safe protect the environment and improve the quality of improve.

Christoph Peylo
Global Head of the Bosch Center for Artificial Intelligence and Co-Head of the working group

On the Way to Intelligent Mobility

Fields of action, opportunities, and challenges (July 2019)

Artificial Intelligence can make an important contribution to the transport revolution. In intelligently networked mobility, people will move from one place to another or transport goods in a way that conserves resources. The report of the working group Mobility and Intelligent Transport Systems describes how safe, more flexible, and more cost-effective movement on the road, rail, in the water or in the air can look.

Application Scenario: Intelligently networked on the move

Carla's Journey (July 2019)

In a few years, intermodally networked travel portals will lead us even more flexibly, safely, and quickly to our destination and not only connect different forms of mobility across the board, but also conveniently combine planning and booking functions. In this way, they will make an important contribution to fluid traffic, especially in large cities and conurbations. The basis for this are self-learning systems that access very different data sources and use them to develop options for individually sensible, economical and resource-saving route guidance. The application scenario outlines an AI-supported travel management and identifies challenges and options for action for realisation in practice.

Application Scenario: Intelligently networked on the move

Ordered? Delivered! (October 2019)

Artificial Intelligence and self-learning systems are fundamentally changing our mobility. Automated driving, intelligent parking systems or robots that deliver packages: In the future, people and goods will reach their destination faster, more resource-efficiently and more flexibly – with the help of AI-based means of transport, infrastructures, and applications. The application scenario outlines exemplary AI-supported logistics and transport processes and identifies fields of action and design options to specifically advance AI-based mobility.

Working group 6

Health Care, Medical Technology, Care

Self-learning systems promise great potential for the healthcare sector. The aim of the diverse **medical AI applications** is not to replace specialists, but to relieve them and support them in the best possible way. At the same time, important societal questions arise, especially in the health sector, be it about the security of data or about liability law in the case of misdiagnoses.

The intelligent linking of patient data promises great progress in medical research, diagnosis, and prevention. In care, AI assistance systems can relieve professionals and enable people in need of care to return to a self-determined life more quickly. Important prerequisites are acceptance and data security. The working group deals with the possibilities that self-learning systems offer for prevention, diagnosis, and therapy in medicine as well as in care and rehabilitation. It also deals with questions of social acceptance as well as data protection in these areas of application. The central guiding questions of the working group include:

- What benefits do patients derive from the evaluation of patient data, clinic data and wearables?
- How can data science and AI be used for prevention approaches?
- What possibilities do AI assistance systems offer for operations and care?
- What role do AI technologies play in prosthetics and exoskeletons?
- How can self-learning systems relieve healthcare professionals?

Results and contribution of the working group

Since 2018, the working group has been able to contribute important impulses to the discourse on the use of self-learning systems in medicine and nursing. The application scenario developed by the working group, "With Artificial Intelligence against Cancer", highlights how AI-based assistance systems can support medical and nursing staff in their work and increase patients' chances of recovery. The application scenario was presented at various events, such as the Digital Summit 2018. As part of the white paper "Secure and safe AI Systems in Medicine – data management and IT security in the cancer treatment of the future", IT security-relevant issues of AI systems in medicine were analysed along the application scenario together with the working group IT Security, Privacy, Legal and Ethical Framework. → P. 41

The working group's report, published for the annual conference of Plattform Lernende Systeme in 2019, discusses the benefits of self-learning systems in healthcare as well as challenges and concrete design options. → P. 49

In October 2019, the working group, together with the German Research Centre for Artificial Intelligence (DFKI) and the Charité Berlin, organised a meeting with patient representatives to discuss the opportunities and challenges regarding the use of AI in healthcare from the perspective of those affected. Based on the results of this exchange, a conference report was published. The working group also supported the establishment of the GAIA-X Health domain group and defined domain-specific requirements for GAIA-X from the health sector.

Outlook: future issues

The focus of the current and future topics of the working group will be on the areas of application scenarios (especially for care), AI business models in the health sector and the development of a database for AI health technologies. In cooperation with the working groups Future of Work and Human-Machine Interaction and Business Model Innovations, an application scenario will be developed on the topic of care, which will concretely illustrate the opportunities and challenges of self-learning systems and their future applications using the example of care for stroke patients. The application scenario is intended to illustrate the potential as well as the technological and legal-ethical challenges for AI systems in this so important, but still little digitised area.

At its own booth at the Digital Summit 2019, the 2019, previous work results of the platform were presented, here by the two co-heads of the working group Health Care, Medical Technology, Care (from left to right), Karsten Hiltawsky and Klemens Budde.

In addition, a white paper on business models in AI-based healthcare is to be developed together with the working group Business Model Innovations. This will analyse how AI innovations can be incorporated into healthcare sustainably and economically, because companies will only invest in the development of self-learning medical products if their inclusion in service catalogues is likely in the medium term.

Furthermore, the working group will continue to be involved in the establishment of a European data infrastructure (GAIA-X). In doing so, the working group supports the concept of making non-personal health data available as training data for AI for all researching organisations (universities, non-university research institutions and companies). As competition on a "level playing field" (a framework with fair conditions) could trigger a much-needed innovation boost that promises economic benefits in addition to medical benefits in the long term.

In the short term, the greatest benefit of AI in medicine will be in diagnostics, for example, in image analysis of diseases or in the analysis of large amounts of data, generated by new molecular techniques or genetic analyses.

Klemens Budde
Senior physician at the Charité Berlin and
Co-Head of the working group

Application Scenario: With Artificial Intelligence against cancer (May 2019)

Cancer patients should benefit more quickly from research results. The application scenario of the working group Health Care, Medical Technology, Care shows how Artificial Intelligence can improve the chances of healing for cancer patients soon. The scenario illustrates how doctors can use AI-based assistance systems to access worldwide medical information sources – from screening to diagnosis to therapy – and thus increase a lung cancer patient's chances of survival based on the latest knowledge.

Self-Learning Systems in the Healthcare System – Basics, Application Scenarios and Design Options (July 2019)

Whether it's prevention, early diagnosis, or the right choice of therapy – AI and machine learning can make a significant contribution to ensuring that people receive better and more individualised medical care soon. The potential of the technology is illustrated in the report of the working group Health Care, Medical Technology, Care by means of research examples and an application scenario on the topic of lung cancer. In addition, the interaction of man and machine in care is highlighted and it is shown how AI-based technologies enable people to live self-determined lives into old age.

AI in medicine and care from the perspective of patients

Conference report on the round table with patient representatives (October 2020)

AI promises great potential for the healthcare system – for prevention, patient-specific diagnoses, and therapies. With all technological advances, the needs of those affected must be the focus. The working group organised a round table event on this topic with representatives of various affected groups. The conference report summarises the results of the discussion.

Working group 7

Hostile-to-Life Environments

Whether in the deep sea, in outer space, in contaminated environments or in crisis areas: Self-learning systems can take over activities wherever it is dangerous, unreasonable or harmful to human health. Depending on the location and task, the **assistance systems** and **robots** used have different degrees of autonomy. In the future, they will be able to carry out sensitive tasks or move independently in a complex, unknown environment. The working group is dedicated to the requirements and technologies for the use of self-learning systems in **difficult-to-access** and **dangerous environments**.

The requirements for self-learning systems are particularly high in hostile environments: they must be intelligent and at the same time and at the same time robust against extreme and find their own way under unpredictable conditions.

Jürgen Beyerer

Professor at Chair for Interactive Real-Time Systems at the Karlsruhe Institute of Technology, Director of the Fraunhofer Institute of Optronics, System Technologies and Image Exploitation and Co-Head of the working group

The working group focuses on the benefits, technical conditions, and challenges of self-learning systems in hostile environments, as well as questions of the transparency of such systems and the decision-making power of humans. Self-learning systems can reduce the risk for deployed personnel during activities in hostile environments, shorten reaction times and compensate for capability gaps. In this context, it is important to explore the possible applications for self-learning systems, for example with regard to long-term autonomy or autonomy in unstructured environments – and which new business models, but also which legal and ethical challenges are associated with them. With regard to the technical conditions, the working group deals with questions about the compensation of functional and subsystem failures, autonomous learning in long-term suspended (autonomous) systems as well as learning on the basis of sparse data and the transfer of what has been learned. Furthermore, technical aspects of degrees of autonomy are among the most important topics of the working group. Finally, self-learning systems in hostile environments pose challenges in terms of their use, as they can also be used against humans or abusively. Protection against misuse is

therefore another focus of the content. The central guiding questions of the working group include:

- What are the benefits of self-learning systems in hostile environments for the individual and society?
- How do adaptation and compensation for functional and subsystem failures work there?
- How does autonomous learning succeed in long-term remote (autonomous) systems?
- How can systems learn from sparse data in one-off situations (keyword: incremental learning)?
- How is learned and generalised learning (inductive learning) transferred?
- What challenges arise when the systems are used against humans (keyword dual use)?

Results and contribution of the working group

With the results of its work so far, the working group has provided important impulses for the future realisation of different autonomous systems in hostile environments, so that in the near future people will have to expose themselves to less health-endangering or even life-threatening environments.

The working group analysed the main benefits and challenges of self-learning systems in hostile environments in a report. This reports also presents key research questions and discusses which framework conditions need to be created in order to implement autonomous systems for use in hostile environments. → P. 52

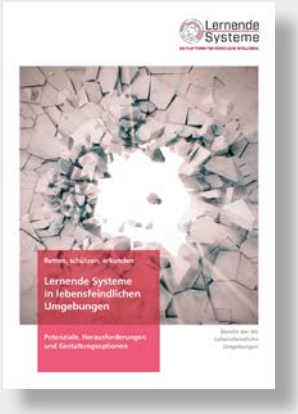
In addition, the working group has developed several application scenarios that show, on the basis of concrete situations, how the use of self-learning systems can be designed in the case of a fire in a chemical factory or during maintenance operations under water. The challenges and necessary options for action to realise the scenarios soon were also presented in the application scenarios. → P. 52

Outlook: future issues

The highest possible autonomy of robotic systems is a desirable goal in hostile environments to reduce risks to human life and limb. However, autonomy is also a central reference point in many debates on Artificial Intelligence that concern legal and ethical aspects or the certification of AI systems. With a planned white paper on the topic of autonomy levels, the working group wants to show, taking into account existing considerations on different autonomy levels, that continuously and smoothly variable autonomy levels are necessary for hostile environments during the deployment time. It will also be shown how a robotic system must be designed to achieve this. Closely linked to the degrees of autonomy is the protection against misuse of self-learning systems. In the future, the working group will look at mechanisms that can prevent misuse of robotic systems. Such mechanisms can include specific rules that are implemented in robotic systems. With the help of such rules implemented at the systemic level, it can be determined, for example, that a robotic system can only perform certain tasks and can only act autonomously in certain cases and situations or only within a certain geographical area. Technical measures can thus make the misuse of robotic systems more difficult.

The great challenge of AI in the coming decade is integration. We need to research intensively and ultimately understand how to integrate the different areas of AI – from logical reasoning to deep learning to robotics – into systems that benefit humanity and are transparent in their development and application.

Frank Kirchner
Chair of Robotics at the University Bremen, Scientific Director of the Robotics Innovation Center at the Bremen location of the DFK and Co-Head of the working group



Self-Learning Systems in Hostile-to-Life Environments – Potentials, challenges, and design options (June 2019)

The use of AI promises beneficial solutions in the future, even in hostile environments. Mobile robots or assistance systems that adapt to changing situations can effectively support humans in activities in dangerous environments – for example, in fires or in disaster control. At the same time, AI-based systems make missions in dangerous or difficult-to-access environments more cost-effective than manned missions. For such missions, there are still some challenges to be overcome from a technical point of view, and these are highlighted in the report of the working group Hostile-to-Life Environments.

Application Scenario: Immediate Assistance during Rescue Missions (May 2019)

Major fires, chemical accidents, earthquakes, incidents in nuclear power plants or terrorist attacks: Disasters and accidents like these, cause great damage and put the emergency services on site in danger. From prevention to hazard prevention and damage repair to emergency rescue – the application scenario of the working group Hostile-to-Life Environments shows how self-learning systems can effectively support rescue forces during operations in just a few years.

Application Scenario: Autonomous Underwater Vehicles (May 2019)

The application scenario shows how self-learning robotic assistance systems can support humans in the future to inspect, maintain and repair offshore installations and other underwater infrastructure. These autonomous underwater vehicles (AUVs) make use of Artificial Intelligence methods.

AI in Germany and in international comparison

Europe on 2nd place for AI publications

USA
18 percent

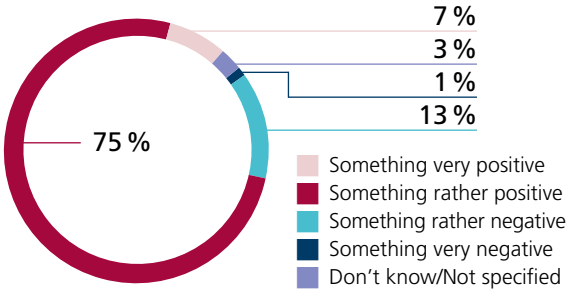
Europe
27 percent

China
28 percent

Source: Elsevier AI Report/Elsevier Scopus data (as of 2020; 2018 figures).

Positive attitude towards AI

The vast majority of companies (82 percent) feel something "positive" or even something "very positive", when they think of AI.



Source: TÜV: „Study Report Artificial Intelligence 2020".

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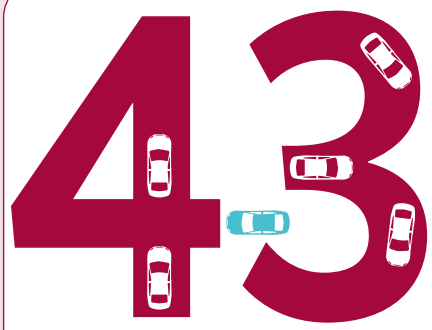


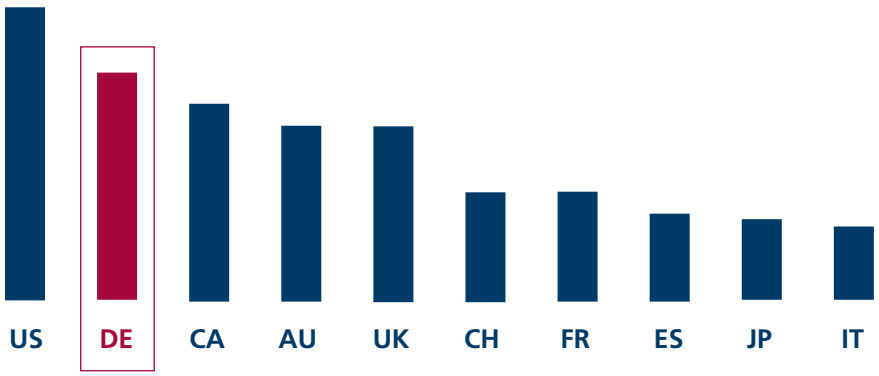
Percent of patent applications relating to autonomous driving come from Germany.

Source: DPMA (patent applications 2019)

The number of AI startups in Germany rose by 15 percent last year. In March 2020, a total of 247 AI start-ups were counted

Source: appliedAI / UnternehmerTUM ecosystem (status: March 2020)

Germany is the world's 2nd most popular destination for highly qualified digital professionals, making it the most attractive non-English-speaking job location in the world.



Source: Boston Consulting Group (BCG), StepStone, The Network (May 2019; survey from 2018).

Germany occupies in the worldwide innovation ranking the

1ST PLACE

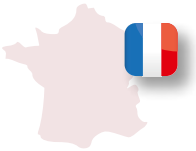
Germany has held a top position in the global innovation ranking of the Bloomberg Innovation Index for several years now. In the current index, Germany moved up to first place, replacing South Korea, which had been at the top for six years.

Source: Bloomberg Innovation Index 2020

Looking beyond borders: AI research worldwide

Artificial Intelligence will change the **economy** as well as **people's everyday lives worldwide** in the coming years. To shape the associated political and social developments and challenges, governments in many countries have presented **specific strategies** for dealing with AI. For the European Union and a **selection** of countries, you can find an overview of the strategic measures as well as the national AI strategies here.

European Union: As early as April 2018, the European Commission published an agenda for the promotion of Artificial Intelligence in Europe, and in December 2018 it presented the Coordinated Plan for Artificial Intelligence with the participation of the High Level Expert Group on AI, a network of leading European AI experts, and the European AI Alliance. This was followed in spring 2020 by the White Paper on Artificial Intelligence, with which the EU Commission put forward for discussion a framework for trustworthy AI based on excellence and trust. Among other things, the proposal calls for the private and public sectors to mobilise joint resources along the entire value chain and to create incentives so that small and medium-sized enterprises can also use AI solutions more quickly. To this end, stronger cooperation with the member states and the research community is also envisaged. AI systems are also to be legally regulated more strongly, for which high-risk and less risky applications will be divided. The European Union is thus pursuing its own approach between China and the USA towards a globally competitive, values-based and inclusive digital economy and society, while at the same time Europe is to remain an open, rules-based market and continue to work closely with its international partners.



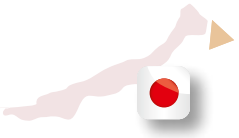
France: In March 2018, President Emmanuel Macron presented the outline of a French AI strategy entitled "AI for Humanity" in a speech. An important basis for this was the report by French MP Cédric Villani, also published in March 2018. France emphasises that Artificial Intelligence must be put at the service of people and assigns the state an important steering function. State investments of 1.5 billion euros are planned by 2022 for the expansion of research and development of AI and its application. The most important political goals are defined as open data policy for the implementation of AI applications, a focus on the four sectors of health, environment, mobility, security/defence, and European cooperation in the field of AI.

United Kingdom: The UK government published a first strategy paper in November 2017 defining AI as a building block for economic and industrial growth. In March 2018, a select committee of the House of Lords presented a report on the economic, ethical, and social impact of AI. In April 2018, a UK AI strategy was published in the form of the AI Sector Deal. The government wants to develop the UK into the world's most innovative economy during digitalisation.

Netherlands: The public-private partnership AINED presented a roadmap for the development of a Dutch AI strategy at the end of 2018. In October 2019, the Dutch government published the Strategic Action Plan for Artificial Intelligence. The policy objectives of the AI strategy were defined as maintaining economic growth and prosperity, contributing to societal challenges such as ageing Dutch society, climate change and food security, and upholding personal rights and non-discrimination. The focus of the Dutch government is on the following areas: Exploiting economic and societal opportunities of AI. Strengthening the foundations: human rights, trust, consumer protection, security. As well as: creating the right conditions: Research, education, data.

USA: As early as October 2016, the Obama administration published Preparing for the Future of Artificial Intelligence, a comprehensive strategy paper on dealing with Artificial Intelligence. The Fact Sheet AI for the American People, published in May 2018, summarises the current guidelines and measures of the Trump administration. With the Summary of the 2018 Department of Defence Artificial Intelligence Strategy, the US Department of Defence outlines new goals and approaches in the use of Artificial Intelligence primarily for military purposes. In October 2019, the National Science Foundation announced a programme to support long-term, large-scale innovation research. In January 2020, the White House published regulatory principles for the development of AI in the private sector with a strong focus on trusted AI.

China: The Chinese Ministry of Industry and Information Technology presented a national strategy for Artificial Intelligence in July 2017 under the title A Next Generation Artificial Intelligence Development Plan. The long-term goal of being the global innovation leader in AI by 2030 is concretised in a three-year plan published in December 2017. The Chinese government sees AI as a key industry of the future. With a comprehensive roadmap and the bundling of all forces, it is pursuing clear economic policy goals. By 2020, China wants to catch up with the USA in the field of AI, and by 2025, major breakthroughs and the leading role in individual AI applications are to be achieved. By 2030, the plan is to become the global leader in AI research, development, and application. The national AI industry is then expected to make a major contribution to the country's value creation.



Japan: The Strategic Council for AI Technology was established in April 2016 to promote AI in Japan. In March 2017, it published the Artificial Intelligence Technology Strategy. Japan's other AI-related strategy papers are the Industrialization Roadmap, the Integrated Innovation Strategy, and the New Robot Strategy. In Japan, the focus of AI is on the opportunity for social development. AI should serve to increase the productivity of society and the creativity of the population. Furthermore, Japan wants to be a leader in medical care and welfare technology using Big Data. AI is also to be used to improve travel for citizens as well as to increase environmental friendliness and better prevent accidents by 2030. Other policy goals of Japan's AI strategy include the creation of robust economic development of AI, accompanied by appropriate evaluation criteria and pricing.

More information on the political goals and important fields of action of selected countries in Europe and worldwide on the topic of AI can be found here: https://www.plattform-lernende-systeme.de/ai-strategies.html

Guest contribution by Klaus Heine

Potentials and challenges of a European AI strategy

Due to the rapid progress in the field of Artificial Intelligence, numerous initiatives and national strategies have emerged worldwide in recent years. **Klaus Heine, Professor of Legal Economics at the Erasmus School of Law in Rotterdam**, and member of Plattform Lernende Systeme, explains what accents are being set with AI strategies in different countries and what the **opportunities and challenges of a European AI strategy** are.

The European path in AI research and application has taken a different course than in the USA or China, for example. While large, privately organised technology giants have emerged in the USA, the new technologies in China are moderated by the state in private companies. Both paths have revealed their own problems in recent years: While in the USA there are mainly unresolved questions of how to deal with the technology giants in terms of competition policy, in China it is questions of democratic control of new technologies in general and AI in particular that need to be resolved. The German AI strategy, on the other hand, is embedded in the European AI strategy: People should be at the centre of all applications of AI! However, it is not yet immediately clear from this intention what this means in concrete terms for Europe's technological and economic competitiveness vis-à-vis the USA or China.

Citizens' trust as a prerequisite

One reading of the German and European AI strategy is that the trustful handling of new technological achievements should be the key to more competitiveness and inclusion at the same time. This means that trust and acceptance by citizens is considered a central prerequisite for anchoring AI sustainably in the economy and society. Such an anchoring becomes significant if the goal of the AI strategy is to secure long-term competitive advantages for Germany and Europe. The EU Commission's White Paper on AI, which outlines a concept for embedding AI technology in society, builds strongly on this long-term approach.

Democracy and participation are not only the central mechanisms for the implementation of AI technologies in the everyday lives of citizens but should also make the new risks posed by AI controllable and legitimate. Legal regulation and technological innovation are thus seen as complementary components of a European AI strategy. This should lead to a transformation into sustainable and innovative business models with AI applications and reduce the gap to the USA and China in AI applications.

Promotion of intergovernmental research cooperation necessary

The cooperation in research and application between the European partner countries in general and the large national research institutes in particular deserves special attention. It should be noted that at the level of research itself,

The fact that Germany was once the incubator for the development of some of the most important legal figures of today should be an incentive to continue to build on this tradition.

Klaus Heine
Professor of Legal Economics, Erasmus University Rotterdam and member of Plattform Lernende Systeme.

for example within the framework of the European research funding of Horizon 2020 and the upcoming Horizon Europe research programme, a large number of joint research projects have already been initiated and will be in the future. In the area of application-oriented intergovernmental cooperation in Europe, however, there is a need to catch up. For example, the GAIA-X project initiated by France and Germany is currently attempting to establish a European data infrastructure. Independently of this, the creation of an innovation- and competition-friendly framework for technologies could also lead to new innovations that can establish themselves on the market and gain acceptance.

Overall, it is to be welcomed that the Franco-German cooperation in the field of AI, outlined in the joint AI roadmap, is a political driving force for the entire EU. The dialogue between France and Germany stimulates the societal discourse on AI without committing to an economic policy style. At the same time, the declaration, like the EU Commission's White Paper, shows that Europe is choosing a different AI strategy than the USA or China.

Historical milestones as models for new solutions

Artificial Intelligence and big data are not only changing business models worldwide (e.g. platform economy), but the new technologies are also having a disruptive effect on our law and challenging existing legal dogma. To meet this challenge, new legal figures and approaches are needed to ensure that the new technologies are used for the benefit of society.

The resistance to questioning long-practised patterns of legal dogmatics and thus tolerating uncertainty in one's own routines is admittedly considerable in legal scholarship and among legal practitioners. This is comparable to the lack of courage of entrepreneurs to test new AI business models on the market because immediate success is not guaranteed. This is more regrettable because other countries are already one step ahead of Germany and the EU in researching and applying AI technologies. It will therefore not be easy to catch up in applying AI with our own business models. In contrast, Germany and Europe could take a leading role regarding the legal dimension of AI and thus become a globally important driving force for liability and competition issues with AI.

The fact that Germany was once the incubator for the development of some of today's most important legal figures should be an incentive to build on this tradition. One need only recall workplace co-determination from the late 19th century onwards, with the introduction of workers' committees to control the manifold risks of mechanised factory work on a society-wide basis. Another example is the famous electricity theft case of 1899. This was about the physical properties of electricity and their significance for its legal registration.

The invention of the German GmbH-law, which allowed small and medium-sized companies to take entrepreneurial risks, also illustrates the importance of binding legal figures. Finally, there is group law, which regulates complex relationships of superiority and subordination between corporations. All these legal innovations date back about 100 years, but they still have a significant impact on German law and have inspired other jurisdictions around the world to make similar legal advances to promote technological and economic progress. inspired other legal systems around the world to take similar legal steps to promote technological and economic progress. In view of the new technologies, a comparable innovation boost in the law would be a considerable location factor for Germany and Europe.

ABOUT THE AUTHOR |

Prof. Dr. Klaus Heine is Professor of Legal Economics and Jean Monnet Chair of Economic Analysis of European Law at the Erasmus University Rotterdam. He is Director of the Jean Monnet Centre of Excellence on Digital Governance since 2019 (together with the University of Leeds and Bar-Ilan University) as well as director of the Erasmus Centre for Data Analytics. Klaus Heine is a member of the working group IT Security, Privacy, Legal and Ethical Framework of Plattform Lernende Systeme.

Define legal personality and accountability of AI

Firstly, the legal personality of AI and the associated attribution of responsibility to AI-based systems must be clarified. This question has a similar scope as the question 200 years ago as to whether companies can have their own legal personality and, if so, which one. Secondly, in addition to the question of the legal personality of AI, the question of data ownership is also central – to this end, the question of whether and under what circumstances data is personal property or property of society as a whole must be discussed. Here, a distinction must undoubtedly be made between the most diverse categories of data. However, the basic question remains to be answered as to which starting point is chosen to distribute rights to data. In this context, we can again refer to a historical example: With nuclear energy, there has already been a technological innovation that promises enormous economic potential on the one hand, but can also be very dangerous for the general public with regard to possible reactor accidents. Moreover, nuclear technology requires sophisticated specialised knowledge in nuclear physics as well as the availability of nuclear fuel rods and a concept for nuclear waste. Enormous investments in this technology are therefore needed to be able to use its advantages in the long term. One possibility is to treat nuclear technology like any other technology by the trade supervisory authority – in other words, to allow the private sector to organise the market privately under certain conditions. This private-sector approach was also discussed extensively in the German Bundestag in the 1950s, before another solution was found under the impetus of the French European politician Jean Monnet. The European Atomic Energy Community (EAEC

or EURATOM) was founded. This independent European institution was created to monitor compliance with the established rules for the handling of nuclear energy in the European economic area. In addition, this authority became the owner of all fuel rods or fissile materials in the EU. However, companies are granted an unrestricted right to use and consume fissile material if the companies fulfil certain conditions for handling the fissile material. Different risk classes of fissile material can also be considered. Should a company not handle fissile material properly or should significant competition problems arise in the nuclear energy market, EURATOM can exercise its right of ownership and exclude the company from using the fissile material.

EU as a driver of legal innovation in AI and Big Data

It is interesting to apply the governance model of EURATOM to Big Data and AI: AI is the core technology, as it were, while Big Data provides the necessary fissile material. AI and big data in combination can be both a blessing and a curse. There is something to be said for considering whether the ownership of data should not in principle be transferred to an independent European institution, which would then grant data usage rights to companies, government agencies or private individuals according to the interest pursued. In this case, among other things risk classes, certain ethical standards, privacy, and technical requirements are taken into account. But the idea of a common digital market in the EU could also be implemented with the help of this solution. Germany and the EU still have every opportunity to become world class in the legal regulation of new technologies.

An independent institution could create a common digital data market in the European Union.

III. Using AI

Practical use of AI technologies in business

How is Artificial Intelligence already being used in companies today – and what future AI applications are companies currently working on? The following chapter will provide an overview of what concrete benefits AI means for people and the economy and what business models are possible from data- and AI-based value creation networks. Here you will find practical case studies from different industries that show how the use of new technologies can concretely support our society today and in the future.

Map on AI of Plattform Lernende Systeme
Research Institutions, Applications and Transfer in Germany

In the coming years, AI will become a **driver of our economy** and thus an important location factor. Which AI applications are already being used in Germany today? Where is research being conducted on the fundamentals and applications of Artificial Intelligence? The continuously expanded Map on AI of Plattform Lernende Systeme provides an overview of AI applications, research institutions and transfer centres in Germany.

In AI research, Germany has been well positioned by international standards for many years. The task now is to develop this into top international AI research and to transfer its results into concrete fields of application in industry. With our AI map, we are making visible who is researching which AI topics in Germany. In this way, we are creating the basis for technology transfer, i.e. for a successful networking of industry and science in AI.

Karl-Heinz Streibich
Co-Chair of Plattform Lernende Systeme and President of acatech – National Academy of Science and Engineering

Making visible how Artificial Intelligence is already transforming the economy and everyday life today and in the future: With this goal, the Plattform Lernende Systeme bundles applications and development projects on the virtual AI map in which AI technologies are used in Germany today and in the near future – acrosss all sectors, fields of application and company sizes. Which research institutions are working on image recognition, data management and analysis, human-machine interaction, speech and text understanding or robotics? The AI map of Plattform Lernende Systeme provides a comprehensive overview with the help of thematic filter functions. In addition to various technological focal points of AI, it also includes institutions that conduct research on social issues surrounding the development and use of Artificial Intelligence.

With the AI Map, the Plattform Lernende Systeme in cooperation with the Federal Ministry for Economic Affairs and Energy (BMWi) fulfilled one of the goals from the Federal Government's Artificial Intelligence Strategy. The AI map is intended to inspire SME entrepreneurs to drive forward the digitalisation of their business processes and develop new business ideas.

Currently, around 950 application examples from research and practice can be filtered by sector and region, but also by field of application, underlying AI technology and value creation activity. The map will be successively expanded with

More info on the AI map can be found here: https://www.plattform-lernende-systeme.de/map-on-ai.html

further examples from science and practice. The spectrum of AI applications is broad and ranges from self-learning chatbots for customer service to condition monitoring of machines and AI-based mobility solutions to assistance systems in healthcare.

The "Research Institutions" section of the AI Map shows which universities and non-university institutions in Germany are conducting research on AI. A filter function allows users to select key topics, such as image recognition, data management and analysis, human-machine interaction, speech and text understanding, intelligent robotics or social issues relating to the development and use of Artificial Intelligence. The AI map lists around 200 scientific institutes and facilities, such as the German Research Centre for Artificial Intelligence (DFKI), which was founded back in 1988. Also included in the list are the AI competence centres funded by the BMBF as part of the national strategy for Artificial Intelligence, as well as numerous university institutes and non-university research institutions.

Where companies are supported free of charge in the introduction of AI and can find offers for networking with partners is shown in the AI map of Plattform Lernende Systeme in the "Strategy and Transfer" section. Throughout Germany, numerous Digital Hubs offer their partners the opportunity to work together to master current technological challenges and create future-proof IT systems and products. As regional and provider-neutral contact points, the Mittelstand 4.0 competence centres support small and medium-sized enterprises as well as craft enterprises in digitalisation. The competence centres are gradually being staffed with AI trainers to provide advice on Artificial Intelligence. The Digital Hubs and the SME 4.0 Competence Centres were initiated by the Federal Ministry for Economic Affairs and Energy (BMWi). The site also provides an overview of the strategic goals and measures of the federal government and the individual federal states to promote Artificial Intelligence.

Particular attention should be paid to small and medium-sized enterprises when it comes to knowledge transfer, demands Karl-Heinz Streibich, Co-Chair of Plattform Lernende Systeme and President of acatech – National Academy of Science and Engineering: "SMEs must recognise the benefits of advancing digitalisation for their business, otherwise they will be left behind. However, they must also be enabled to exploit the AI potential through the availability of data in secure open data spaces".

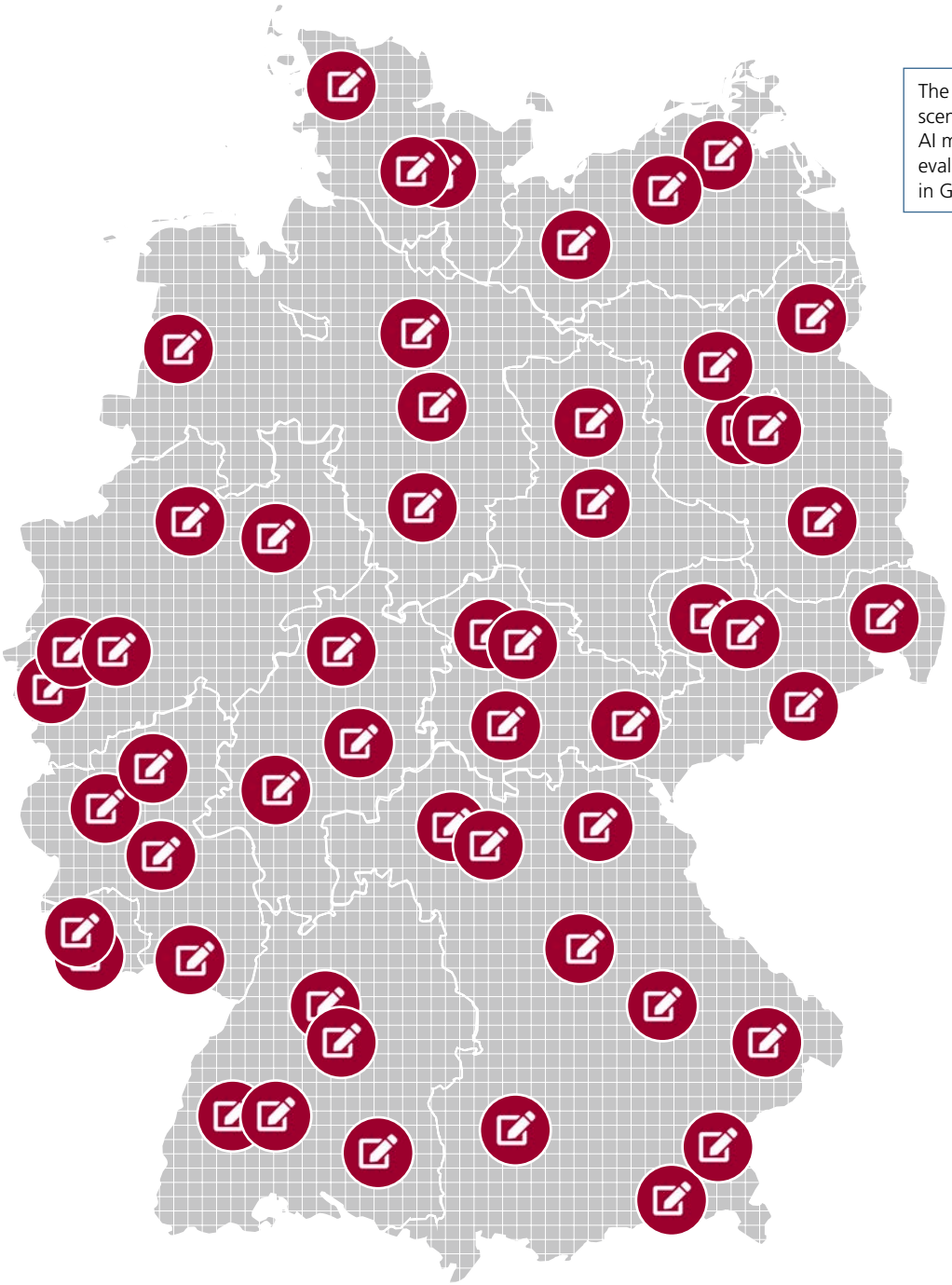
Artificial Intelligence is considered a key technology of the future. Companies are already looking for skilled workers to develop AI applications. Artificial Intelligence methods are also increasingly being used in many research disciplines. Students can now find a diverse range of relevant degree programmes of varying depth and with different focuses. The continuously updated AI map provides an overview of which universities and higher education institutions in Germany offer study programmes related to Artificial Intelligence and data science.

Successful transfer to the economy

Among the AI-based solutions for industry, the AI map presents, for example, the collaborative lightweight robot LBR iiwa developed by KUKA AG and already ready for the market. Thanks to a haptic programming approach, its pre-programmed sequence can be intuitively changed by touch and guidance. The robot thus learns new assembly positions quickly and easily from its human counterpart in production and can perform previously undefined monotonous tasks independently.

Artificial Intelligence in Germany

The AI Map maps AI applications, AI research institutions and AI transfer centres throughout Germany. Today, AI applications are already being used in numerous companies in various functional areas. The evaluation of the entries on the AI Map of Plattform Lernende Systeme illustrates the different sectors, fields of application and value creation activities of AI applications.



The figure shows a fictitious scenario for the entries of the AI map and not a representative evaluation of the different regions in Germany.

Applications

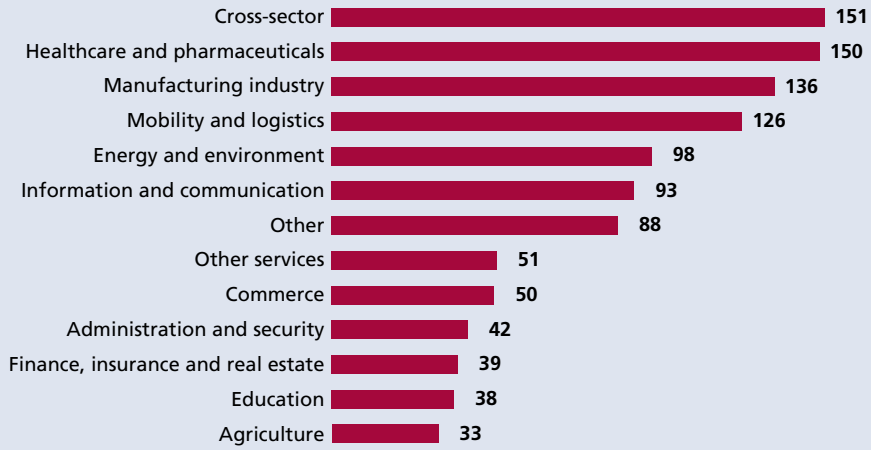
Research Institutions

Strategy and Transfer

Study programs

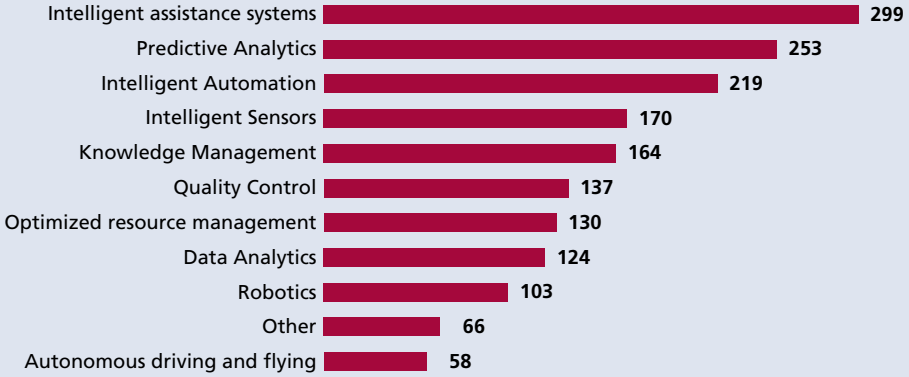
For their support in supplying the data for the AI map, we would like to thank the Forum Digitale Technologien, Fraunhofer IAIS, DFKI, VDI/VDE-IT, appliedAI, BMWi and the working group Business Model Innovations as well as other members of Plattform Lernende Systeme.

AI applications by industry



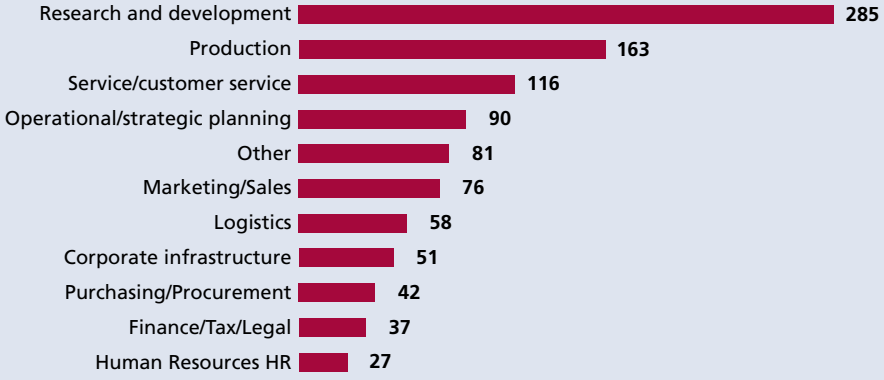
Note: N=731. AI use cases from the AI map by industry.

AI applications according to fields of application



Note: N=687. AI use cases from the AI map by industry.

AI applications by value creation activity



Note: N=675. AI use cases from the AI map by industry.

AI use cases from the AI map by industry. At the time of the evaluation, the AI map comprised approximately 745 use cases (as of June 2020). Since AI applications can often be assigned to several categories, the cases in the AI map have also mostly been assigned to several categories.

AI Practice for Society:
Case studies on the concrete benefits of AI methods

What concrete benefits does Artificial Intelligence create for people and the economy? From start-ups to small and medium-sized enterprises to large corporations – with the help of selected case studies from very different industries, we show how the use of new data and **AI-based technologies** can already support our everyday lives today and also in the future and lead to **new business models**.

Use of AI: Large corporations

Fast alarm in case of fire and smoke through AI-based fire detection system

Smoke detectors hang from the ceiling in many factories and warehouses. But the electronic watchdogs detect many fires only late – when the smoke has risen to the top. This puts people at risk, causes damage to property, and massively disrupts work processes. Bosch Building Technologies has developed an AI-based fire detection system that sounds the alarm much faster in the event of fire and smoke.

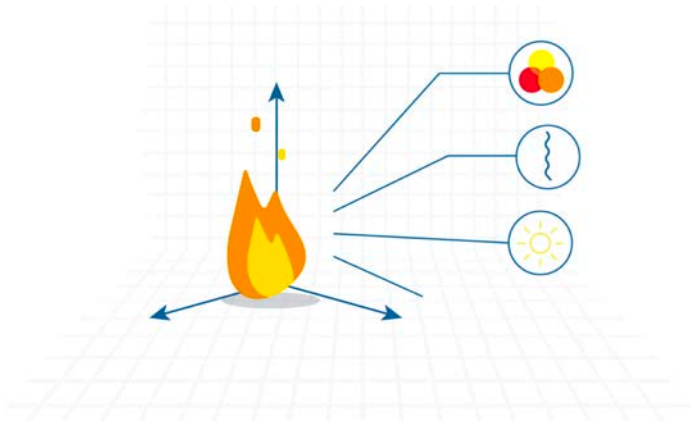
A Monday morning like any other: The huge press shop in the factory hall of an automotive supplier is moulding car tailgates as usual. Suddenly, light grey smoke comes out of the plant. None of the people present notice the small column of smoke that slowly rises the side wall.

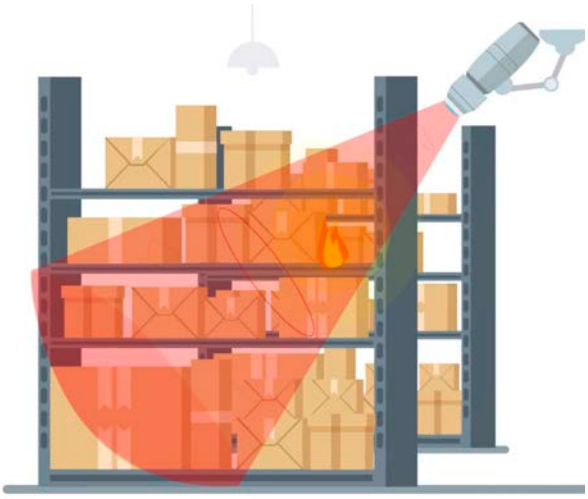
In this fictitious case, it would be very likely that the small column of smoke would develop into an open fire. This is because, as a rule, classic smoke detectors hang from hall ceilings in industrial plants, which can also be well over 15 metres high. How much time would have passed before the smoke would have reached there? When would the concentration have been sufficient for an alarm? Would dust and humidity have delayed the alarm?

Physical algorithms for smoke and flame detection

A video-based fire detection system from Bosch significantly reduces response times. It is already in use in many plants, warehouses, power plants and tunnels in Europe, Asia, and North America. The system, called AVIOTEC, uses intelligent algorithms that are integrated directly into the cameras. These monitor all sensitive areas of the factory and feed their data into a central management system. The information converges in the control centre of the factory fire brigade and is displayed on a uniform user interface. In addition to the pure alarm, AVIOTEC can transmit video images in HD quality in real time – a plus point for assessing the actual danger and for subsequent analysis. Bosch is currently com-

A small column of smoke at the press shop – the AI-based fire detection system AVIOTEC detects it immediately.





bining classic physical algorithms with methods of decision-making based on Artificial Intelligence. "Physical algorithms form the basis. You must imagine it like this: Our developers have watched videos of fires and analysed them. How does the smoke develop and behave? What do flames look like and how do they move? Then they developed algorithms that map these visual manifestations," explains Sören Wittmann. The product manager at Bosch Building Technologies explains how the AI-based fire detection system works. In the future, the AI component is to be further increased to detect fires even faster and more reliably. "We have to adapt the depth and structure of the neural networks to recognise the different manifestations of smoke and flames. This also places enormous demands on the data sets we use to train the networks. Finally, we need to understand what the AI has learned. This requires independent testing and validation datasets. And finally, processors that fit into our cameras are not powerful enough now. So, it will still take a little while," says Sören Wittmann.

AI-PROVIDER

https://www.boschbuildingsolutions.com/de/de/loesungen/gebaeudesicherheit/systeme/anlagentechnischer-brandschutz/aviotec/

Vision Zero – Reducing traffic accidents with the help of AI systems

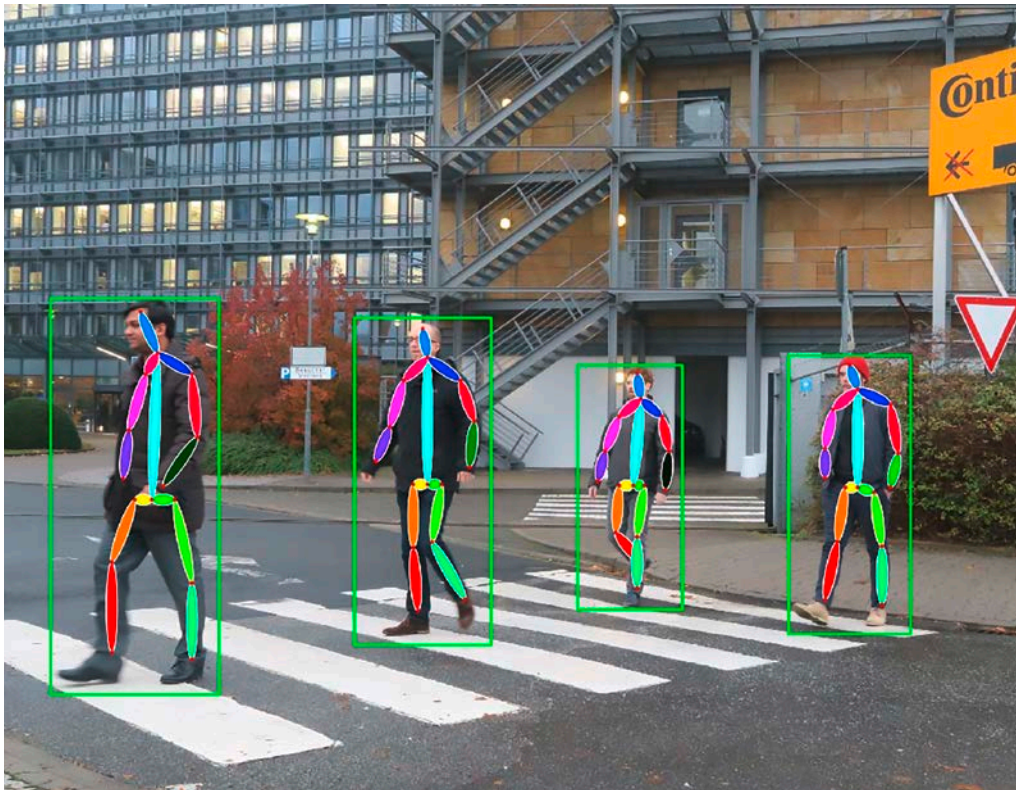
Whether it's a case of car body damage or personal injury, the number of road traffic accidents worldwide has been declining for decades. But despite technical innovations such as seat belts, ABS and airbags, there are still fatal accidents in Germany every year. Continental has taken up this challenge – with an ambitious goal: in the future, there should be fewer road deaths, fewer injuries, and fewer accidents overall. Technological know-how and Artificial Intelligence are needed to achieve this.

It often happens quickly: too high a speed, bad weather conditions or looking in the wrong direction – and there's a crash. In the worst case, it is not just a dented car body, but people are injured or killed. To mitigate the consequences of an accident or to avoid the crash altogether, car manufacturers and suppliers have been researching innovative technologies on and in the car for years. Field-tested assistance systems such as the electronic stability control (ESC) or the lane departure warning system support the driver in tricky situations and noticeably increase safety in one's own car. But what happens when a constellation is more likely to pose a danger to other road users? This is where assistance systems whose functionality is based on Artificial Intelligence can help.

Recognise attention and predict behaviour

Pedestrians and cyclists are often unprotected in road traffic and therefore particularly vulnerable. A quick movement of the handlebars, an ill-considered step, a quick step on the accelerator. Any mistake can have fatal consequences when cars and people get too close to each other.

Artificial Intelligence can enable the vehicles of tomorrow to intervene here to save lives. State-of-the-art camera and sensor technologies for accelerated object recognition allow intelligent software, for example, to detect the behaviour of other road users and predict their actions. Specifically, the procedure is based on the detection of so-called key points on people, i.e. eyes, nose, ears, but also shoulders or elbows. From these key points, the system generates a skeletal representation – and thus recognises body posture and direction of gaze. If these indicate, for example, that a pedestrian is inattentively about to cross the road, an assistance system can either support the driver in initiating emergency braking or carry this out independently if the driver realises the danger too late. Of central importance here is that the system reliably recognises and evaluates the key points even when pedestrians or cyclists are partially obscured – a feat that would not be possible without the use of Artificial Intelligence.

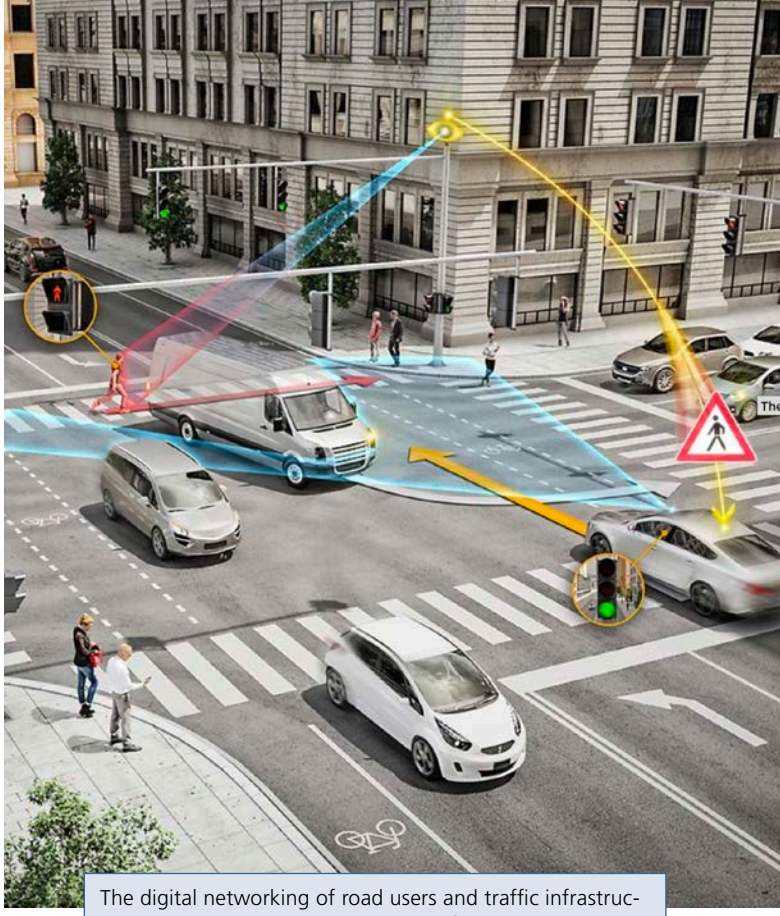


Keypoint detection for pedestrians with the help of neural networks.

An interplay of many factors

For us to turn improvements into reality in different contexts, sometimes utopian goals are needed. However, many factors are necessary to get closer to the goal of a future with fewer road accidents – especially if we consider the developmental progress towards a world of autonomous driving. It is essential to think of mobility holistically at this point. This includes not only the combination of assistance systems, AI applications and safety features of individual vehicles. The digital networking of road users and the transport infrastructure will also be of fundamental importance. And finally, raising awareness of avoidable dangers. The project staff and engineers at Continental know this first-hand. Because serious accidents involving tyres happen again and again – but not because of material or design defects. Rather, people still underestimate the effects of insufficient tread depth, incorrect air pressure or simply the unpredictability of summer tyres on slippery winter roads.

AI-PROVIDER
https://www.continental-reifen.de/autoreifen/ueber-continental/vision-zero



The digital networking of road users and traffic infrastructure can contribute to greater road safety.

Use of AI: Small and medium-sized enterprises

Pretzels, bread and Big Data – AI-based sales planning in bakeries

Every evening, German bakeries must dispose of goods that have not been sold. According to a recent study by the Münster University of Applied Sciences, between six and 17 per cent of fresh baked goods do not end up on the customer's plate but end up in the waste container. The reason: too much is produced. The start-up meteolytix supports bakeries with AI-based software for better daily sales planning.

Even bakers with many years of experience find it difficult to estimate how many loaves of bread and other baked goods are needed for the next day. The expenses resulting from miscalculations are enormous. In addition, there are the moral aspects of wasting food. In 2009, Nils Passau and Meeno Schrader from Schleswig-Holstein founded meteolytix GmbH to remedy these problems. The entrepreneurs developed a software that supports large and small bakeries in planning purchasing, production, sales and personnel requirements. Surplus goods and empty shelves should be a thing of the past.

Weather, construction sites and other sales factors

Founder Meeno Schrader, who holds a Phd in meteorology, previously worked as a research assistant at the Kiel Institute of Oceanography, among other things. There he realised that weather forecasts allow a statement about the expected customer traffic of small businesses such as bakeries. But it's not just sun or rain that decides the current order situation: the start-up determined over 400 additional factors that are decisive for sales in the baking industry.

AI-based predictive analytics can lower costs for companies and reduce overproduction.

For example, is a construction site in the street obstructing access to a branch? Is there a public festival taking place in the area? Is the nearest tram line cancelled due to track work? Are there school holidays now? These and numerous other factors are considered by meteolytix in its complex calculations. The software uses algorithms from the field of predictive analytics and calculates the data of the external factors with the help of Artificial Intelligence. The following applies: the more data a bakery can provide, the more accurate the forecast will be. Ideally, the data history of an entire year is available.

Precise forecasts also for other industries

Many German bakeries now rely on the forecasts provided by meteolytix using Artificial Intelligence. But they are not the only ones to benefit from the new forecasting possibilities: Travel agencies, butchers, fashion stores and wholesale markets could also reduce their costs by using predictive analytics. For their solution, which also benefits smaller SMEs, they were awarded the Digitalisation Prize of the State of Schleswig-Holstein in 2019.

AI-PROVIDER
https://meteolytix.de/

Select the best photos quickly with Deep Learning

The smartphone has fundamentally changed photography. The permanent availability of the camera built into the phone enables users to capture almost every moment of their own lives. Day after day, gigantic quantities of images and data are created in this way. The photo service provider CEWE relies on neural networks to support its customers in the future in viewing and evaluating these photos.

Today, far more pictures are taken with a smartphone than with a digital camera. At the same time, the shooting behaviour of users has changed. Special experiences and unforgettable moments are still photographed. However, mobile phone users take photos much more often for purely informative or communicative purposes – the photo becomes a visual reminder or a short message for friends. The flood of images on the devices is correspondingly large; it continues to grow through sharing via apps or social media. Due to the sheer volume, the photos can neither be curated, organised nor designed afterwards. Important photos also disappear into the depths of ever-larger storage media – and are printed out less frequently.

AI recognises relevant and well-made recordings

The photo service provider CEWE wants to support hobby photographers in coping with the flood of data – with the help of AI. The Oldenburg-based company had already launched software for designing photo books in 2006. The basis was algorithms that could not only identify the technically best pictures on a device, but also – with the help of intelligent clustering – the most relevant ones. However, automatically finding the essential photos and determining and presenting a selection of photos with classic methods based on algorithms and heuristics was not possible based on these algorithms. CEWE therefore relies on Deep Learning. What is

needed above all is relevant data in large quantities, as is produced in sufficient quantities in mobile photography.

The focus of the AI applications developed by CEWE is on neuronal networks which are taught to determine the best picture in a series, for example. Basic rules of photographic design are applied, such as the rule of thirds, which is based on the theory of proportion of the golden section. Photographs with relevant people and places can also be detected automatically. Photos with people are automatically combined by means of face recognition. The object recognition used is based on an extensive thesaurus and groups suitable pictures, for example according to keywords such as "beach" or "mountains". Location recognition rounds off the image organisation through geographical clustering. Images of desired persons, in a favoured setting and with suitable temporal parameters can thus be searched for and filtered. For the customer, this means saving time and possibly a more targeted selection of photos in a shorter time.

Positive feedback from the industry

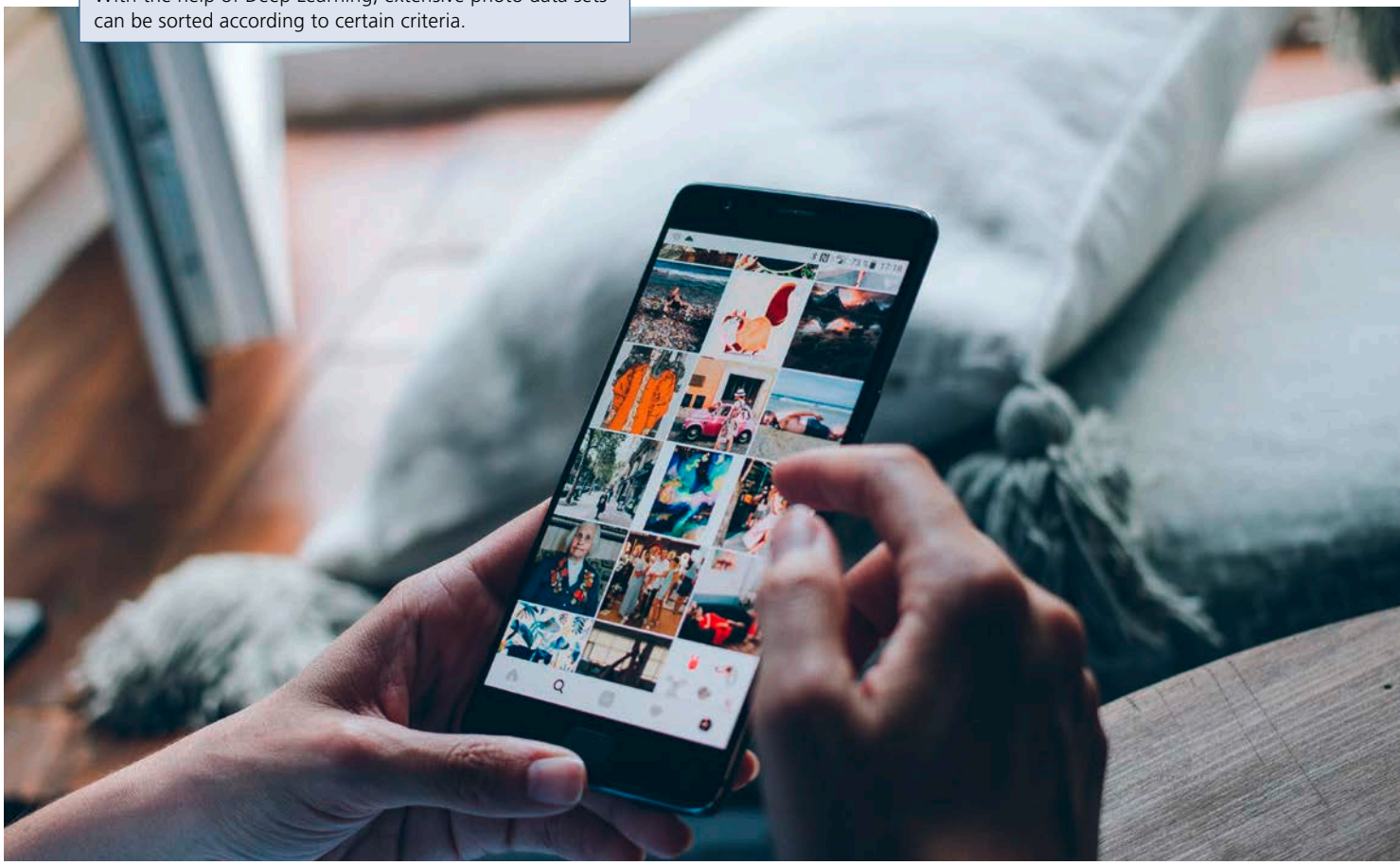
The new technology is still under development and not ready for commercial use. However, CEWE has already defined and tested the first use cases together with its development partner, OFFIS – Institute for Informatics, which is also based in Oldenburg. These met with a positive response at the photokina photo trade fair in Cologne. As it still takes time to develop a completely AI-controlled solution for selecting and processing photos, CEWE is currently taking a two-pronged approach: individual partial solutions can be integrated into the applications available on the market in advance.

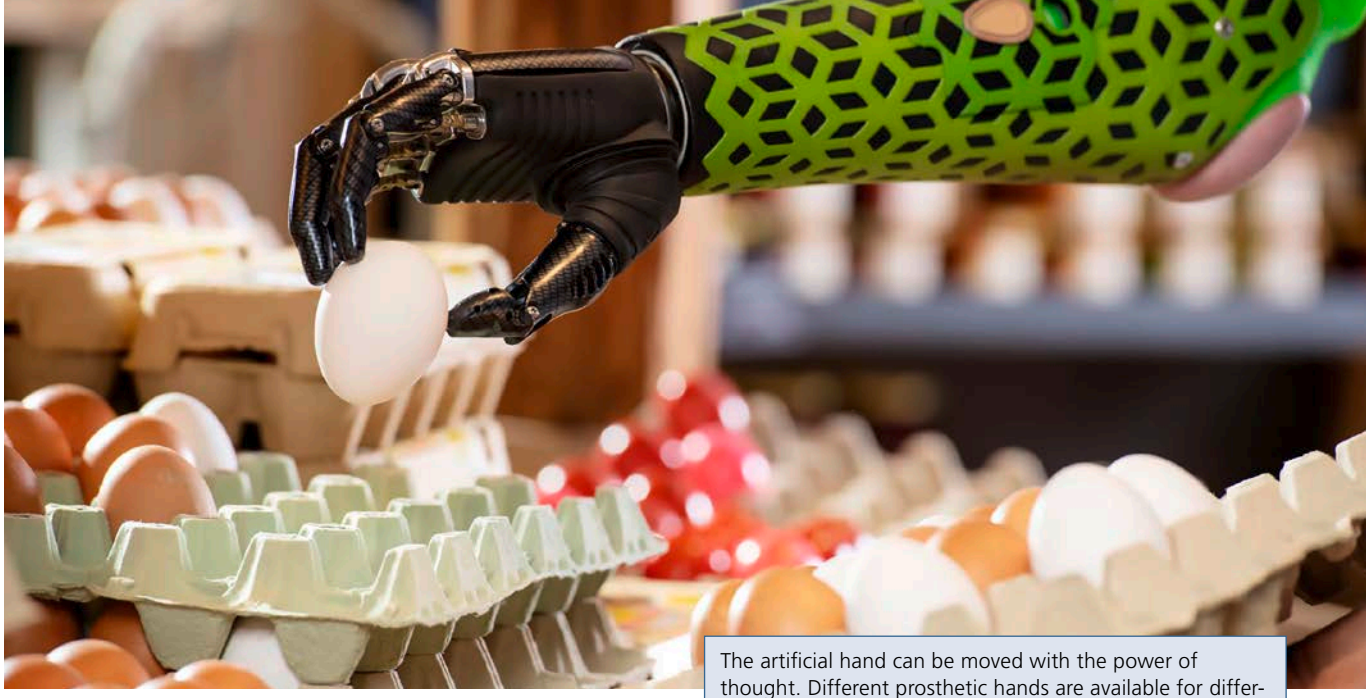
The use of Artificial Intelligence requires responsibility in an area as personal as photography. For this reason, CEWE has adopted a customer charter. It states that the benefit of people and the protection of privacy are always in the foreground for all technical solutions – currentt and future. Whether the customer wants to use the technical possibilities is up to him: Those who want to edit their pictures without the help of AI can deselect the corresponding option.

AI-PROVIDER

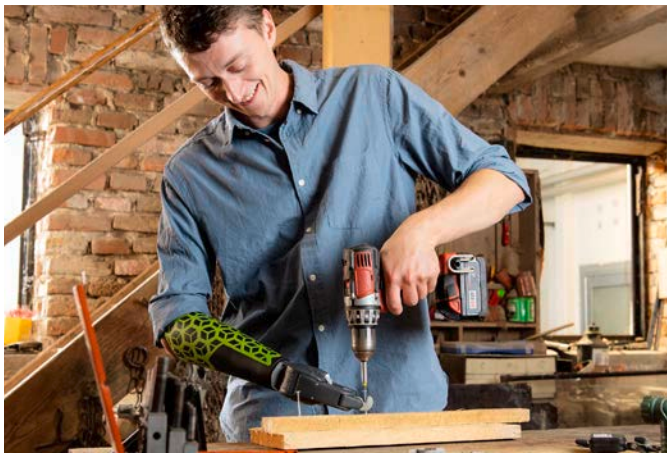
https://company.cewe.de/de/home.html

With the help of Deep Learning, extensive photo data sets can be sorted according to certain criteria.





The artificial hand can be moved with the power of thought. Different prosthetic hands are available for different tasks.



More independence through AI – The self-learning prosthetic hand

The medical technology company Ottobock has developed a prosthetic hand based on Artificial Intelligence. Hand amputees can control it intuitively with the power of their thoughts and thus lead an active, independent life.

Wolfgang Bauer is 21 years old when he gets his right hand caught in a chopper. "Of course, at the beginning I hoped that it might still be possible to save the hand. But it quickly became clear to me that that was not possible," recalls the now 24-year-old. In the meantime, Wolfgang Bauer has become a future master farmer and is fully committed to his parents' farm: He supplies the animals with hay and water, carries crates, works in the farm's small workshop or on the computer, and even sorts raw eggs – all with both hands.

Classify patterns, trigger movements

This is made possible by the "Myo Plus" hand prosthesis controller from the medical technology company Ottobock in Duderstadt. The neon green-black high-tech instrument is based on pattern recognition and Artificial Intelligence. The special feature: Bauer operates his artificial hand solely with the power of his thoughts. As soon as he wants to make a certain hand movement, his brain sends signals to his forearm muscles. Despite the accident, Bauer can still imagine opening, closing, or turning his hand. In doing so, he activates the remaining muscles in the stump. With the help of eight electrodes, "Myo Plus" measures the incoming signals and recognises patterns from them that belong to individual movements. The intelligent prosthesis can classify and amplify the signals and patterns to finally translate them into a hand movement. "I don't even have to think about the control. Within a second, it's practically automatic. Just like a real hand," Bauer tells us. On his old prosthesis, he had always had to flip a kind of switch with his left hand. "Today, I simply think of the movement I want to make, and the prosthesis control system implements it.

Fine tuning via app

A self-learning prosthesis also makes sense from a medical point of view. "The big advantage overall is that the prosthesis learns from the user, rather than the user having to learn how a prosthesis works or adapt to how the prosthesis works, as was previously the case," explains Dr Thomas

Fuchsberger. As a senior physician at the BG Clinic in Tübingen, he treated the first patients there with the "Myo Plus" prosthesis control system as part of a clinical study.

The first adjustment is made by an orthopaedic technician. But an app allows patients to optimise the control themselves. This allows them to better train movement patterns, refine them and then save them. "I always open my hand quickly and then go into the individual grips. It all goes through the subconscious and that's why I'm very, very fast," Wolfgang Bauer explains the learning process of the "Myo Plus" pattern recognition.

Different hands

Ottobock's prosthetic controller can process more signals and trigger more hand movements than conventional systems and can be controlled faster, more precisely and more intuitively. In addition, Wolfgang Bauer can use different prosthetic hands for different tasks on the farm – for example, one for light but varied work and another to grip firmly. His new prosthetic hand based on Artificial Intelligence sets him hardly any limits.

AI-PROVIDER
https://www.ottobock.com/de/

Use of AI: Start-ups

Online translations at the push of a button

For years, online translations were ridiculed as gibberish – the results were too unwieldy and sometimes even nonsensical. Artificial Intelligence methods brought a breakthrough here. Also for DeepL. Today, the small Cologne-based company is one of the leading AI companies in the German-speaking world. In online translations, it now competes with market giants such as Google and Microsoft.

The beginnings of DeepL date back to 2009, when former Google developer Gereon Frahling teamed up with a school friend to break new ground in online translation. They founded the start-up Linguee, an online dictionary for 25 different languages. Eight years later, the founders presented a fundamental technical advancement – a new translation tool based on Deep Learning methods. From now on, the aim was not to translate individual words, but entire sentences at once. In future, the translated texts should be more fluent and make more sense. With the use of the new technology and in line with it, the founders also renamed their company – DeepL.

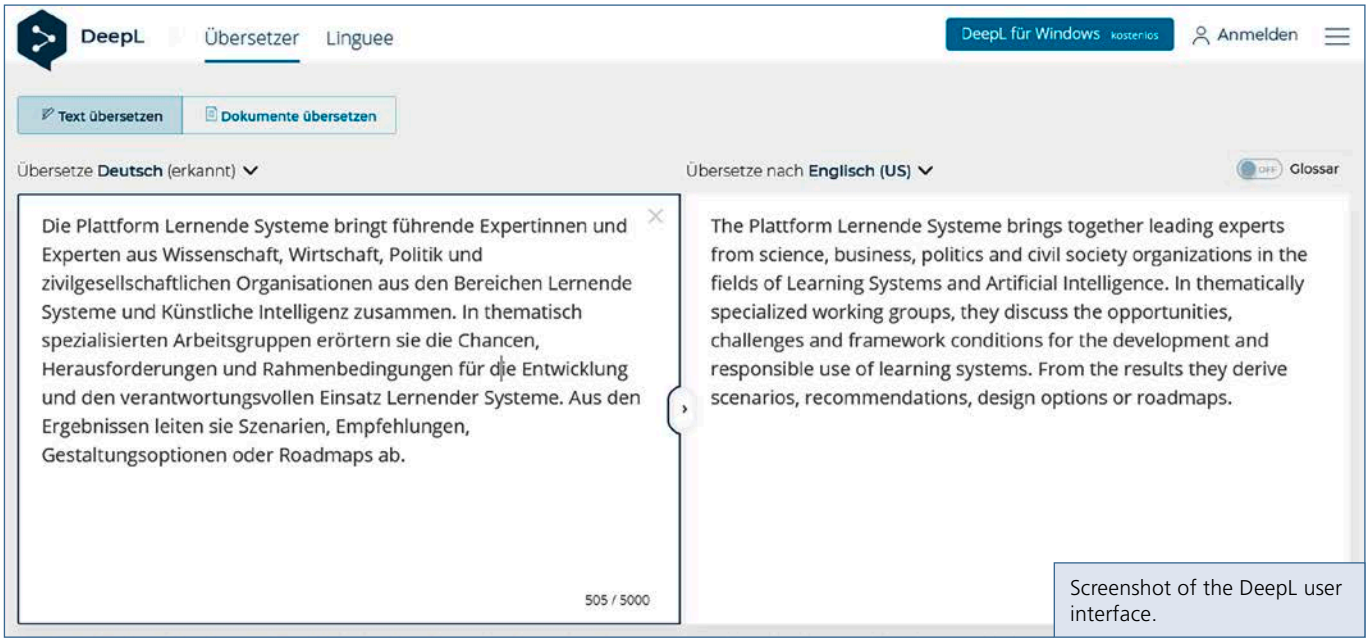
Better than Google, Microsoft and Facebook

To launch the new translation software, the Cologne-based start-up launched a challenge: It had 100 sentences translated by Google Translate, Bing Microsoft Translator, Facebook Translator and its own tool and then had the results judged by professional translators. They did not know which translation came from which system. The result: the translations from DeepL were rated far better than the competition. Why? Because they sounded more natural. Unlike Google and Microsoft, DeepL uses so-called Convolutional Neural Networks (CNNs) that are trained with the company's own Linguee database. The translation is generated by a supercomputer that achieves 5.1 petaflops (= computing operations per second). With this, DeepL manages to translate a million words in less than a second. The neural networks were trained with over one billion translated sentences provided by the translation search engine Linguee. Many text samples also came from documents from multilateral institutions such as the European Union.

Time and resource savings through neural networks

A basic version of the online translation tool is available free of charge on the internet. For professional use, the company offers subscription models. What takes a human being some days, if not weeks, the translation tool from DeepL can do in seconds. The significance of the AI-based translation suggestions lies primarily in the time and resources saved. The company has shown that it is not always necessary to invest billions to compete with the big players in an industry. Sometimes the intelligent application of algorithms is enough. In this case, they help to fulfil an old dream of mankind: To end the great confusion of languages on earth – at least in written language.

AI-PROVIDER
https://www.deepl.com/translator



Screenshot of the DeepL user interface.

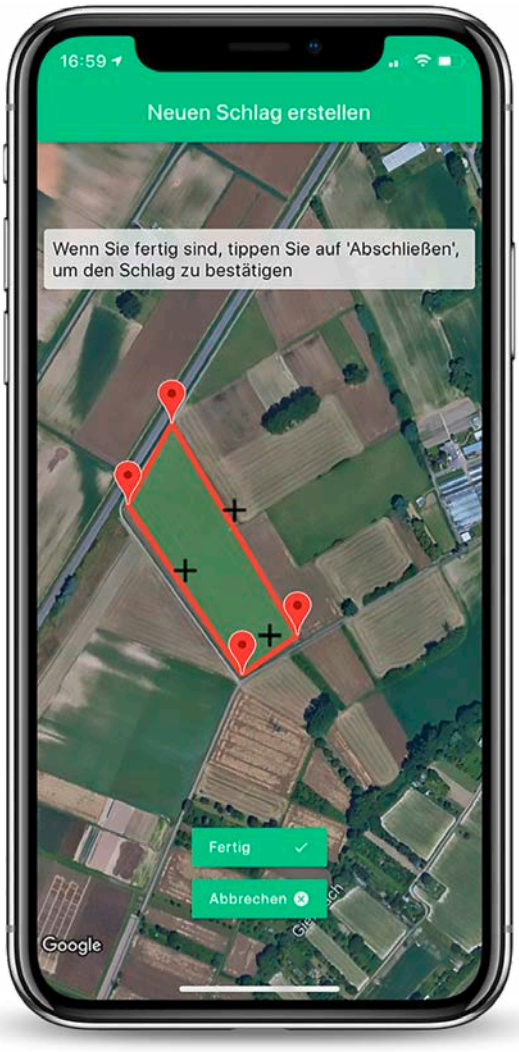
More efficient irrigation in agriculture through AI

Drought, weather variability and moisture-related diseases are responsible for billions of dollars of damage to agriculture each year and threaten the food security of millions of people worldwide. More accurate information about the condition of plants and soils can help farmers take effective measures against crop failure and drought damage and irrigate more efficiently. The start-up heliopas.ai from the Karlsruhe Institute of Technology (KIT) analyses satellite images with AI and thus supports farmers in resource-conserving, more sustainable agriculture.

After drought and heat in the extreme summer of 2018 led to significant crop failures in German agriculture, the Federal Ministry of Agriculture provided millions of euros in emergency aid for farmers. "Unfortunately, this is not a regional problem," explains founder Ingmar Wolff of the start-up heliopas.ai. Due to global warming, an increase in extreme weather situations must now be expected worldwide, he says. Together with his fellow founder Benno Avino, he wants to help farmers deal with the new situation: "We use Artificial Intelligence to understand very precisely what is actually happening in the field, how the plants are doing and where any problems arise. We use these insights to bring recommendations to the farmer's smartphone so that he can react optimally to the weather," says Wolff.

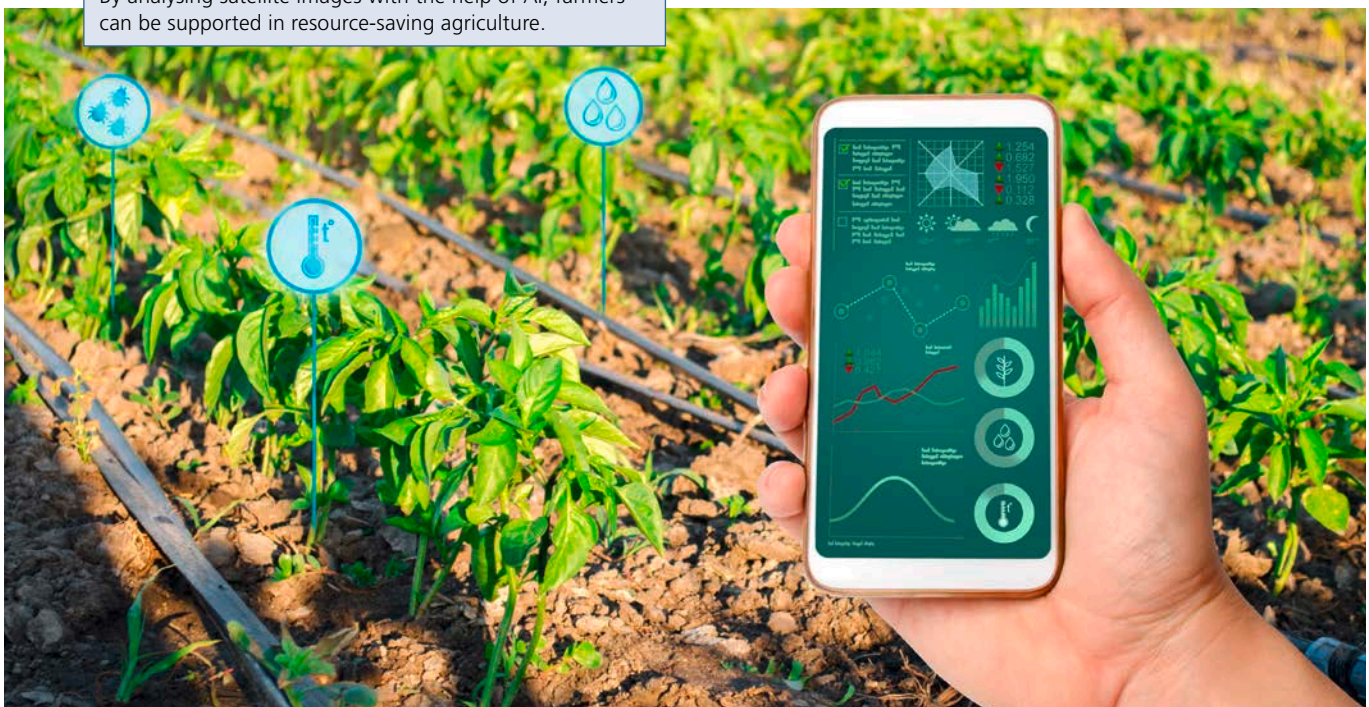
AI app helps farmers protect plants and nature

Farmers would not need to install any sensors or other devices on their land. The AI technology analyses what is happening in the field, how the plants are doing and where problems may arise. The new technology is based on the analysis of daily satellite images, precipitation amounts and other data, in which an Artificial Intelligence can then recognise relevant parameters such as soil moisture, but also a disease infestation of the plants. Thus, the Artificial Intelligence of heliopas.ai has been trained to evaluate parameters such as soil type, crop type, tillage, plant health and natural weather values as well as weather history. By combining these parameters, it detects when a plant is developing unfavourably in the field, even before the farmer can observe it from the field edge. The early warning, combined with a concrete recommendation for action, is made available to the farmer through the smartphone app "Waterfox". Customers can test the product free of charge, after which use is billed by the hectare – so the service can be worthwhile, especially for small farms. With the help of the data, yields can be maximised while complying with environmental regulations: "Thanks to the simple and clear recommendations, the farmer then only irrigates where it is actually necessary," says Wolff. "This saves him water in irrigation and effort in planning and coordinating his seasonal workers." In addition, for example, less prophylactic pesticide needs to be sprayed on the fields, which protects the crops and nature. In future, in addition to recommendations on irrigation, there will also be instructions on precise fertilisation and well-dosed plant protection. Farmers thus increase their crop yields, produce healthier food, and protect the environment.



AI-PROVIDER
https://waterfox.heliopas.ai/

By analysing satellite images with the help of AI, farmers can be supported in resource-saving agriculture.



AI and data-based value networks

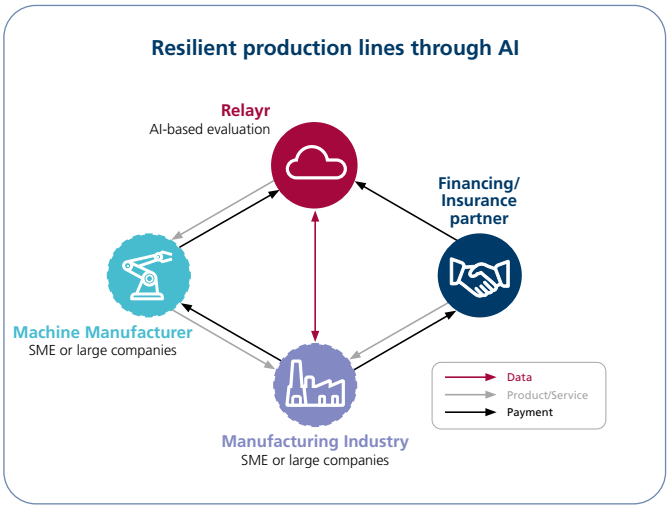
AI enables disruptive economic change processes in various industries. At the same time, it creates far-reaching opportunities for large companies, start-ups, and SMEs to make existing processes and routines more efficient and to design and implement innovative data-driven and platform-based business models. This goes along with new forms of the benefit or value proposition, the value creation finances or revenue generation, the value creation architecture, and the value creation network.

Value creation networks enable innovative service offerings based on platform-based, data-driven business models through flexible, dynamic, and automated interaction or collaboration between different actors. The prerequisite for this is secure, largely open data access and exchange from various sources across company and industry boundaries. In most cases, individual companies alone do not have all the necessary core competencies and system components for AI and data-based business models. In addition to access to data sources, organisations often lack competences in data analytics and AI. Cooperation with providers of data, technologies and digital platforms can help to build up the necessary knowledge via value creation networks or alliances within digital ecosystems.

Collaborative creation of product service systems

Key to this is the collaborative creation of individualised product service systems (PSS) that can be tailored to the user and offered via platforms. These PSS can be realised mostly through an overarching, automated exchange of data between different actors. This requires that traditional value chains are broken up and dynamic value networks are established. Flexible digital ecosystems are thus created along data and service platforms.

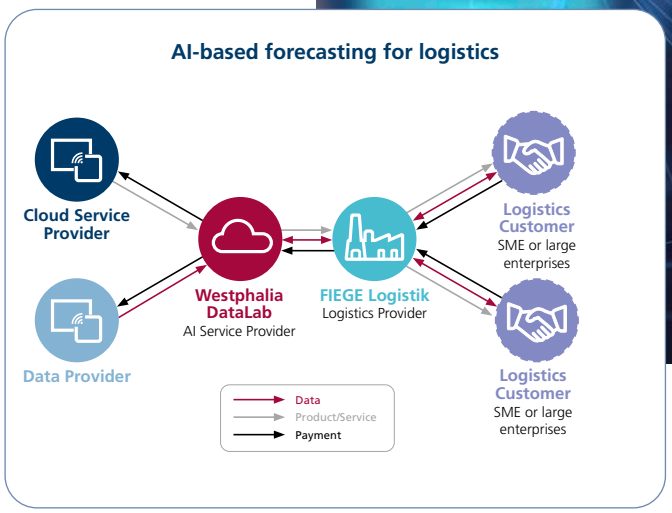
With the help of AI and data-based value networks, the actors involved generate knowledge based on shared data and the implementation of Artificial Intelligence methods, thereby creating added value and achieving measurable benefits overall.



In the following, two case studies of active and successful value networks based on shared data processed with AI methods will be presented. They are intended to illustrate what is important in the implementation of data- and AI-based value creation networks, especially in medium-sized companies, which particular challenges need to be considered and why the exchange with partners and cooperation with application partners is so important.

Resilience through AI analysis in production lines

In the highly automated manufacturing industry, unplanned downtime generates high production losses. The data-based innovation in this case study is that machine function is monitored by machine-integrated sensors and AI-based evaluation with the help of Relayr as an expert in predictive maintenance. Untypical behaviour is reported, the machine is checked and, if necessary, serviced before a failure occurs. The added value is that unplanned plant downtime is prevented and the risks of potential damage due to production failures are minimised. As part of the Munich Re Group, Relayr can draw on several possible financing and insurance models and partners to offer a suitable value creation model. The data security required in many industries is a hurdle for monitoring using smart maintenance. In addition, measurements of the relevant parameters can generate very large amounts of data, which poses a challenge for the IT infrastructure. AI-based evaluation on the edge, directly at the machine, and assessment as typical or atypical machine behaviour can reduce the amount of data to a minimum. In addition, the



Based on shared data and the implementation of AI methods, companies can establish new business models.

use of AI methods makes monitoring agnostic, i.e. it is not possible to draw conclusions about the actual processes in production.

AI-based forecasting using the example of logistics

In the logistics sector, the forward-looking planning of the necessary storage capacities, considering all influencing factors, is difficult to realise. The data-based innovation of this value network is that Westphalia DataLab offers AI-based forecasting: Existing data form the basis for calculating future sales figures and provide information about the factors influencing a company's sales.

The service is provided as Software as a Service (SaaS). Value is created by FIEGE Logistik acting as an innovation driver and not only as an investor in this network, but also as a customer benefiting directly from the forecasting service. Depending on the type, the data is provided by the customer, crawled from the internet, or purchased from free data providers. Due to the lack of standards and the poor quality of master and transaction data, more extensive data cleansing is often required to be able to create reliable forecasts using AI methods. In addition, the willingness to share data is less pronounced in Germany than in other countries, where sales and partly forecast data from different retail chains are exchanged under co-opetition conditions.

FURTHER INFORMATION

These and other case studies of AI- and data-based value creation networks are presented in the publication "Creating Value from Data – Potentials of data- and AI-based value networks".

Interview with Svenja Falk

AI-based business models: Lifting data treasures together with partners

In the age of digitalisation, **value creation** is increasingly achieved through digital services. This calls for new forms of cooperation in so-called **digital value networks**. **Svenja Falk** explains in an interview which advantages these networks bring, why data and AI-driven applications are also interesting for SMEs and what needs to be considered when introducing value creation networks. She is Managing Director at Accenture Research, honorary professor at Justus Liebig University in Gießen and member of Plattform Lernende Systeme.

What potential do data- and AI-based value networks offer and what challenges do they face during implementation?

Artificial Intelligence is ushering in a new phase of value creation. However, companies are analysing very carefully which value creation is feasible. We are still at the very beginning of data- and AI-based value networks. One of the biggest challenges is that the value proposition of AI has not yet arrived in most companies. While we now understand that value creation is increasingly shifting towards digital services, scaling and monetisation is still a challenge. Bringing the physical and digital worlds together will play a decisive role in international competition in the future. It is therefore essential that we understand the architecture of business models that enable data-based value creation. It is important to look at the potential not only from a business perspective, but also from an economic perspective. To this end, these technology innovations must be adapted as broadly as possible to realise economic benefits.

The question of monetisation is the decisive challenge for the further development of digital value networks – regardless of the respective company size. This challenge affects not only Germany, but many countries around the world – for instance China – which has already made great progress in scaling such business models. In addition, further challenges arise in the economic use and permanent integration of partners within such networks. These include technical questions about interfaces, data formats and the interoperability of the systems involved, but also trust in the partners involved and their security measures.

Many SMEs are still hesitant about introducing and implementing data- and AI-based applications. Why is it worthwhile for them to get involved?

Data and AI-based applications offer SMEs great potential to increase production efficiency, prevent production downtime and reduce logistical bottlenecks. If you look at production, maintenance management or quality control in companies, it becomes clear that more SMEs are already using data-based value creation than you might think. There are already several interesting practical examples, which are also presented on the AI map of Plattform Lernende Systeme. Of particular interest for small and medium-sized enterprises are use cases for regional cooperation, for example between local bakeries. Before implementation, however, it must first be clearly defined why such AI or

data-based value creation can be worthwhile for a company, how it fits into the corporate strategy and whether the assumed potential added value is realistic. If we look at the specific bakery example, for example, it becomes clear that the aim here is to optimise supply and demand in a regional market. The aim is to be able to meet consumer demand and at the same time to have to destroy fewer overproduced products. This may sound trivial at first, but it is incredibly attractive for companies to be able to balance markets. Of course, this can also be transferred to other use cases, for example, to minimise downtimes within a company with the help of new technologies, to increase quality standards or to gain a better understanding of the breaking points in the processes in a company.

What should companies consider when implementing such value networks?

"Buy, build or borrow? It is very important for companies to decide: What strategy do I pursue to optimise and exploit the potential? For individual, small companies, it may make sense to think about forms of consortia or cooperation with other service providers or smaller companies. After the strategic evaluation of why data- and AI-based applications should be implemented in

One of the biggest challenges is that the value proposition of AI has not yet arrived in most companies.

Svenja Falk
Managing Director at Accenture Research and member of Plattform Lernende Systeme.

Tanja Rückert (Bosch Building Technologies, from right to left), Olga Mordvinova (incontext technology) and Wolfgang Faisst (ValueWorks GmbH, co-head of the working group Business Model Innovations) discuss at the Digital Summit 2019 how AI can drive the platform economy.

the company, the second important step is to define a strategy for implementation. Here, costs, but also personnel considerations play a role in deciding how to sustainably implement, operate, analyse, and make such an application useful for the individual company in the long term. Regardless of the size of the company, the initial consideration must be: How can this technology innovation benefit me? What is the value proposition for my customers, for my employees, but also for my own company goals? The next step is to design the implementation of these technologies.

ABOUT THE INTERVIEW PARTNER |

Prof. Dr. Svenja Falk is Managing Director at Accenture Research. She is responsible for market and trend studies, strategy development and partnerships with global multi-stakeholder platforms. Svenja Falk is a member of the board of the Accenture Foundation, head of the working group on Digital Business Models in the Plattform Industrie 4.0 and member of the working group Business Model Innovations of Plattform Lernende Systeme. She is also an honorary professor at the Justus Liebig University in Gießen and a fellow at the Hertie School of Governance.

The concept of Smart Data Innovation Challenges (SDI-C), which extend the Smart Data Innovation Lab (SDIL), represents a funding opportunity for SMEs to implement data strategies and issues related to the integration of data in the company. The Federal Ministry of Education and Research (BMBF) funds AI micro-projects with a clear reference to industrial data, in which companies (or also public authorities) are involved as associated application partners and data providers.

AI in Germany in research, teaching, innovation

Competence centers for AI research

The existing centers at universities in Munich, Tübingen, Berlin, Dortmund/ St. Augustin, Dresden/Leipzig will be expanded from January 2022, subject to a successful scientific scientific reviews, will receive permanent funding from the funding. The further development of the DFKI will be advanced in parallel.

Source: BMBF

480 billion euro GDP growth

An analysis of over 150 use cases across all relevant industries and all corporate functions shows: If companies use the potential of AI comprehensively, a total potential of around EUR 488 billion will be created for the German economy in 2025. This corresponds to a 13 percent increase in GDP compared to 2019.

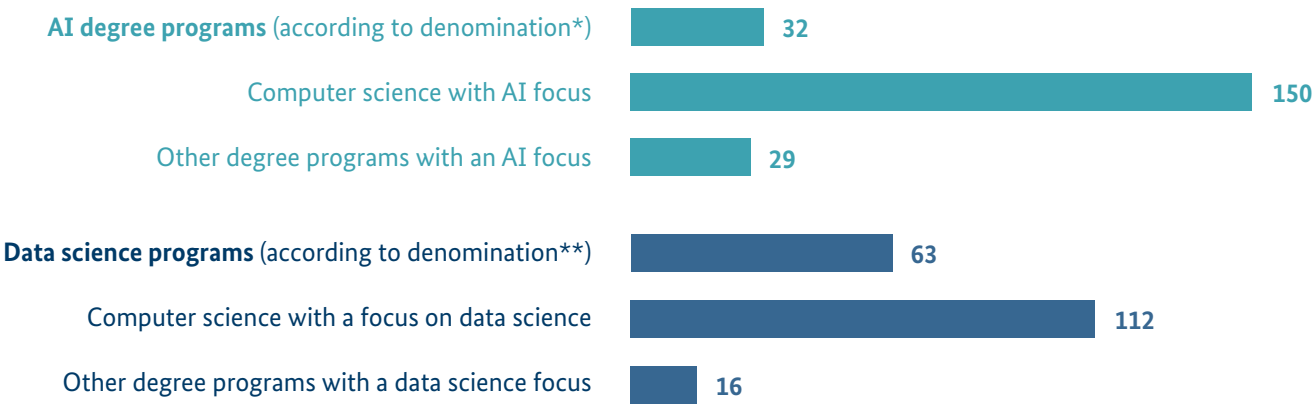
Source: Study „Artificial Intelligence: Potential and Sustainable Change in the Economy in Germany", eco e. V. in cooperation with Arthur D. Little

28 new AI professorships filled

Since the adoption of the AI strategy, 28 AI professorships have already been filled - despite the intense global competition for AI expertise - which are the result of BMBF funding or were established by the Länder in the context of the aforementioned measures.

Source: BMBF

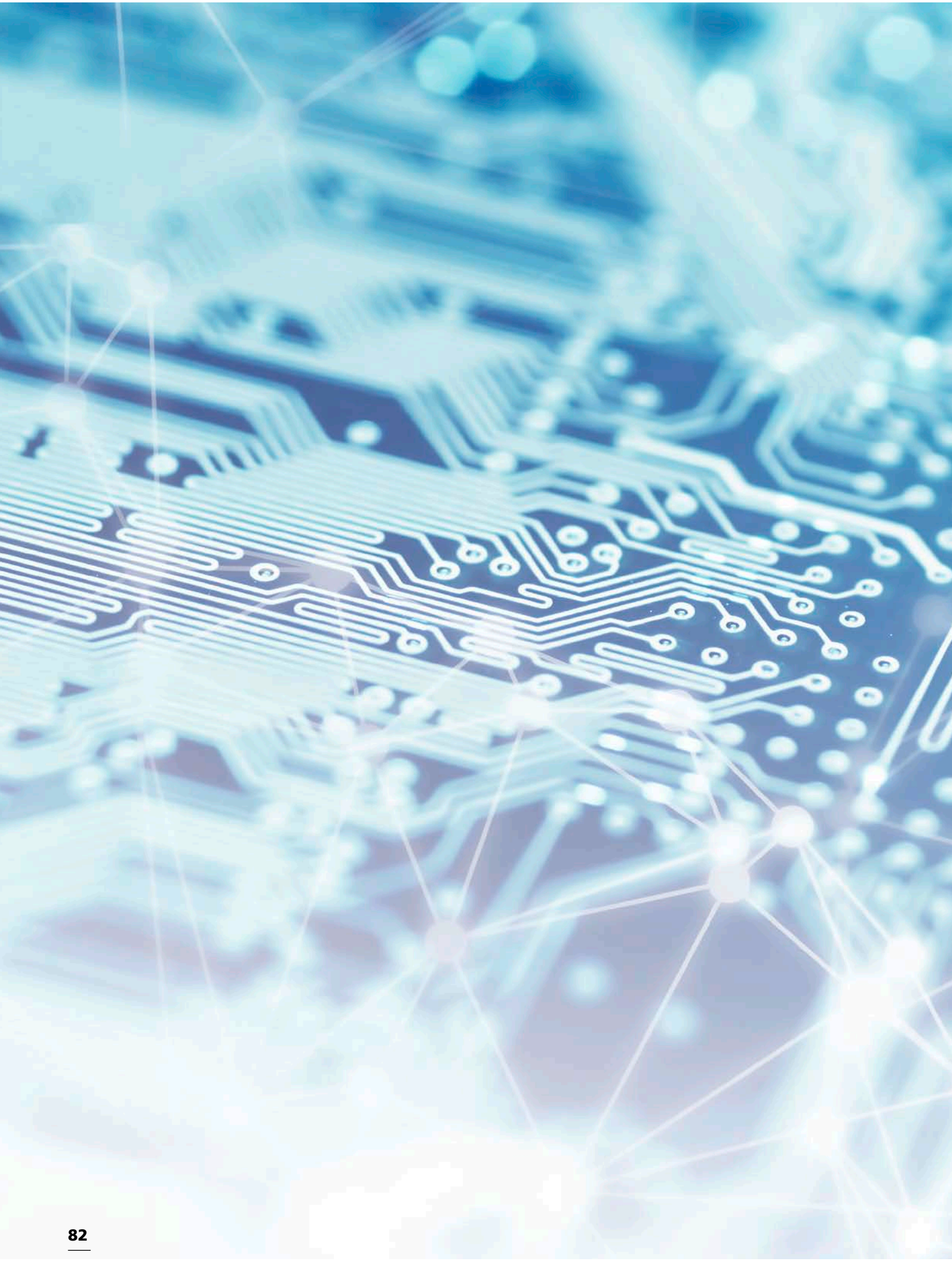
Number of study programs around AI and data science



* Title of the program contains one of the following terms: Artificial Intelligence, Machine Learning, Machine Learning, Intelligent Systems, Intelligent (Adaptive) Systems, Autonomous Systems, Autonomous Driving, Cognitive Computing, Cognitive Systems..

** Title of the program contains one of the following terms: Data Science, Data Science, Big Data.

Source: Plattform Lernende Systeme.
Note: Study programs included in the AI map oft Plattform Lernende Systeme (as of November 2020). Multiple entries possible.



IV. Review

Events and Publications of Plattform Lernende Systeme

The members of Plattform Lernende Systeme contribute to the social discourse on Artificial Intelligence through jointly published papers and contributions to debates at numerous events. In this chapter you will find a review of important events as well as a general overview of the previous publications of Plattform Lernende Systeme.

Plattform Lernende Systeme
Events

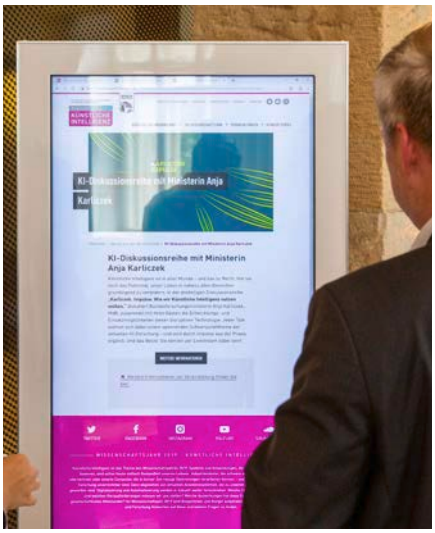
Annual Conference 2019

Shaping Artificial Intelligence for the benefit of society with this claim, the Plattform Lernende Systeme organises the exchange between science, business and civil society on this topic of the future. At its first annual conference, entitled " AI – Made in Germany", the on 3 and 4 July 2019 at the Berlin-Brandenburg Academy of Sciences and Humanities experts from politics, research, business and society discussed how we in Germany and Europe want to use Artificial Intelligence for the benefit of humankind.

The Co-Chair of Plattform Lernende Systeme, Anja Karliczek, accentuated the importance of the importance of AI for research, business and society.

Panel discussion with Tanja Rückert (Bosch) and Wolfgang Wahlster (DFKI) at the Annual Conference of Plattform Lernende Systeme 2019.

Blogger and author Sascha Lobo enriched the conference with his debate contribution.



Top: The conference was accompanied by an exhibition of the "Year of Science".
Left: Members of the various working groups present their latest publications at the conference.

An AI-based 3D model of the human heart – a so-called digital twin – was presented at the Digital Summit 2018.

German Chancellor Angela Merkel was a guest at the Digital Summit in 2019.

The Plattform Lernende Systeme organised a panel for the Digital Day 2019, among others on the topic "Research – AI for digital platforms".

Digital Summit 2018 and 2019

The Digital Summit and its in-year process are the forum for the cooperation of politics, business, science and science and society in shaping the digital transformation. In December 2018, Plattform Lernende Systeme presented its AI map with application examples of applications. At the Digital Summit in October 2019, the Plattform Lernende Systeme organised a discussion panel on how self-learning systems revolutionise the economy and everyday life. In addition, previous results of the platform's work were presented at a separate stand.

Acatech President and Co-Chair of Plattform Lernende Systeme in conversation with Bavarian State Minister for Digital Affairs, Judith Gerlach, at the Digital Summit 2018.

Hubertus Heil (3rd from left), Federal Minister of Labor and Social Affairs, at the stand of Plattform Lernende Systeme at the Digital Summit 2019.

Plattform Lernende Systeme
Publications

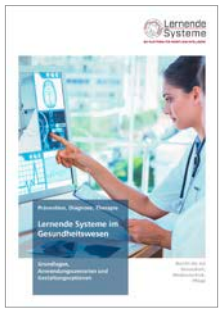
Reports of the working groups

Working group Hostile-to-life Environments
(June 2019)

Self-Learning Systems in Hostile-to-Life Environments –
Potentials, challenges and design options

Working group Mobility and Intelligent Transport Systems (July 2019)

On the Way to Intelligent Mobility –
Fields of action, opportunities and challenges



Working group Health Care, Medical Technology, Care
(July 2019)

Self-Learning Systems in the Healthcare System –
Basics, application scenarios and design options

Working group Business Model Innovations
(October 2019)

New Business Models using Artificial Intelligence –
Target images, case studies and design options

All publications **(reports, white papers)** are available for download in the online library:

White Paper

Working group IT Security, Privacy, Legal and Ethical Framework (April 2019)

Artificial Intelligence and IT Security – Stocktaking and solution approaches

Working group Technological Enablers and Data Science (July 2019)

Machine Learning and Deep Learning – The engine for "AI made in Germany"

Working group Future of Work and Human-Machine Interaction (July 2019)

Work, Training and Human-Machine Interaction – Approaches to the design of Artificial Intelligence for the working environment

Working group IT-Security, Privacy, Legal and Ethical Framework (July 2019)

Artificial Intelligence and Discrimination – Challenges and solutions

Working group IT Security, Privacy, Legal and Ethical Framework; Working group Technological Enablers and Data Science (April 2020)

Certification of AI Systems

Working group IT-Security, Privacy, Legal and Ethical Framework; Workin group Health Care, Medical Technology, Care (April 2020)

Secure and safe AI Systems in Medicine – Data management and IT security in the cancer treatment of the future

Working group Future of Work and Human-Machine Interaction (June 2020)

Criteria for Human-Machine Interaction with AI – Approaches for human-centered design in the working environment

Working group IT Security, Privacy, Legal and Ethical Framework (October 2020)

Ethics Briefing – Guidelines for a responsible development and application of AI systems

Working group Health Care, Medical Technology, Care (October 2020)

AI in medicine and care from the perspective of patients – Conference report on the round table with Patient advocacy groups

Working group Technological Enablers and Data Science (November 2020)

From data to AI – Intelligent data management as a basis for data science and the use of self-learning systems

Working group Future of Work and Human-Machine Interaction (November 2020)

Introduction of AI systems in companies: Design approaches for change management – Design approaches for change management

Steering Committee of Plattform Lernende Systeme (November 2020)

Securing the future with AI – Approaches for increased resilience and digital sovereignty

Working group Technological Enablers and Data Science; Working group IT Security, Privacy, Legal and Ethical Framework (November 2020)

Certification of AI systems – Compass for the development and application of trustworthy AI systems

Working group Business Model Innovations; Working group Mobility and Intelligent Transport Systems (November 2020)

AI business models for travel and transport – More efficiency and sustainability in the mobility of the future

Application Scenarios

Working group Mobility and Intelligent Transport Systems (October 2019)

Integrated transport management – Ordered? Delivered!

Working group Mobility and Intelligent Transport Systems (July 2019)

Integrated transport management – Carla's journey

Working group Future of Work and Human-Machine Interaction (July 2019)

Information Butler for the Office

Working group Health Care, Medical Technology, Care (May 2019)

With Artificial Intelligence against Cancer

Working group Hostile-to-life Environments (May 2019)

Immediate Assistance during Rescue Missions

Working group Hostile-to-life Environments (May 2019)

Autonomous Underwater Vehicles

Working group Future of Work and Human-Machine Interaction (July 2019)

Robotic tool with learning capability in assembly

All application scenarios are available for download in the online:

Plattform Lernende Systeme
Involved actors and organisations

Working group – Technological Enablers and Data Science

The working group is led by:
Prof. Dr. Katharina Morik, Technische Universität Dortmund
Prof. Dr. Volker Markl, Technische Universität Berlin

Members of the working group are:
Prof. Dr. Ulf Brefeld, Leuphana Universität Lüneburg
Dr. Carl-Helmut Coulon, INVITE GmbH
Dr. Wolfgang Ecker, Infineon Technologies AG
Prof. Dr. Kristian Kersting, Technische Universität Darmstadt
Dr. Markus Kohler, SAP SE
Prof. Dr. Daniel A. Keim, Universität Konstanz
Prof. Dr. Stefan Kramer, Johannes-Gutenberg-Universität Mainz
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Prof. Dr. Erhard Rahm, Universität Leipzig
Prof. Dr. Wolfgang Rosenstiel, Eberhard Karls Universität Tübingen (†)
Prof. Dr. Kai-Uwe Sattler, Technische Universität Ilmenau
Dr. Harald Schöning, Software AG
Prof. Dr. Volker Tresp, Ludwig-Maximilians-Universität München
Dr. Joachim Tödter, KION GROUP AG
Dr. Jilles Vreeken, Helmholtz-Zentrum für Informationssicherheit (CISPA) / Max-Planck-Institut für Informatik
Prof. Dr.-Ing. Gerhard Weikum, Max-Planck-Institut für Informatik
Prof. Dr. Stefan Wrobel, Fraunhofer-Institut für Intelligente Analyse- und Informationssysteme IAIS

Working group – Future of Work and Human-Machine Interaction

The working group is led by:
Prof. Dr. Elisabeth André, Universität Augsburg
Prof. Dr. Prof. e.h. Wilhelm Bauer, Fraunhofer-Institut für Arbeitswirtschaft und Organisation IAO

Members of the working group are:
Prof. Dr. phil. Lars Adolph, Bundesanstalt für Arbeitsschutz und Arbeitsmedizin
Prof. Dr.-Ing. Jan Christian Aurich, Technische Universität Kaiserslautern
Vanessa Barth, IG Metall
Klaus Bauer, TRUMPF Werkzeugmaschinen GmbH & Co. KG
Nadine Bender, KUKA Deutschland GmbH
Prof. Dr. Angelika C. Bullinger-Hoffmann, Technische Universität Chemnitz
Prof. Dr.-Ing. Barbara Deml, Karlsruher Institut für Technologie (KIT)
Prof. Dr. Andreas Dengel, Deutsches Forschungszentrum für Künstliche Intelligenz GmbH
Dr. Jan-Henning Fabian, ABB AG Forschungszentrum Deutschland
Prof. Dr.-Ing. Sami Haddadin, Munich School of Robotics and Machine Intelligence, Technische Universität München
Prof. Dr. Michael Heister, Bundesinstitut für Berufsbildung (BIBB)

Prof. Dr.-Ing. Rolf Hiersemann, Hiersemann Prozessautomation GmbH
Dr. Norbert Huchler, Institut für Sozialwissenschaftliche Forschung e.V.
Dr. Nadine Müller, Vereinte Dienstleistungsgewerkschaft (ver.di)
Dr. Rahild Neuburger, Ludwig-Maximilians-Universität München
Dr. Matthias Peissner, Fraunhofer-Institut für Arbeitswirtschaft und Organisation IAO
Prof. Dr.-Ing. Annika Raatz, Leibniz Universität Hannover
Prof. Dr. Jürgen Roßmann, RWTH Aachen
Prof. Dr. Christoph M. Schmidt, RWI – Leibniz-Institut für Wirtschaftsforschung
Prof. Dr. Jochen Steil, Technische Universität Braunschweig
Andrea Stich, Infineon Technologies AG
Prof. Dr.-Ing. habil. Sascha Stowasser, ifaa – Institut für angewandte Arbeitswissenschaft e.V.
Oliver Suchy, DGB Bundesvorstand
Dr. Hans-Jörg Vögel, BMW Group
Jochen Werne, PROSEGUR Germany

Working group – IT Security, Privacy, Legal and Ethical Framework

The working group is led by:

PD Dr. Jessica Heesen, Eberhard Karls Universität Tübingen
Prof. Dr. Jörn Müller-Quade, Karlsruher Institut für Technologie (KIT)

Members of the IT Security and Privacy sub-working group are:

Prof. Dr. Bernhard Beckert, Karlsruher Institut für Technologie (KIT)
Prof. Dr. Peter Buxmann, Technische Universität Darmstadt
Prof. Dr. Werner Damm, OFFIS Institut für Informatik e. V./Carl von Ossietzky Universität Oldenburg
Prof. Dr. habil. Claudia Eckert, Fraunhofer AISEC
Marit Hansen, Unabhängiges Landeszentrum für Datenschutz Schleswig-Holstein
Joachim Hechler, Kobil Systems GmbH
Prof. Dr. Thorsten Holz, Ruhr-Universität Bochum
Dr. Detlef Houdeau, Infineon Technologies AG
Prof. Dr. Konrad Rieck, Technische Universität Braunschweig
Peter Rost, secunet Security Networks AG
Thomas Schauf, Deutsche Telekom AG
Prof. Dr. Werner Schindler, Bundesamt für Sicherheit und Informationstechnik
Dr. Dirk Wacker, Giesecke+Devrient GmbH

Members of the IT Legal and Ethical Framework sub-working group are:

Prof. Dr. Susanne Beck, Gottfried Wilhelm Leibniz Universität Hannover
Prof. Dr. Christoph Bieber, Center for Advanced Internet Studies
Dr. Angelika Christoph, HUK-COBURG
Prof. Dr. Peter Dabrock, Friedrich-Alexander-Universität Erlangen-Nürnberg, bis 04/2020 Vorsitzender Deutscher Ethikrat
Prof. Dr. Gerd Gigerenzer, Max-Planck-Institut für Bildungsforschung
Prof. Dr. Armin Grunwald, Karlsruher Institut für Technologie (KIT)/Institut für Technikfolgenabschätzung und Systemanalyse (ITAS)
Ralf-Peter Hayen, Deutscher Gewerkschaftsbund DGB
Prof. Dr. Klaus Heine, Erasmus University Rotterdam
Prof. Dr. Thomas Hoeren, Westfälische Wilhelms-Universität Münster
Prof. Dr. Jan Cornelius Joerden, em. Europa-Universität Viadrina Frankfurt (Oder)
Prof. Dr. Tobias Matzner, Universität Paderborn

Prof. Dr. Catrin Misselhorn, Georg-August-Universität Göttingen
Prof. Dr. Alexander Roßnagel, Universität Kassel
Thomas Schauf, Deutsche Telekom AG
Prof. Dr. Judith Simon, Universität Hamburg
Prof. Dr. Louisa Specht-Riemenschneider, Rheinische Friedrich-Wilhelms-Universität Bonn
Dr. Susann Wolfgram, SAP SE
Prof. Dr. Katharina Anna Zweig, Technische Universität Kaiserslautern

Working group – Business Model Innovations

The working group is led by:

Prof. Dr. Susanne Boll-Westermann, Carl von Ossietzky Universität Oldenburg
Dr. Wolfgang Faisst, Co-Founder und CEO der ValueWorks GmbH

Members of the working group are:

Prof. Dr. Irene Bertschek, ZEW – Leibniz-Zentrum für Europäische Wirtschaftsforschung/ Justus-Liebig-Universität Gießen
Prof. Dr. Michael Dowling, Universität Regensburg
Prof. Dr.-Ing. Roman Dumitrescu, Fraunhofer-Institut für Entwurfstechnik Mechatronik IEM
Prof. Dr. Svenja Falk, Accenture GmbH
Stephanie Fischer, datanizing GmbH
Dr. Christian Friege, CEWE Stiftung & Co. KGaA
Christian Gülpen, RWTH Aachen University
Dr. Andreas Liebl, appliedAI Initiative (UnternehmerTUM GmbH)
Olga Mordvinova, incontext.technology GmbH
Prof. Dr.-Ing. Astrid Nieße, Carl von Ossietzky Universität Oldenburg
Prof. Dr. Alexander Pflaum, Fraunhofer-Institut für Integrierte Schaltungen IIS
Prof. Dr. Frank Thomas Piller, RWTH Aachen
Dr. rer. nat. Uwe Riss, FHS St. Gallen – Hochschule für Angewandte Wissenschaften
Fabian Schmidt, Software AG
Dr. Markus Schnell, Infineon Technologies AG
Barbara Susec, Vereinte Dienstleistungsgewerkschaft (ver.di)
Prof. Dr. Orestis Terzidis, Karlsruher Institut für Technologie (KIT)
Dr.-Ing. Eric MSP Veith, OFFIS – Institut für Informatik
Iris Wolf, IG BCE – Industriegewerkschaft Bergbau, Chemie, Energie

Working group – Mobility and Intelligent Transport Systems

The working group is led by:

Dr.-Ing. Tobias Heese, Deutsches Zentrum für Luft- und Raumfahrt e. V. (DLR)
Dr. Christoph Peylo, Bosch Center for Artificial Intelligence (BCAI)

Members of the working group are:

Univ.-Prof. Dr.-Ing. Albert Albers, Karlsruher Institut für Technologie (KIT) – IPEK
Dr. Claus Bahlmann, Siemens Mobility GmbH
Prof. Dr.-Ing. Fabian Behrendt, Fraunhofer-Institut für Fabrikbetrieb und -automatisierung IFF
Dr. Astrid Elbe, Intel Deutschland GmbH

Prof. Dr.-Ing. Stefanos Fasoulas, Universität Stuttgart
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Dr. Rudolf Felix, PSI AG
Dr. Peter Schlicht, Volkswagen AG
Dr. Anatoly Sherman, SICK AG
Prof. Dr.-Ing. Philipp Slusallek, Deutsches Forschungszentrum für Künstliche Intelligenz GmbH
Prof. Dr.-Ing. J. Marius Zöllner, Karlsruher Institut für Technologie (KIT)

Working group – Health Care, Medical Technology, Care

The working group is led by:

Prof. Dr. Klemens Budde, Charité – Universitätsmedizin Berlin
Dr.-Ing. Dr. med. Karsten Hiltawsky, Drägerwerk AG & Co. KGaA

Members of the working group are:

Prof. Dr. Roland Eils, Berliner Institut für Gesundheitsforschung
Dr. Elsa Kirchner, Deutsches Forschungszentrum für Künstliche Intelligenz GmbH
Stefan Kley, GRB Gesellschaft für Risiko-Beratung mbH
Dr. Manfred Klevesath, Merck KGaA
Prof. Prof. h. c. Dr. med. Thomas Lenarz, Medizinische Hochschule Hannover
Hannelore Loskill, BAG SELBSTHILFE
Johannes Heuckeroth, B. Braun Melsungen AG
Hardy Müller, Aktionsbündnis Patientensicherheit
Prof. Dr. Thomas Neumuth, Universität Leipzig
Dr.-Ing. Matthieu-P. Schapranow, Hasso-Plattner-Institut für Digital Engineering gGmbH
Eva Maria Welskop-Deffaa, Deutscher Caritasverband e.V.
Prof. Dr. Karin Wolf-Ostermann, Universität Bremen
Prof. Dr. Ing. Thomas P. Zahn, Gesundheitswissenschaftliches Institut Nordost (GeWINO)
Christian Zapf, Siemens Healthineers AG

Working group – Hostile-to-Life Environments

The working group is led by:

Prof. Dr.-Ing. habil. Jürgen Beyerer, Karlsruher Institut für Technologie (KIT), Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung IOSB
Prof. Dr. Frank Kirchner, Universität Bremen, Deutsches Forschungszentrum für Künstliche Intelligenz GmbH

Members of the working group are:

Prof. Dr.-Ing. Alin Olimpiu Albu-Schäffer, Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)
Prof. Dr.-Ing. Tamim Asfour, Karlsruher Institut für Technologie (KIT)
Prof. Dr. Sven Behnke, Rheinische Friedrich-Wilhelms-Universität Bonn
Prof. Dr. Andreas Birk, Jacobs University Bremen

Prof. Dr. rer. nat. Dipl.-Ing. Thomas M. Deserno, Technische Universität Braunschweig
Dr.-Ing. Jeronimo Dzaack, ATLAS ELEKTRONIK GmbH
Dr. Thomas Egloffstein, ICP Ingenieurgesellschaft mbH
Dr.-Ing. Michael Gustmann, Kerntechnische Hilfsdienst GmbH
Prof. Dr. Andreas Nüchter, Universität Würzburg
Dr.-Ing. Hauke Speth, Institut der Feuerwehr NRW
Dr. Sirko Straube, Deutsches Forschungszentrum für Künstliche Intelligenz GmbH
Dr.-Ing. Igor Tchouchenkov, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung IOSB
Martin Zimmermann, imsimity GmbH

The working groups are supported by

Maria Anhalt, Continental Teves AG & Co. oHG
Fabian Biegel, SAP SE
Dr. Andreas Braun, Accenture GmbH
Daniel Buttjes, Ottobock SE & Co KGaA
Prof. Dr. Michael Decker, Karlsruher Institut für Technologie (KIT)
Dr. Tim Gutheit, Infineon Technologies AG
Mirco Kaesberg, Bosch Sicherheitssysteme GmbH
Dr. Hannah Köpcke, Web Data Solutions
Dr. Wulf Loh, Universität Tübingen
Philipp Schlunder, RapidMiner GmbH
Dr.-Ing. Jack Thoms, Deutsches Forschungszentrum für Künstliche Intelligenz GmbH
Martin Wegele, Fraunhofer-Gesellschaft e. V.
Dr. Johannes Winter, acatech – Deutsche Akademie der Technikwissenschaften

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About this report

This progress report was prepared by the managing office of Plattform Lernende Systeme. The report aims to present the current and future topics, publications, actors and events of the platform as well as its contribution to the scientific, economic and socio-political AI discourse in Germany. The managing office of Plattform Lernende Systeme acts as an connecting point between the members of the platform and with the public. It coordinates the working process of the working groups and organises the dialogue and knowledge transfer internally and externally. The staff of the office are contact persons for interested stakeholders from business, science, politics and society as well as for media and institutions from Germany and abroad.

Managing Office[2]
Dr. Johannes Winter, Head of the Managing Office
Dr. Thomas Schmidt, Deputy Managing Officer
Mandy Börner, Assistance
Stephanie Dachsberger, Scientific Officer
Rebecca Ebner, Scientific Officer (until 2020)
Dr. Andreas Heindl, Scientific Officer (until 2020)
Maximilian Hösl, Scientific Officer
Alexander Mihatsch, Scientific Officer
Birgit Obermeier, Press and Puclic Relations
Dr. Ursula Ohliger, Publications
Linda Treugut, Press and Puclic Relations
Dr. Erduana Wald, Scientific Officer
Karin Weller, Assistance

Editorial
Dr. Ursula Ohliger, Managing Office of Plattform Lernende Systeme
Birgit Obermeier, Managing Office of Plattform Lernende Systeme
Dr. Andreas Heindl, Managing Office of Plattform Lernende Systeme

2 The managing office of Plattform Lernende System is staffed with seven full-time equivalents.

Imprint

Editor
Lernende Systeme –
Germany's Platform for Artificial Intelligence |
Managing Office | c/o acatech |
Karolinenplatz 4 | D-80333 Munich

Design and Production
PRpetuum GmbH, Munich

Status
December 2020

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For questions or comments about this publication, please contact Johannes Winter (head of the managing office): kontakt@plattform-lernende-systeme.de

Follow us on Twitter: @LernendeSysteme

www.plattform-lernende-systeme.de