The
Federal Government

Nationale Strategie für
Künstliche Intelligenz
AI Made in Germany

Artificial Intelligence Strategy

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The Federal Government's Artificial Intelligence (AI) strategy was jointly developed by the Federal Ministry of Education and Research, the Federal Ministry for Economic Affairs and Energy, and the Federal Ministry of Labour and Social Affairs based on suggestions taken from an nationwide online consultation.

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Foreword

In this Artificial Intelligence (AI) Strategy, the Federal Government sets out a framework for a holistic policy on the future development and application of AI in Germany.

In this Strategy, the Federal Government takes particular account **firstly** of the rapid advances in AI technology and global changes in production and value chains resulting from new AI technologies. Research and innovation are the foundations for the AI technologies of the future. Here, Germany is very well positioned due to its excellent, broad-based research landscape. The Federal Government aims to strengthen Germany as a centre for AI research.

Secondly, the Federal Government is responding to the many signals from the business, science and policy-making communities that AI should be regarded as a key enabling technology and that lasting investment in applications should be undertaken or facilitated. We want to help our companies to make better use of the potential of AI technologies deriving from research so that they can thrive in the face of international competition. The Federal Government therefore intends to prioritise the funding of AI applications in the business sector, and particularly in small and medium-sized enterprises.

Thirdly, the Strategy is based on the democratic desire to anchor such a far-reaching technology as AI, which may also be deployed in sensitive areas of life, in an ethical, legal, cultural and institutional context which upholds fundamental social values and individual rights and ensures that the technology serves society and individuals. This requires that future developments, including opportunities and risks, are anticipated as far as is possible, because although AI is currently coming into our day-to-day lives in the shape of isolated applications of autonomous and smart systems, the level of expertise and experience with the technology is not yet sufficiently widespread for society to have clarified its relationship with the technology. The Data Ethics Commission and the Study Commission of the Bundestag which took up their work a few weeks ago are doing important pioneering work here and will support the Federal Government by making recommendations.

In order to plan the future approach, the federal cabinet adopted key points for the AI Strategy on 18 July 2018. These were developed further and fleshed out on the basis of feedback from expert forums and a comprehensive public consultation process. The results of these processes are documented (in German) at www.ki-strategie-deutschland.de.

Against the backdrop of the dynamic development of this field of technology, this Strategy serves as a framework for action by the Federal Government. It is part of the Federal Government's digitalisation implementation strategy. At the beginning of 2020, the Strategy will be developed further in line with the status of the debate and the needs, and will be brought into line with the latest developments and requirements.

Definition of "artificial intelligence"

There is no definition of AI which generally valid or used consistently by all stakeholders. The Federal Government's AI Strategy is based on the following understanding of AI:

In highly abstract terms, AI researchers can be assigned to two groups: "strong" and "weak" AI. "Strong" AI means that AI systems have the same intellectual capabilities as humans, or even exceed them. "Weak" AI is focused on the solution of specific problems using methods from mathematics and computer science, whereby the systems developed are capable of self-optimisation. To this end, aspects of human intelligence are mapped and formally described, and systems are designed to simulate and support human thinking.

The Federal Government is oriented its strategy to the use of AI to solve specific problems, i.e. to the “weak” approach:

1. Deduction systems, machine-based proofs: deduction of formal statements from logical expressions, systems to prove the correctness of hardware and software

2. Knowledge-based systems: methods to model and gather expertise; software to simulate human expertise and to support experts (previously designated “expert systems”); to some extent coupled with psychology and cognitive sciences;

3. Pattern analysis and pattern recognition: inductive analytical processes in general, machine learning in particular;

4. Robotics: autonomous control of robotic systems, i.e. autonomous systems;

5. Smart multimodal human-machine interaction: analysis and “understanding” of language (in conjunction with linguistics), images, gestures and other forms of human interaction.

Summary “AI made in Germany”

The Federal Government will take on the task of providing a policy response to the rapid advances in the field of AI and will make comprehensive use of the innovations triggered by the technology for the benefit of society at large. We want to safeguard Germany’s outstanding position as a research centre, to build up the competitiveness of German industry, and to promote the many ways to use AI in all parts of society in order to achieve tangible progress in society in the interest of its citizens. We will focus on the benefits for people and the environment, and continue the intensive dialogue with all sections of society.

Germany is already extremely well positioned in many areas of AI. This Strategy builds on existing strengths and transfers them to areas where no or little use has been made of the potential.

In the 2019 federal budget, the Federation has taken a first step, allocating a total of €500 million to beef up the AI strategy for 2019 and the following years. **Up to and including 2025, the Federation intends to provide around €3 billion for the implementation of the Strategy.** The leverage effect this will have on business, science and the Länder will mean that the overall amount available is at least doubled.

1. **We want to make Germany and Europe a leading centre for AI and thus help safeguard Germany’s competitiveness in the future.**

   - We will further develop our existing Centres of Excellence for AI at supra-regional level, establish additional ones, and develop them into a **national network of at least twelve centres and application hubs**. As we do so, we will be offering working conditions and remuneration that are internationally attractive and competitive. We will launch a programme to support junior researchers and to reinforce academic teaching in the field of AI. We want to create **at least 100 additional professorships** for AI to ensure that AI has a strong foothold within the higher education system.

   - Working with France, we will drive forward the **development of a Franco-German research and development network (“virtual centre”)** that is based on existing structures and the particular skills offered by each of the two countries.

   - We will make AI one of the priorities for the envisaged **Agency for Breakthrough Innovations**.

   - We will form a **European innovation cluster** providing funding for cooperative research projects over the next five years.

   - We will increase our AI-specific support for small and medium-sized companies. **The Mittelstand 4.0 centres of excellence will have ‘AI trainers’ contact at least 1,000 companies per year**.

   - The Federal Government wants to help companies **establish test beds**.

   - The **EXIST** (Business Start-ups in Science) programme’s budget for 2019 will be twice as high as in the previous years.

   - We are creating new **funding opportunities for venture capital and venture debt** and will launch a **Tech Growth Fund Initiative**.

   - We are further expanding our **advisory and funding services targeted at start-ups**.

   - The Federal Government will improve incentives and the policy framework for the voluntary sharing of data in compliance with data protection rules, and will progress the establishment of a trustworthy **data and analysis infrastructure** including the building of a cloud platform with upgradable storage and computing capacity on which this infrastructure can be run.

2. **We want a responsible development and use of AI which serves the good of society.**

   - The Federal Government will establish a **German observatory for artificial intelligence** and will support the establishment of similar **observatories at European and international level**.

   - The Federal Government is initiating a **European and transatlantic dialogue on the human-centric use of AI in the world of work**.

   - As part of a National Further Training Strategy, the Federal Government will develop a **broad-based set of instruments to foster the skills of the workforce**.

   - The Federal Government will use the results of a new skills monitoring to inform and develop its **Skilled Labour Strategy** in the fields of digital skills and new technologies such as AI.

   - The Federal Government will safeguard the **possibilities for works councils to engage in co-determination** when it comes to the introduction and use of AI.

   - We will fund **in-company innovation spaces** for AI applications in the **world of work**.

   - We will fund **AI applications to benefit the environment and the climate**, and will develop assessment principles for this. Our goal is to initiate **50 flagship applications in this field**.

3. **We will integrate AI in society in ethical, legal, cultural and institutional terms in the context of a broad societal dialogue and active political measures.**

   - The Federal Government will invite **data protection authorities and business associations** for a **round table** and work together to develop joint **guidelines for developing and using AI systems in a way that is compatible with data protection rules** and to highlight best practice examples.

   - The Federal Government is providing funding for the **development of innovative applications** that support self-determination, social inclusion, cultural participation and the protection of citizens' privacy.

   - The Federal Government will establish a **Digital Work and Society Future Fund** (Zukunftsfonds Digitale Arbeit und Gesellschaft) to get the message out and to promote multidisciplinary social technology design.

   - The Federal Government will further develop the **Plattform Lernende Systeme** into an Artificial Intelligence Platform that hosts a dialogue between government, science and commerce with civil society.

1. Goals

The comments received during the consultation were broadly in line with the goals outlined in the Key Points Paper for an artificial intelligence strategy. In view of this, and of the similarly holistic approach taken by the European Union in the European Strategy on Artificial Intelligence, the Federal Government sets itself the following goals, each of which is of equal ranking:

I. We want to make Germany and Europe a leading centre for AI and thus help safeguard Germany's competitiveness in the future.

a. The Federal Government is committed to achieving and maintaining leading global excellence in the research, development and application of AI in Germany and Europe. Germany is to become a leading centre for AI, especially through the pursuit of a speedy and comprehensive transfer of research findings to applications and the modernisation of administration in the context of the needs of a state based on the rule of law. 'Artificial Intelligence (AI) made in Germany' is to become a globally recognised quality mark.

b. We want to broaden the strong scientific basis for AI that we have in Germany and link it up with other promising technological developments and applications in order to develop new applications in a range of industries, in public administration and in different areas of society. We want Germany to build on its strong position in *Industrie 4.0* and to become a world leader in AI applications in this field. We want our strong sector of small and medium-sized enterprises to benefit from AI applications and will put the necessary services and policies in place for this.

c. We want Germany to build upon its very good position in AI research, both independently as well as in cooperation with European partners and leading developers of technology, and to become a world leader in this area. We strive to be an attractive research, innovation and business centre for AI experts from Germany and abroad, attracting and holding on to the best talents in AI, and to considerably expand our training capacities in the field of AI.

d. We want to establish the right framework conditions to create value from applications of AI in Germany, and to focus our efforts on developing the benefits of AI for our citizens – both at an individual and at societal level.

e. We want our specific data stock to be used to the benefit of our society, the environment, business, culture and country, and for AI-based business models to be developed in Germany and to become new top exports, whilst strictly observing data security and people's right to control their personal data.

f. By expanding the smart infrastructure for real-time data transmission and analysis in the gigabit society, we are creating a central basis for stationary and mobile AI applications. This is to benefit public administration and the network infrastructure of the Federation as well.

g. We want to ensure that IT systems that use and apply AI are equipped with a high level of IT security in order to protect the sensitive technology involved from manipulation and misuse and to prevent risks to public security in the best way possible.

II. We want a responsible development and use of AI which serves the good of society.

h. The Federal Government sees it as its duty to drive forward the responsible use of AI which serves the good of society. Here, we are adhering to ethical and legal principles consistent with our liberal democratic constitutional system throughout the process of developing and using AI. We will take into account the recommendations of the Data Ethics Commission as we implement the Strategy.

i. We want to develop a European solution for data-based business models and find new ways of creating value from data that correspond to our economic, value and social structure.

j. We want to raise awareness on the part of the relevant stakeholders – from developers to users of AI technology – regarding ethical and legal limits of the use of artificial intelligence and to examine whether the regulatory framework needs to be further developed in order for it to guarantee a high level of legal certainty. We want to demand and foster compliance with ethical and legal principles throughout the process of developing and using AI.

III. We will integrate AI in society in ethical, legal, cultural and institutional terms in the context of a broad societal dialogue and active political measures.

k. We are working to ensure that the development and use of AI applications is people-focused, especially with regard to the use of AI in the world of work. We want to ensure that the development of AI is centred around the labour force, allowing for the development of skills, talents and creativity, enabling self-determination, providing security and protecting health. At the same time, fostering and adequately representing diversity will be a guiding principle for all our thinking. We will give consideration to the special needs of people with disabilities in order to improve their full participation in working life.

l. We want to use the potential of AI further to improve security, efficiency and sustainability in particularly important fields of application whilst also promoting social and cultural participation, freedom of action and self-determination for each and every citizen, both here in Germany and at European and global level.

m. In particular, we want to utilise the potential of AI for sustainable development and thus to help achieve the sustainable development goals in the Agenda 2030, which have been declared binding for the policies of the Federal Government in the German Sustainability Strategy.

n. We want to create a policy environment for AI applications that creates and maintains diversity and guarantees the necessary scope for the development of cultural and media freedoms. This is due to the fact that, in the digital age, the level of freedom of a democratic society is still measured in terms of the cultural and media diversity and the independence of the media in particular.

2. Current situation

Over the past few years, artificial intelligence has matured considerably and, as a fundamental innovation, is becoming the driver of digitalisation and autonomous systems in all areas of life. The public sector, society, business, administration and science are all called upon to embrace the opportunities it provides and to face up to the risks it poses. The Federal Government wants to put the conditions in place for the opportunities and potential of AI to be used. As it does so, it is seeking to actively shape AI in all areas of policy with a view to a human-centric use oriented to the common good by business and society on the basis of the principles of democracy. The progress currently being made in AI, particularly in the field of machine learning, is the result of exponential growth in hardware capabilities and the use of these capabilities to process large volumes of data.

With its differentiated and efficient research community, its broad-based economic structure and its technological lead in key fields of industry such as *Industrie 4.0*, Germany is extremely well-positioned to utilise the potential for future value creation contained in AI technologies. We need to dovetail these assets and deploy them widely.

AI is now finding its way from research into an increasingly broad range of applications in business. Large digital corporations are investing substantially in the development and use of AI technologies. They expect these investments to raise the efficiency of existing business models and/or open up new ones. In many countries around the world, the level of public investment in AI is also rising. AI technologies are increasingly penetrating the economy and aspects of daily life. Successful use of AI depends – whilst complying with the individual's right to control their own data – on access to data, the systemic embedding of AI technologies in complex products, services and business models, and a well-founded trust in the new technology among the general public. This trust needs to be based on active participation, transparency of the processes used and an understanding of how it works and why it is beneficial.

The challenges faced by Germany, as in other countries, involve shaping the structural changes driven by digitalisation and taking place in business, the labour market and society and leveraging the potential which rests in AI technologies. Enormous opportunities are arising in particular for the manufacturing sector, which has traditionally been strong and dominated by small and medium-sized enterprises. At the same time, the international race to attract talent, creativity, technology, data and investment is rapidly picking up speed. There is also the challenge involved in transferring the new AI technologies across our economy, which is dominated by small and medium-sized enterprises. However, this complex transfer process and the exchange of data, especially between small and medium-sized enterprises (SMEs), also provide the greatest potential for value creation. AI is also believed to offer a great deal of potential for parts of public administration and public-sector tasks.

Technological developments are accompanied by societal changes and raise questions about the need for changes to the legal framework on the use of AI. At the same time, we need to establish a fundamental and broad-based understanding of AI in order to ensure that the public debate is more facts-based and evidence-based. The Strategy of the Federal Government is also intended to help boost 'AI made in Germany', a special and specific approach to technology that focuses on creating benefits for the country and society.

A number of countries have already presented their own AI strategies. The European Union has recently presented an overall strategy for the EU, and on this basis is currently preparing a joint implementation plan with the Member States. We will need greater cooperation on many challenges within Europe and also internationally if we are to have an economically successful and human-centric use of AI, particularly when it comes to uniform and ethically sophisticated rules for the use of AI technologies in Europe.

The EU's General Data Protection Regulation (GDPR) is a first important step and forms an important basis for future European cooperation. Europe must not only utilise its strong technological capabilities and market power, but must also proactively promote its values in order to help shape international rules and to set benchmarks in the EU.

The Federal Government's AI Strategy makes a contribution towards the implementation of the current High-Tech Strategy 2025, which focuses on AI as a forward-looking capability for Germany's economy and which defines the transfer of AI into applications as a joint mission for the Federal Government.

On the basis of the existing national and international experience with the development and use of AI technologies, the Federal Government regards the following fields of action and measures as being a priority with a view to shaping the future of AI and its use in Germany and Europe.

3. Fields of action

In order for these goals to be achieved, business, science, government and civil society must all work together. The various measures set out in this strategy are horizontal in nature. In addition to this, the Federal Government will also use lend its particular support to key fields of AI applications in individual industries and in the utilities; the scope of this (vertical) support will be defined by the political and budgetary provisions of the Coalition Agreement. Some of the measures that form part of the AI strategy are already being implemented and their financial implications have been factored into the current financial plan.

The Federal Government would like to invite the Länder, the business community, scientific and academic organisations and all relevant stakeholders within society to contribute to the implementation of this strategy. Making sure that we use the opportunities AI can offer to our society is a task that concerns all of society and that can by no means be shouldered by the Federal Government alone. For instance, much will depend on how we succeed in adapting our education and training programmes to the challenges ahead. This is an area where action must primarily come from the Länder and the social partners.

In the 2019 federal budget, the Federation has taken the step that now seems necessary, allocating a total of €500 million to reinforce the AI strategy for 2019 and the following years. Combining this with a certain fraction of the increase in research and development funding that is earmarked to attain the target of spending 3.5% of the Gross National Product on Research and Development, the Federation will be able to make available approx. €3000 million for implementing the AI strategy in the period from 2018 to 2025. The leverage effect this will have on business, science and the Länder will result in the overall amount available being at least doubled. Consequently the Federal Government will engage with these groups without delay on how measures can be implemented on the ground. The tax breaks envisaged for research will also significantly strengthen the AI strategy in a permanent way.

3.1 Strengthening research in Germany and Europe in order to be drivers of innovation

AI research is a very heterogeneous field, spanning several different areas. At present, pattern and speech recognition and machine learning, artificial neural networks (ANNs) and expert systems are attracting the most attention. Members of the research community tend to specialise in one or several AI-related fields. Overall, AI research is highly dynamic and marked by short innovation cycles. It is therefore impossible to make reliable predictions on how AI research as a whole and its individual fields (such as machine learning or artificial neural networks) will develop over the next few years and which technologies will be used in which applications and in which sectors. This is why the AI research strategy will not be focused on individual approaches or applications, but on building a broad-based, dynamic ecosystem for AI that makes it possible for researchers to respond quickly to the latest trends and developments. The quality of this kind of AI ecosystem will much depend on the ability of researchers and creative minds to deliver excellent work, on the existence of an excelling research infrastructure, and on the quality of the overall framework for AI research in Germany and of national and international cooperation. Data-intensive experiments conducted within major research infrastructures, for instance, can drive the development of efficient and effective analytical methods for AI that can also be used in other fields.

This will require both structural measures as well as research programmes designed for the short and medium terms, in each case covering both basic research as well as individual high-priority fields of application.

An expert forum that considered research-related aspects of the Key Points Paper underpinning the Artificial Intelligence Strategy was held in Berlin on 13 September 2018. The online consultation considered these aspects also.

The vast majority of the feedback garnered approved of the approach chosen by the Federal Government: a broad-based, decentralised one that aims at establishing a vibrant AI ecosystem. Furthermore, there was a consensus on the need for both basic research and specialised work targeted to the needs of individual industries and applications. Repeatedly, there were calls for networking and cooperation throughout Europe and beyond. Discussions about structural measures focused on training/education for the up-and-coming generation, the general research environment for AI, and financing. There were calls for greater efforts to promote research into the assessment and transparency of AI algorithms, so as to render these understandable.

> *We will further develop our existing Centres of Excellence for AI at supra-regional level, establish additional ones, and develop them into a national network of at least twelve centres and application hubs. As we do so, we will be offering working conditions and remuneration that are internationally attractive and competitive.*

We want to continue on the path of establishing (supra-)regional Centres of Excellence for AI and expanding these. This is especially important given that Germany's scientific expertise on AI and also its users and applications are not concentrated in one or just a handful of places, but are distributed across the entire country (as is the case of Europe as a whole). This means that having just a single centralised cluster of excellence for all industries would not fit in with the structures that have evolved in Germany, and could not do justice to all the various scientific, societal and economic needs that must be factored in when using and improving AI. When establishing and developing the existing Centres of Excellence and the clusters, there should be a focus on centres concentrating on gaining new results, methods and technologies and also others that look to resolve challenges arising in specific fields of action within particular sectors and industries. In the latter case, in particular, the core business of the centres should be a transfer of knowledge and close cooperation with industry and the relevant stakeholder groups, so as to enable ideas to be turned into marketable innovations. It will be essential to ensure that centres can draw on a broad level of interdisciplinary skills, allowing for the full potential of AI to be harnessed for very different applications. This also means that so-called 'transfer hubs' are to be added on to both to existing and future clusters, and that the clusters are to work with the Mittelstand 4.0 centres of excellence (cf. field of action 3.4) so as to expedite the use of new research findings.

A special role in this will be played by the German Research Center for Artificial Intelligence (DFKI), which is the world's largest research institute dedicated to AI and has earned itself a very strong reputation internationally. Thanks to its excellent implementation strategy, the DFKI has given rise to more than 70 spin-off companies so far, and a large number of patents in various fields of AI. Now the task is to further develop the public-private partnership underpinning the institute and to make its structure shipshape for the future. We will enter into negotiations with the shareholders on this matter without delay.

We want to use structural measures such as skill-building and cluster formation to create long-term added value. We are therefore planning soon to reach an agreement with the Länder regarding a long-term funding commitment. This is necessary to give the organisations and people concerned the certainty they need for long-term planning. Any long-term commitment will have to be based on an added value for society and on work that is excellent by international standards. This is why we will immediately appoint an advisory council with international members that will be tasked with evaluating and further developing the centres.

One of the particular challenges for the centres is to recruit the world's best and brightest minds for each task, to ensure that the research conducted is at the cutting edge and that findings can be quickly transformed into marketable products. In the field of AI, in particular, where there is tough competition between science organisations and industry, it is absolutely essential to offer working conditions that are attractive enough to secure top-level staff. Companies are often able to offer much better conditions – not least in terms of remuneration – than publicly funded organisations. For this reason, the Federal Government will be putting together an overall package that is guided by the scope of the Academic Freedom Act and goes beyond the mere financial aspects to also include individual career prospects (e.g. dual-career models, an existing start-up ecosystem, possibilities for 'industry-internship' programmes and temporary

secondments giving staff a chance to move between academic work and business). Beyond this and the need for attractive research institutions it is also important for the German centres to have a high international profile and to provide strong infrastructure and the right socio-economic framework for research, if they are to attract top-level staff from Germany and abroad.

> *We will establish regional Centres of Excellence for Labour Research in order to better dovetail labour research in the age of AI with labour design in actual companies. The relevant Federal Ministries will coordinate their transfer structures and develop a joint AI transfer concept.*

The world of work will change as AI is increasingly implemented. The division of labour between human beings and machines must be re-negotiated. Technology is to support human beings and ease their burden, so that they can bring the capabilities unique to them - empathy, creativity and solving problems in complex situations – to the task. For this to work, technology must be designed to serve the needs of human beings. This in turn means that it is highly important to consult and involve workers as specific applications are developed and introduced.

Artificial intelligence and digitalisation result in far-reaching changes in the way work is organised and laid out. Not only the cooperation between humans and machines is changing, but also corporate culture – with knowledge and skills, cooperation and management, health and safety and data protection all in flux.

We will establish regional Centres of Excellence for Labour Research, where we will bring together scientists and practitioners who will develop innovative strategies and concepts for using AI to design a positive working environment. The focus of the centres' work will be on imparting the necessary skills to management and the workforce, and on transferring research findings into small and medium-sized companies.

Seeking to take a holistic view of these challenges in the context of AI and to avoid parallel structures, the competent federal ministries – the Federal Ministry of Education and Research, the Federal Ministry for Economic Affairs and Energy, and the Federal Ministry of Labour and Social Affairs – will develop their transfer structures and bring them together into a joint transfer concept for AI.

> *We will establish cooperative structures under a national research consortium and reinforce our cooperation with external stakeholders.*

Beyond the existing and envisaged Centres of Excellence and the clusters, the Federal Government will establish a national research consortium, i.e. a network between various sites, some of them driven by methods and technologies and others with a focus on certain domains or user-driven. This consortium is to include the Centres of Excellence mentioned above, outstanding working groups based at universities and research institutions , curated data and computing infrastructures for scientific and/or industrial use, and industry-specific transfer hubs (complementing field of action 3.3). The transfer hubs are designed to accelerate the transfer by developing exemplary applications for society and the market. The national research consortium is to be a network bringing together all the expertise on research and infrastructure that is available, thereby accelerating the transfer process into application and creating added benefits to society. Large research infrastructures (such as CERN or the National Supercomputing Centre (NHR)) have the potential to provide an important impetus for the development of AI. The national research consortium depends on cross-disciplinary research, i.e. close cooperation with external stakeholders from the public sector, civil society and the business community, including the social partners, and other user groups, starting as early as during the research and development (R&D) process and informing the funding programme as well (cf. also fields of action 3.2 and 3.12). The national platform 'Plattform Lernende Systeme – the Platform for Artificial Intelligence', which was established in 2017 and brings together representatives from academia, business and civil society, is to intensify its work. It will serve as an advisory body in the field of R&D cooperation in AI, making practical recommendations as to what developments would be preferred by business and society.

We will launch a programme to support junior researchers and to reinforce academic teaching in the field of AI. We want to create at least 100 additional professorships for AI to ensure that AI has a strong foothold within the higher education system.

This measure is designed to support junior AI specialists by facilitating the return of German AI experts working abroad and by offering attractive working conditions to outstanding international doctoral students and post-doctoral researchers. Young scientists with excellent academic training are to be prepared for taking up leadership roles in business or science. Moreover, we will work with the Länder to explore ways in which the human resources for training AI experts and researchers could be strengthened through an "AI professorship programme". Any measures that concern training and teaching in the field of AI and the overall attractiveness of Germany as a workplace for AI researchers and practitioners will be developed in cooperation with the Länder. The Federal Government will establish a 'teach-and-learn AI' platform and support its operations, thereby contributing to securing and developing the skills base in AI – a field that is important for the country's overall technological prowess. The platform is to host content targeted at specific user groups and provide additional teaching/tutoring support. It is to give learners access to online classes guaranteed to be high quality..

Working with France, we will drive forward the development of a Franco-German research and development network ("virtual centre") that is based on existing structures and the particular skills offered by each of the two countries.

The work of the Franco-German research and development network will focus on basic research, on transferring research results into specific applications, and on delivering innovation. In the coming months, we will be implementing the following activities in this context: establishing a bilateral programme providing funding for basic research, with an annual call for proposals held for a specific sub-field or field of application of AI; linking up existing French and German centres of excellence to form a virtual centre, e.g. by providing funding for joint conferences, staff exchange programmes, and joint training programmes for young researchers (joint doctorates, summer schools etc.). Furthermore, we are planning to put in place bilateral AI clusters focusing on specific industries (e.g. healthcare, environment, robotics, mobility). This is also to include measures designed to bring together both country's AI transfer activities, e.g. through jointly operated test beds, the joint use of data sets, and through exchanging best practice activities (cf. also 3.2 and 3.11).

We will promote hardware-software co-design, resulting in a systems approach.

Applications of AI have stringent efficiency and performance requirements for key enabling technologies – such as computers and chips as well as cognitive systems made of sensors and actuators that bring AI to life. The Federal Government's goal is an AI that is compatible with European values, such as citizens' control over their own personal data and data security, and that protects and further strengthens these. This will only be reliably achieved when critical hardware and software components are also under our control, meaning there is no dependency on third parties. For the future use of AI in Germany, it will therefore be essential to ensure that our digital infrastructure is also developed and further expanded.

For this to be put into practice, it is essential that we have the skills needed for developing bespoke microelectronics systems and computer architectures. It is therefore important that we retain and expand the skills base we have in microelectronics both in Germany and in Europe. It is necessary to develop secure and reliable systems that go far beyond the current state-of-the-art, particularly for mobile AI applications such as autonomous driving, robotics and in highly sensitive areas such as critical infrastructures. This 'hardware-software co-design' approach closely involves AI users in the development. This includes the creation and operation of data and analysis platforms (cf. field of action 3.8).

We will promote research regarding explainability and accountability of algorithm-based forecasting and decision-making systems

In our view, making AI explainable, accountable, and transparent is the key to winning over the public's trust in AI. There are, however, a larger number of applications where the technology is still a black box. Often, it is impossible for users and those affected by an AI system to understand how the system has arrived at a certain decision or result as these are lacking in transparency; this is the case of algorithm-based systems designed to prepare decision-making and all the more so of systems taking their decisions autonomously. For an AI system to be recognised as 'trusted AI' and meet the legal requirements, it must be clear how it takes decisions.

This is why the Federal Government will promote research into transparent and explainable AI systems. In addition to this, the Federal Government will adjust the regulatory framework to this effect, wherever necessary (cf. field of action 3.9).

We will promote research and development for applications that protect consumers' interests and their privacy, so that personal data can be treated in a differentiated way based on consumers' own choices.

The development and application of artificial intelligence can improve everyday life for consumers. AI-based applications give them a stronger position on the market and allow them to play an active role in the economy and in society at large. We will therefore promote the development of consumer-enabling technologies (e.g. legal tech providing advice to consumers) that will support consumers in their purchasing decisions.

In the interest of realising and protecting people's privacy and the right to informational self-determination, we want to provide adequate funding for applications that make it easier for those affected to manage the consent they have given. Technologies designed to guarantee the high level of data protection and privacy standards achieved in the EU build citizens' trust in new AI technologies and can therefore give German and European companies a competitive advantage internationally.

AI-driven data science makes it possible for patterns, sub-patterns and correlations to be recognised in big data sets. This in turn opens up new fields of applications particularly related to personal data – such as the possibility to identify a person's individual health risks and to address these early on. The use of pseudonymised and anonymised data in this field can help strike the right balance between protecting people's right to control their personal data and harnessing the economic potential of big-data applications.

The Federal Government will promote research into novel ways for pseudonymising and anonymising data and for differential privacy (the compilation of synthetic training data; cf. field of action 3.8). This will also include work to ensure such procedures are designed to be lawful and to find out to what extent data held by the public sector and by scientific institutions can be made available for this purpose. The Federal Government subscribes to the principle of 'ethics by, in and for design' (cf. field of action 3.9). This is an aspect that is also taken into account in the standardisation process (see field of action 3.10).

We want to harness the opportunities that can be opened up by combining AI with key enabling technologies like biotech and production technologies.

Biotechnology is an example of how AI can enable innovation in other key enabling fields. Over the past few years, the amount of life-sciences data – particularly from high-throughput analyses – has increased enormously, and with it the biological knowledge derived from this information. A smart system formed by combining the biological knowledge available in digital form with automated processes can help considerably speed up product and process development in biotechnology and make this more efficient. Furthermore, the application of both biological knowledge and biological processes can spur on technological development: it means that cognitive capabilities can be

integrated into technical systems – a highly promising approach when it comes to improving flexibility in the production environment. Artificial neural networks have been put forward by computational neuroscientists as approaches inspired by the design of biological nervous systems. Furthermore, bringing together knowledge from agricultural and life sciences with the latest developments in digital technologies opens up opportunities for innovating agriculture and the food industry, also at international level. This is a way in which smart systems for biotechnology can future-proof industrial outputs. If integrated with technical, computational and biological knowledge, this work can result in biological smart systems that can be used for smart production technology.

Another key enabling technology underpinned by AI is autonomous driving – a technology that can render our mobility sector safer, more environmentally friendly, better and cheaper at the same time. For a vehicle to be able to correctly recognise objects even in a complex traffic situation and to reliably take driving decisions, more research and development is needed, particularly into advanced electronics solutions. These technologies rely on large amounts of data from different sources such as the vehicle's own sensors, digital maps and the infrastructure linked up to the vehicle to be processed, mostly in real time. This kind of mobile solution requires small local computing centres that can provide the computing power required from a short distance to the device. For this reason it is essential for the network infrastructure (e.g. the 5G standard) to be further developed so that the potential of AI for this sector can be harnessed.

We will harness the opportunities for using AI in agriculture and along the food production chain.

AI technologies are an important investment in the future of agriculture and the food industry. AI technology can contribute to sustainability, resource efficiency, animal welfare, competitiveness, food security and safety, and transparency.

Harness AI for overcoming global challenges such as the need to protect the environment, resources and the climate.

So far, limited use has been made of the potential of AI for reaching the 17 sustainable development goals (SDGs) set out by the United Nations. Major potential has been recognised mainly when it comes to better understanding complex natural and economic systems and to achieving societal progress. The Federal Government will foster research into AI technology, data-based applications and the use of AI, so that key areas such as mobility, our energy systems, agriculture and food security, healthcare, the protection of resources and mitigating climate change can be organised in a more sustainable way – both in Germany and across the world. This work may involve working with international partners to create new AI applications, for instance when it comes to large infrastructures designed for climate research or basic research in physics.

We will invest in research and development into AI-based technologies for civil security.

Autonomous and semi-autonomous systems can be used to support civil security officers, ease their burden and eliminate the need for them to be present in dangerous situations. There are plans for robots to be used especially in critical circumstances arising in an inhospitable environment, for instance when there has been a calamity in a chemical factory or when the structure of buildings has to be assessed in the wake of an earthquake. As part of its programme providing funding for security research, the Federal Government will establish two new Centres of Excellence that will test how autonomous systems can be used in inhospitable surroundings.

In response to new threats to our security from within and without the country, the Federal Government will promote research into both civil security and into the detection of manipulated and automatically generated content, also as part of its work on cybersecurity. The competent ministries will take charge of any research conducted into the use of AI to protect the country's external security and for military purposes.

We will improve the resilience of AI systems against attacks and make greater use of AI as a cornerstone of overall IT security.

As digitalisation progresses, it is essential for AI systems to be protected against attacks. The Federal Government therefore considers artificial intelligence to be a key building block of our future IT security architecture. Many aspects of IT security can benefit from AI. These notably include the security assessment of IT products and surveillance and monitoring of networks, interfaces and protocol data.

The Federal Government aims to add further to the expertise that Germany already has in the field of operational security of AI systems. Measures that could be taken in this context include greater redundancy in IT systems and the use of emergency software programmed in the traditional way.

The Federal Government therefore seeks to promote public-sector research in this field and to ensure that the relevant authorities acquire in-depth expertise. A key role in this work will be played by the Federal Office for Information Security.

AI for improving the security and performance capability of communications and information systems

Modern communication and information systems form the central nervous system of our digital economy and society. Reliable high-performance networks depend on the development of new communications systems that are capable of learning and adapting, and of using resources efficiently and sustainably. Gigantic amounts of data must be analysed instantaneously if anomalies in networks and IT and production systems are to be detected. This in turn will require research and development into new (semi-)automated systems underpinned by AI.

We will make use of the opportunities AI offers for the healthcare sector and support the use of data from distributed sources – always in conformity with data protection law and taking account of patients' protected interests.

With the progress made in molecular biology and on digitalisation, the number of large, heterogeneous and complex sets of life sciences data is growing exponentially. There is a major potential for this data to be used to arrive at a better understanding of the mechanisms underpinning disease and to make further advances in personalised medicine. We want to exploit this potential and do so in conformity with our constitutional and data protection law, which is why we will continue to promote funding for research into mathematical and computational methods used to integrate, analyse and interpret biomedical data. The key pillars on which this research will rest are systems medicine, computational life sciences, and the creation of a distributed bioinformaticsinfrastructure. One key challenge here is to bring together health data from the healthcare system and from research and to ensure that these are interoperable. One way for pooling data from distributed sources is to establish data integration centres at university hospitals, as is being done under the medical computing initiative, e.g.. In addition to the need for compliance with data protection law, we are also promoting the principle of everyone being in control of their personal data, so that patients have the final say on how and for what purposes their data is used.

We will expand AI research and development for applications in the nursing sector.

Demographic change is leading to a worsening ratio of persons requiring and giving nursing care. In addition, caregivers need to be able to use better equipment to avoid long-term damage to their own health. Robotics can be part of the solution here, and we will do more to support this. It opens up opportunities for the elderly, in particular – providing them with the support they need to stay in their own homes for as long as possible. Robotic systems designed for use in in-patient and out-patient care or in people's homes can take a variety of forms, starting with individual

components like robotic arms through to full humanoid robots. Smart robotic systems can be used for treatment purposes, communication and interaction, moving people and helping them stay mobile, assisting and accompanying them.

The Federal Government will foster research and development into space technology combined with AI.

Satellites collect information from Earth observation that can be useful for instance for predicting the development of commodity prices, observing and monitoring the impact of climate change and for managing risks. It will take new AI technologies tailored especially to these purposes to first analyse this information together with other geo-information as well as with information garnered from other sources such as citizens' science and social media, and then make sense of it and turn it into valuable geo-information. More research and development into this field can translate into urban planning, transport and mobility trends towards greater environmental sustainability and to more reliable information being available on natural resources and the way they are being used (land and water use, deforestation caused by agriculture, forestry and mining).

Mixed teams made up of human beings and machines are important in the field of space technology. This involves developing highly automated miniaturised, energy-efficient AI systems and fitting these with robotic capabilities. As a result, for instance, small cameras linked up to AI can allow for autonomous movements in difficult terrain such as during power plant dismantling or in deep-sea mining. Automation, AI and robotics are key enabling technologies that help reduce the cost of developing and operating space technology systems. In this context, smart and adaptable (learning) satellites that can be serviced and have a longer lifetime will be developed, which also helps address the issue of satellite debris.

From an early stage on, the Federal Government will feed regulatory expertise into those research and development activities that must meet particularly high regulatory requirements in order to complete the trajectory into real-life applications.

The objective must be to consider not only the established R&D partnerships formed by stakeholders in research and business – particularly those catering to fields of applications in specific industries or niches – but to also factor in the regulatory framework for later use, thus enabling a broad range of applications. This is to be achieved by involving experts from licensing authorities and from organisations that have an influence on market access early on in the process. The healthcare sector would be one example, as would be other markets that have stringent safety, security and reliability standards, such as private and public-sector transport systems.

The Federal Government will review its existing funding mechanisms to tailor them to AI research and initiate the development of more agile and of novel funding schemes.

We will streamline the framework for research funding as much as possible. The Federal Government will fully use the margin of discretion available under funding and state-aid rules to render research funding schemes more efficient and attractive – particularly for start-ups and innovative SMEs– and to make research findings more easily accessible. We will also factor in lessons learned e.g. from the Prototype Fund and from the treatment of intellectual property rights in spin-out companies and from other ways of transferring research findings to industry.

Harness the potential of AI for the environment, resources and the climate

Digital technologies can make a significant contribution to the protection of our environment, our resources, our climate and biodiversity, and to cleaning up our air, soil and water. The manifold opportunities associated with AI-based innovations come with a responsibility to keep in check potential risks, such as rising demand for energy, rebound effects or a lack of resource security.

For this reason, the Federal Government will step up research into AI technology and data-based applications for social and environmental change and also develop criteria for assessing the environmental impact of AI, thus paving the way for environmentally-friendly applications to be developed. To this end, we will

- support AI applications designed to protect the environment, the climate and natural resources; this support will come in the form of funding and financing schemes for the development and deployment of these applications (target: 50 flagship applications);
- build a cloud for environmental data to ensure that valid access to this data is available to scientists, businesses and society in a transparent way, and to enable the development of AI applications centred on the needs of human beings and our environment.

3.2 Innovation competitions and European innovation clusters

Innovation challenges are a key element of our work to foster research, development and innovation. There already are a number of challenges and competitions that allow for benchmarking and provide incentives for finding new and better solutions – particularly in the field of data-driven AI software applications based on machine learning.

We will make AI one of the priorities for the envisaged Agency for Breakthrough Innovations.

Much of the work done at the Agency for Breakthrough Innovations will be in the field of artificial intelligence. We are planning to also provide funding for entirely new ideas for technologies and/or business models, including ideas based on multiple disciplines, with researchers enjoying a maximum of scope in their work and with regard to the administrative set-up. We are planning to work with the French Conseil de l'innovation on AI.

We will form a European innovation cluster providing funding for cooperative research projects over the next five years.

Many of the systemic developments described in the above will depend on cross-border innovation partnerships for their success. For this reason, we will work with other European partners from science and the business community on specific research and development projects, for instance as part of a EUREKA cluster. The representatives from SMEs and the industrial sector that take part in the Franco-German cooperation (cf. 3.1) should act as a nucleus for this kind of European cooperation, which is needed to highlight Europe's role in research and also to make us more competitive. This can be achieved by pooling financing and sharing infrastructure and data (including data infrastructure or high-performance computing. This is the only way for us to reach the scale that is competitive at an international level (cf. also 3.11). Our goal for the medium term is to set up an integrated pan-European network of scientists and businesses, rooted in shared values and a joint regulatory framework ("European AI").

The Federal Government is considering the launch of an Important Project of Common European Interest in the field of AI.

The Federal Government is prepared to work with other European partners to establish and co-finance an Important Project of Common European Interest (IPCEI, pursuant to Art. 107 Treaty on the Functioning of the European Union) in the field of AI, where necessary.

3.3 Transfer to business, strengthening the Mittelstand

The Federal Government wants the German and European industries to remain competitive and become even more so, thanks to a broad-based take-up of innovative technologies. This is particularly true of AI, a key enabling technology. The enormous success of U.S. and Asian global players has not changed the fact that Germany is still one of the most important centres of business. This is mainly thanks to the German Mittelstand, a type of company that is unique to Germany. German Mittelstand companies are home to a large number of key enabling technologies, and combining these with AI can bring them to the next level of value creation. The Federal Government will provide targeted support for Mittelstand companies for this purpose.

Whilst there are some German companies that are at an advanced stage of development of AI applications, the large majority of firms, particularly among SMEs, have no experience in this field. This even applies to companies operating in industries or fields of application where AI might seem highly promising or is even successfully being used by competitors. For this reason, the Federal Government will focus on measures enabling German companies of all sizes – start-ups, SMEs and international corporations – to not only use AI applications, but also to develop them and integrate them into their internal processes.

We will venture down new paths and use a holistic approach to transfer applied AI expertise from research to companies, thus helping to build corporate AI capabilities. Networks including start-ups will also guide us in our work.

AI in the industrial sector

Industrial AI applications are tools that allow for industrial process data to be processed efficiently and to be interpreted for the benefit of companies and their customers alike. This makes AI a key component and an essential driver promoting smart monitoring, management and control of these processes, for rendering them more flexible and for thus taking Industrie 4.0 to the next level.

The objective here must be to market industrial products together with digital services and AI applications, allowing for innovative business models. Besides the research conducted at university or in research institutions, industrial research close to the market also has an important role to play when it comes to successfully transferring research findings into AI applications used by a wide range of companies. At the same time, it is important for Mittelstand companies, in particular, to be given easier access to AI technologies, computing capacity and cloud platforms. Open standards can serve as an effective means to help ensure that technologies of this kind are used by all companies.

The Federal Government will begin this work by creating ways for expertise and skills in the field of AI applications to be transferred to a broad base of companies. Furthermore, the importance of living labs and test fields for AI applications and regulatory approaches has been reiterated, after these had already been described in the Key Points Paper.

The Federal Government will strengthen and expand existing transfer structures.

The Federal Government is launching a transfer initiative designed to support companies in speedily turning research findings into products and services. We will engage with the stakeholders (mostly businesses) to find out what adjustments are needed in order to improve existing transfer instruments and what new mechanisms may be needed. Whilst the approach will basically be technology-neutral, it will also cover the field of AI. For quite some time now and within the limits of its constitutional scope, the Federal Government has been supporting institutes of higher education, public-sector research institutions and SMEs as they file patents. This is a way of fostering legal certainty and making it easier for innovative ideas to be turned into profits, whilst also disseminating (technological) expertise by publishing the patent. The funding instrument used to achieve this will be evaluated at the beginning of 2019 and readjusted for the next funding period, taking account of any room for improvement that still exists.

The Federal Government will improve its funding and promotional schemes and establish additional networking formats.

Any successful transfer of expertise is based on direct contact between science and business. The Federal Government will initiate measures to promote networking between stakeholders. We will revisit our well-established programmes to see if there is scope for expanding existing networks or for establishing new ones. At the same time, we want to foster cooperation between students and companies.

The technology-neutral Central Innovation Programme for SMEs (ZIM), which allows companies to choose their own innovation projects and initiate these, is already providing funding for a number of research and development projects in AI. There are also ZIM networks in this field. We will do more to bring the various parties involved closer together and initiate cooperation among them and with other AI activities and movers, so as to pave the way for even better communication among them.

We will provide funding for joint projects bringing together science and academia with the aim of creating pilot AI applications to prove technical feasibility and of translating the outcomes into marketable products, solutions and business models. We will explore the possibility of creating collaborative platforms, which would allow working groups formed across companies and institutions to work on joint projects for specific industries or across disciplines. Furthermore, we will make AI projects undertaken jointly by business and science a stronger focus of our Industrial Collective Research programme.

We will look into possibilities of better channelling funding for AI into projects whose outcomes are likely to be transferred into products that can sustain themselves on the market. We will also look into ways of further speeding up the application process for funding.

We will increase our AI-specific support for small and medium-sized companies. The Mittelstand 4.0 centres of excellence will have 'AI trainers' contact at least 1,000 companies per year.

We will use our Mittelstand 4.0 centres of excellence and our centre of excellence for digital skilled crafts to strengthen SMEs' competitiveness and ability to innovate in a lasting way; this will be achieved by systematically enabling them to tap into AI applications that are ready to be sold on the market and are relevant to SMEs. There could be AI trainers offering advice to all target groups. These trainers would have to keep up with the latest trends and developments in AI. There will be at least 20 AI trainers based at the Mittelstand 4.0 centres of excellence visiting SMEs in 2019 to inform and educate them about the use of AI technology.

The Federal Government wants to help companies establish test beds.

We want to support the establishment of test beds – similar to those established for automated and connected driving. The new test beds should give SMEs an opportunity to try out new technologies and business models in the real world. The test beds should have their own computing capacity and infrastructure for data analysis populated with data from the public sector and – if possible – corporate data fit for use in this test environment.

The Federal Government will initiate, support and follow up on the establishment of living labs.

We support the establishment of living labs like the one on the A9 autobahn, which make it possible for technologies to be tested (cf. test beds) in a real-life setting and for the regulatory environment to be screened for any needs for adjustment. With regard to the living labs – a horizontal instrument creating regulatory sandboxes for a defined period of time and in a set space – we are planning to launch a general initiative for broadening networks, providing information to business and initiating pilot projects. Whilst the initiative will be technology-neutral, it is open to pilot projects involving AI.

We will promote flagship projects financially and by giving them greater visibility.

We will support cross-company and cross-institutional flagship projects in AI and make them known all over the country. To this end, we will organise road shows for German Mittelstand companies and start-ups and their international strategic partners, complete with a demonstration centre where visitors can discover research projects in a way that is easily accessible. The road shows will facilitate transfer and an exchange of experience about ongoing or recent research projects in the field of AI. These projects should serve as inspiration for other AI applications and help further establish 'AI made in Germany'.

We will create a map highlighting interesting examples of AI applications.

The 2018 Digital Summit will unveil the first map highlighting interesting examples of AI applications used in business and institutions; the map will continue to be updated after the event. This collection of examples is to serve as inspiration for Mittelstand companies, in particular, encouraging them to embrace digitalisation by making it part of their business processes, cooperating with start-ups and developing creative digital business ideas.

The Federal Government will support B2B cooperation.

We will support cooperation between companies within the framework of competition law and supporting the creation of consortia that strengthen the global competitiveness of German and European business. The Federal Government has established the Commission on Competition Law 4.0, which is to render German and European competition law fit for the challenges associated with digital change. The Commission serves as a political platform for a debate on how to further develop competition law, particularly at the European level. Specific recommendations for action are to be presented by the Commission by autumn 2019 (cf. field of action 3.8).

We will conduct an AI monitoring to find out the penetration rate of AI.

At regular intervals, the Federal Government will assess the penetration rate of AI in Germany. The monitoring will determine the extent to which AI is used in companies representing various sectors, the sales figures for AI applications, and the origin and use of data and hardware.

3.4 Fostering the founding of new businesses and leading them to success

The Federal Government is determined to unleash higher momentum when it comes to start-ups in the field of AI-based business models and products. We want to improve access to venture capital in Germany, especially for AI-based business models, whose growth phase tends to be particularly capital-intensive. For this to happen, investors have to be given the right incentives. Furthermore, the Federal Government wants to achieve a considerable increase in the number of spin-offs from research.

The following measures will be taken:

> *The Federal Government is exploring the possibility of reinforcing the budget for the Business Start-ups in Science Programme (EXIST) as of 2020 by shifting resources within the relevant individual budget. The programme's budget for 2019 will be twice as high as in the previous years.*

The additional spending is to be used to stabilise and increase the number of spin-offs from university and non-university research institutes. Furthermore, a new round of funding for the EXIST Culture of Entrepreneurship in Higher Education programme is to start in 2019.

> *We are creating new funding opportunities for venture capital and venture debt and will launch a Tech Growth Fund Initiative.*

The Federal Government is continuing to use its successful, well-established funding instruments for start-ups (e.g. High-tech Start-up Fund, INVEST - Grant for Venture Capital, coparion Co-investment Fund and cooperation programmes with the KfW and the European Investment Fund), and is also developing new instruments designed to strengthen the German venture capital and venture debt markets. This includes the new, independent KfW Capital equity entity, which is to increase the annual amount of investment KfW provides to the Venture Capital and Venture Debt Funds to €200 million by 2020, thereby making it easier for young, innovative and high-growth technology firms to secure financing for their start-up and growth stages.

Last year, the Federal Government also launched a Tech Growth Fund initiative whose instruments are designed to help companies, particularly those in the growth stage, receive venture-debt financing at a market rate. Venture debt is a form of debt financing that is used by commercial banks and funds in addition to equity financing and that is still too uncommon in Germany. The Tech Growth Initiative is to put this market segment on a broader footing and make it an important building block of the venture capital market.

All of the funding instruments used by the Federal Government are technology-neutral and open to all industries, so as to encourage investments in start-ups that develop AI-based business models and products, and in venture capital and venture debt funds that invest in start-ups in the field of AI.

> *We are further expanding our advisory and funding services targeted at start-ups.*

The new start-up platform launched by the Federal Government in April 2018 (www.gruenderplattform.de) is an interactive online tool that supports start-ups – including those developing AI-based business models – from their initial idea through to the process of finding financing for their actual launch. This is achieved by pointing them to the services provided by some 400 partners across all of Germany. The funding services are continuously being improved and expanded.

- *We will use our Digital Hub Initiative to make start-ups more AI-savvy.*

We will considerably foster dialogue on AI within the Digital Hub Initiative. We will strengthen AI skills in line with the needs of start-ups and established companies.

AI in the financial sector

AI and big data give rise to innovations that can overhaul the financial market as well, allowing for essential banking processes to be conducted more effectively and efficiently. It opens up opportunities for new service providers and their data-driven business models to enter the market and change traditional business processes and market structures. New products are emerging. All of this needs technical knowledge and banking expertise – and this expertise is also required in the regulatory authorities overseeing the banking system. The FinTech Council has been established by the Federal Government to help with this change. The Council has also made recommendations on AI, which have been fed into this strategy. In June 2018, the Federal Financial Supervisory Authority published a study providing an in-depth analysis of the opportunities and risks of big data and artificial intelligence for the financial sector and of the implications for oversight mechanisms and regulation in this field.

3.5 World of work and labour market: shaping structural change

AI will take the changes in our world of work to a new level compared to the automation and digitalisation processes we have seen so far. This is why we will scrutinise employment forecasts and scenarios and readjust our strategies for designing work and making it more humane. AI has implications with regard to the skills required, jobs, business organisation and industrial relations. It is essential that we follow a holistic, human-centric and user-centred approach as we develop AI for the workplace and put it to good use there. Only if these requirements are met will we be in a position to fully harness the potential for innovation and the productivity gains that AI promises to deliver. We will therefore not only invest in technological advancement, but also in having technologies designed to be socially compatible and in giving workers the skills they need. As we do so, we should give equal consideration to our workers' interests – i.e. give them opportunities to develop and use their own talents and skills, provide for social security, health and safety, participation in society and inclusion – and to companies' interests. We will help ensure that companies and workers can adequately prepare for change and successfully go through the transformation process together.

A key priority for those involved in the consultation process for this field of action is a National Further Training Strategy and its swift implementation. The aim here is to open up opportunities for more flexible and less formalised digital continuous training, to make it easier for people to gain an overview of the options that are available, and to improve the quality of the training itself. Various stakeholders in the consultation process pointed out that it was important to discuss not only how education and (continuing) training courses should be designed, but also the financial and human resources required (time for workers to take part in courses). For example, participants in the consultation pointed out that many small and medium-sized enterprises (SMEs) cannot currently afford to give their workforce the time to engage in necessary training, simply because their order books are full.

The potential for AI to serve society as a whole lies in its promise of productivity gains going hand in hand with improvements for the workforce, delegating monotonous or dangerous tasks to machines so that human beings can focus on using their creativity to resolve problems. This requires a proactive approach to the design of future work. Participants in the consultation process highlighted the extremely important role of the social partners and of allowing the workforce to participate as AI makes its way into the world of work. The earlier and better the changes associated with the use of AI are captured thanks to networking (including internationally), the sooner will the relevant stakeholders be able to take initiative with regard to designing the future world of work. This is why funding will be provided for in-company-based innovation spaces overseen by the social partners and subject to scientific evaluation. The work undertaken in this field of action will take account of gender and diversity-related aspects and of the specific situation of self-employed people.

Taking all this into account, the Federal Government wants to take the following measures:

The Federal Government will establish a German observatory for artificial intelligence and will support the establishment of similar observatories at European and international level.

We will systematically monitor and analyse the implications smart and autonomous systems have in the world of work. For this purpose, we will create a **German AI observatory** tasked with monitoring the uptake and the impact of AI, i.e. with conducting an impact assessment of these technologies with regard to their implications for the world of work and society as a whole. The observatory will also take on an active role in shaping multi-disciplinary studies and projects looking into how technology can be designed to be socially compatible. International comparative studies can also give us key insights. We therefore support the establishment of **AI observatories** at the European and international levels. In particular, we are supportive of the French proposal (which is set out in that country's AI strategy) for a functional equivalent of the Intergovernmental Panel on Climate Change (IPCC) to be established in order to monitor the development of AI. This body should also look into global repercussions that could be of a negative nature, for instance job losses in developing countries.

We will use the findings gathered by the observatories for drawing up joint guidelines and frameworks for the use of AI in the world of work. These guidelines and frameworks will be continuously reviewed. We will work closely with the European Commission and international organisations such as the Organization for Economic Cooperation and Development (OECD) and the International Labour Organization (ILO). The observatories will be able to help develop a European understanding of what ethical AI could look like and feed this into these organisations.

The Federal Government will examine ways of auditing AI for use in companies.

We will use the research findings produced in the German and international observatories to examine how AI for use in companies could be audited. Our goal is to set benchmarks for employment, technical design, human-machine interfaces, health and safety, and data protection.

The Federal Government is initiating a European and transatlantic dialogue on the human-centric use of AI in the world of work.

The Federal Government will initiate European and transatlantic dialogue on the use of AI in the world of work. Both researchers and practitioners are to be involved in this dialogue. Together, we will identify potential conflicts of interests associated with the use of smart and autonomous systems in the workplace and also potential for adjustment. This identification will take place early on in the process and we will draw up solutions which we will seek to promote through existing transfer channels. During this process, we will consult the relevant international and European technical standards on health and safety and upgrade these.

As part of a National Further Training Strategy, the Federal Government will develop a broad-based set of instruments to foster the skills of the workforce.

With smart and autonomous systems being used in the workplace, the jobs done by humans and the skills-set required will change fundamentally and continuously. This makes it all the more important for us to act at an early stage and in a preventative capacity, and to strengthen employees' skills across their entire careers. The draft for a Opportunities for Qualifications Act, which was approved by the Federal Cabinet on 19 September 2018, marks an initial step by the Federal Government towards launching a large-scale qualifications and training initiative. The draft legislation wants to give employees whose jobs are at risk of becoming lost to technologies, those otherwise affected by structural change, and

those wishing to train for a profession for which is labour is scarce, an opportunity to acquire the skills they need. This will also include employees whose jobs will be taken over by artificial intelligence. From 2019, under the Opportunities for Qualifications Act, the Federal Government wants to give workers belonging to the groups described above, and also workers claiming benefits pursuant to the Social Code II in addition to their work, an opportunity to adjust and deepen their professional skills base – irrespective of their previous level of education, age and of the company's size. Funding is to be provided not only for the (partial) cost of the training itself, but also for topping up employees' wages or salaries. The grants available for small and medium-sized companies are to be much higher than those for large companies. The Federal Employment Agency is also expanding and upgrading its advisory services for working individuals.

We need to build on the manifold continuing training opportunities already being offered by companies to their staff and on the motivation of workers wishing to broaden their skills base. This means establishing a new continuing training culture in Germany – a culture guided by the principle of life-long learning. This is to be achieved by the National Further Education Strategy which is being developed by the Federal Government and the social partners in close cooperation with the Länder. Under this strategy, the continuing education programmes offered by the Federation and the Länder respectively will be pooled together, rendered more transparent, and reshaped to fit the needs of workers and companies. The strategy is to be presented to the public in summer 2019. Given the major importance continuing training has for employees, the Federal Government will strengthen the right of works councils to initiate continuing training.

In addition to this, we will provide funding for measures designed to support SMEs on in-company training for individual target groups. These measures will also build on existing support services already available to SMEs. We must eliminate obstacles that stop individual employees or groups of employees from making use of continuing education services. In particular, we have to address gender-specific differences and the specific needs of certain groups (e.g. those working part time, those with a low level of skills, refugees) and the continuing education needs of self-employed workers.

> *The Federal Government will use the results of a new skills monitoring system to inform and develop its Skilled Labour Strategy in the fields of digital skills and new technologies such as AI.*

The Federal Government has developed the **skills monitoring** system for labour market projections, which will be the analytical tool underpinning our new Skilled Labour Strategy. This strategy will look at all sectors and seek to determine the potential labour pool in Germany, in the EU, and internationally. There is also a need for sector-specific employment projections complete with various employment scenarios that make it possible for us to identify which skills will be needed in the future.

With regard to our **domestic skills potential** it is particularly important that we maintain and improve employability levels among employees that are already on the labour market. This is due to both digital and demographic change. The National Further Training Strategy is our response to this.

At the centre of the **strategy's European leg** is the need to make it easier for skilled professionals to move between EU Member States. In a joint effort with the Länder, the Federal Government wants to reduce obstacles that exist with regard to the recognition of diplomas, certificates and other educational and professional qualifications, language learning and financial support for apprentices and students.

We will make the task of harnessing the domestic and European skills potential a priority. The third leg of our skills strategy is about tapping the international skills potential. For Germany to be able to attract more skilled professionals from outside the EU in a targeted and meaningful way, we will need to adjust the legal framework by adopting a Skilled Labour Immigration Act and also take a number of additional practical measures that build on one another, forming coherent policy-making by the Federal Government. At the beginning of October 2018, the Federal Government has laid the basis for this by adopting the Key Points Paper on skilled immigration from third countries. We will do our best to make sure that the recruitment of skilled professionals does not cause a brain drain in developing or emerging economies.

A **fully-fledged Skilled Labour Strategy will be implemented** as part of the partnership for skilled professionals. The Skilled Labour Strategy is an ongoing process that has been launched in three different areas for which the relevant lead ministries take responsibility and in dialogue with the social partners, the Länder and other stakeholders.

> *The Federal Government will safeguard the right to co-determination, including where the introduction of AI application is concerned; the Federal Government will look into the question of whether a dedicated Workforce Data Protection Act could improve the level of legal certainty where this type of application is introduced in companies.*

Co-determination and the right for works councils to be involved in processes early on are ways of building trust and acceptance levels among the workforce prior to the introduction and use of AI. This is a prerequisite for the public to adopt a positive view of AI and also for companies to be able to successfully implement AI applications.

As part of their co-determination rights as per the Works Constitution Act, works councils can already have a say when it comes to the use of AI for the purpose of monitoring employees' performance. It is, however, likely that the trend towards greater use of AI will have a lasting impact on work processes and that these will change. This is why the Federal Government wants to safeguard and codify the rights of works councils when it comes to the introduction and use of AI. Section 90 of the Works Constitution Act will be amended to clarify that the measures listed therein include the use or intended use of AI applications.

We are exploring the possibility of a new Workers' Data Protection Act that would protect employees' data in the age of AI. This Act would be designed to be compliant with EU law. Not least with regard to AI applications, we want to use this to raise the level of legal certainty within companies and safeguard employees' personal rights and their right to control their own data.

Recruiting is another labour-related field of application for AI. Algorithms can be used to manage applications and select candidates. Depending on the software, this can embrace a large number of criteria. Section 95 of the Works Constitution Act stipulates that works councils have a right to co-determine the selection criteria used for recruiting, re-assigning, promoting/demoting and laying off workers. The Federal Government will amend the Works Constitution Act to clarify that this right also applies when AI is used in these processes.

Works councils can only live up to their tasks if they have the relevant expertise in the field of AI. Furthermore, decisions on IT tend to be complex ones that also have to be taken quickly. This is why we will make it possible for employers and works councils to jointly agree on consulting an external IT expert when taking decisions as per Section 87(1) No. 6 of the Works Constitution Act. This option will exist notwithstanding the general provisions and procedures set out in the Act and is to help works councils, in particular, to better exercise their co-determination right as per Section 87(1) No. 6 of the Works Constitution Act where technical applications designed to supervise workers or monitor their performance are to be introduced. We will also work with the social partners to develop training and advisory services targeted at works and staff councils.

> *The Federal Government wants to support knowledge transfer in the field of human-centric AI in the world of work by launching funding guidelines for in-company innovation spaces for AI applications.*

In-company innovation spaces are an opportunity for companies to monitor, scientifically evaluate and adjust the impact of AI and machine learning, which is often impossible to predict. The Federal Government has developed a concept for 'in-company learning and innovation spaces', which is part of the social partners' Initiative New Quality of Work designed to promote innovative in-company solutions for digitalisation. Part of this concept is our online platform experimentierraeume.de, which enables an exchange of best practices between companies. Furthermore, the Federal Government is examining the possibility of issuing funding guidelines on the establishment of in-company innovation spaces for AI-based applications in the world of work, especially with regard to human-machine interaction, health and safety and data protection.

We will establish regional Centres for the Future in eastern Germany and test these in a pilot project.

There are many regions in Germany that are hit especially hard by the challenges of demographic change and the digital transformation. This particularly applies to rural areas. We want to address these challenges by establishing **Centres for the Future**, starting with eastern Germany where we will try out these centres. These are to take account of the differing needs of individual regions and sectors and address these, particularly by offering innovative upskilling opportunities for employees, works councils, managers, employees working in the field of professional continuing education, and the self-employed. Each of the Länder in eastern Germany will have its own regional Centre for the Future designed to strengthen these target groups by imparting skills needed for independent learning, particularly within SMEs. These will benefit in terms of their capabilities, competitiveness and ability to innovate. A Centre for Digital Work will support the regional Centres for the Future by feeding information about new scientific findings on technologies such as AI to the centres and to local stakeholders.

In addition to this a **House of the Self-employed** is to be established to support one-person companies and freelancers in the digital world of work. The House will provide information on the right to set up unions and self-regulating procedures that could be used to improve remuneration levels, working conditions and social security levels of one-person companies and those working for platforms. The Centres for the Future will be piloted in eastern Germany before being rolled out across the country.

3.6 Strengthening vocational training and attracting skilled labour/experts

Vocational training and education (including continuing education) need to be adapted to the changing requirements linked to the digital transformation and, in this context, AI. Many of the main issues surrounding digitalisation are not specific to AI. Vocational training syllabi should not be limited to technology, but should be about bringing about informed, self-determined individuals who know how to deal with both the technical as well as the ethical, social, and societal aspects of AI as one area of digitalisation. As humans will always be superior to technical systems at things such as design-related skills and critical thinking, creativity, emotional intelligence and the ability to communicate and cooperate, the use of AI can help create room within the education system and training courses so that a stronger focus can be placed on the teaching of social and creative skills.

Taking a holistic approach is key here as the challenges linked to digitalisation are not only experienced by schools, vocational training centres and in higher education, but also when it comes to acquiring new skills in the workplace and in research and development. This means that all stakeholders in the education and training sector need to work together.

The recommendations for action outlined in the Key Points Paper have been confirmed in a consultation process. These include in particular the requirement to treat AI as an inter-disciplinary subject at universities and to provide more funding for the establishment of professorships in AI. AI teaching should place a stronger focus on ethical questions and sociological aspects.

One of the points stressed by the participants in the expert forums and online consultation was the need for basic digital skills such as coding to be taught across Germany and from an early age. The consultation process identified easily accessible, less formalised and customised (continuing) training services as a way to achieve this, wherever possible in combination with AI. It found that one of the requirements for these skills to be taught across Germany and from an early age was to provide training institutions with needs-based equipment including the latest infrastructure and digital learning services. It also stated that teachers across all institutions need to regularly update their digital skills. The consultation process also highlighted a number of exemplary education and training initiatives (including hackathons, workshops, summer schools and projects) that are already being widely used. The consultation process also found that it was important to discuss not only how education and (continuing) training courses should be designed, but also the financing and time (also with regard to human resources) needed for these. This important aspect will be developed further by the Federal Government in its National Further Education Strategy (see also field of action 3.5). In addition, the Federal Government will implement the following measures.

Helping young people develop an understanding for AI early in their lives by providing them with learning opportunities and hands-on experiences.

We welcome the initiatives undertaken by the Länder in this area and are engaging in dialogue with them to discuss how these measures can be intensified and supplemented by initiatives by the Federal Government.

Under its Digital Pact for Schools programme, the Federal Government will provide funding in this legislative term for the digital infrastructure needed across all German schools (including vocational schools) to promote the uptake of digital skills. In order for the Federal Government to be able to provide this kind of funding nationwide, an amendment of Article 104c of the German Basic Law is required. The Federal Government welcomes the objectives and fields of action adopted by the Länder on schools, vocational schools, universities and continuing education in the strategy entitled Education in the Digital Age. All children who start school in the year 2018/2019 or after are to have acquired a broad set of digital skills by the time they graduate. This will ensure that all pupils gain a sound, basic understanding of the digital transformation and its consequences.

Initiatives like the Learning Factories 4.0 funding programme could be rolled out more widely and be extended to include AI. Learning Factories 4.0 are laboratories that are organised and equipped similarly to private-sector facilities, featuring automated solutions and professional equipment, where pupils can learn how to use technologies and processes in practice. The Learning Factories are places for initial and further training where pupils can gain a hands-on-experience of the digitalisation of the economy.

Funding for initial and further training programmes, taking into account the specific features of individual sectors, such as healthcare or the food supply chain.

The potential that AI holds for healthcare and food supply can only be fully harnessed if we establish initial and further training programmes so that professionals in these sectors can acquire the relevant knowledge. This also requires a major change in the way healthcare and IT professionals work together and the creation of the necessary job profiles, positions and professions in healthcare and the food sector.

Firmly establishing basic AI knowledge as a part of syllabi, not just in computer science, but also in other natural, social, cultural, media-related and engineering sciences for initial and further vocational training, where appropriate.

In the context of the ongoing digital transformation and as far as is meaningful, we need to make increased use of AI in vocational training. We will drive forward the acquisition of digital skills by teachers and examiners working at vocational schools and support the development of teachers' digital skills in the Länder. We also support the initiatives on digital skills development launched by the social partners and companies. These efforts need to be further intensified, placing a special focus on AI.

Under the guideline for promoting the funding of research into the design of learning processes by taking into account the challenges posed by the digital transformation (Digitalisation II), the Federal Government is providing funding for projects that seek to identify strategies for designing learning processes that use the potential of digital media to support successful learning, both for individuals and groups. The guideline is part of the 'Digitalisation of education' segment of the Framework Programme for Empirical Educational Research. Potential research projects could look at, for example, the opportunities and limits of using learning progress assessment in self-directed learning and in the promotion of diverse learning biographies, thereby analysing the role AI could play in learning processes. This also includes looking at ways in which learning analytics can be used by taking into account ethical and data protection aspects and related issues.

3.7 Using AI for tasks reserved for the state and administrative tasks

Using AI in the public sector

The use of AI offers the public sector the possibility to provide information and services to citizens and companies and within the public sector in a more targeted, more tailored and more easily accessible manner. Using AI will mean new requirements, rules and opportunities for the public sector.

The Federal Government seeks to take on a leading role in using AI in the public sector in order to improve the efficiency, quality and security of public sector services.

The Federal Government is already using artificial intelligence, for example in the area of complex alphanumerical searches. These searches are mainly based on case-based-reasoning algorithms. These are combined with a number of different text and image comparison algorithms in order to provide users with the best-possible support as they conduct their research. The use of AI may lead to requests being handled more quickly and allow citizens to submit requests from wherever they are. This is also a response to citizens' expectation that digital technology will make dealing with authorities easier, reduce processing times and give them faster results – an expectation formed by what they have become accustomed to in the private sector.

The provision of open government data for unrestricted further use is to be expanded.

The provision of open government data for unrestricted further use is to be expanded in line with data protection rules. Data is to become 'open by default', so that making data publically available will become the new normal for public authorities. This is to be taken into account in the evaluation of the First Act Amending the E-Government Act (Open Data Act). Another possibility would be establishing an open data platform for the Federal Government. Using a wide range of different AI technologies to improve the analysis of information from different public and non-public data sources is to help provide a better basis for decision-making and encourage public authorities to handle procedures digitally.

Using AI for emergency response and for maintaining internal and external security

AI technology can help security forces to respond to threats both from within and outside the country and for emergency response. An appropriate level of both control and transparency will be ensured.

From an objective point of view, and like all other forward-looking technologies, AI and its applications pose both opportunities and risks for national security. The Federal Government seeks to harness these opportunities and to allow deploying AI in all ways that comply with the law, for the benefit of the state and society. There is a need to develop appropriate emergence response measures and the relevant protection mechanisms, not only in areas involving reconnaissance, data analysis and evaluation, but also to counter potential AI-based attacks against our government, economy or society. The use of AI can give rise to new types of threats such as the manipulation or falsification of information. Even if we decide to reject a particular, technologically feasible application for political, legal or ethical reasons in the future, it will nonetheless be necessary to look into the consequences that this application would have if it were to be used by others, so as to fully guarantee the internal and external security needs for Germany and its citizens. The use of AI-based technologies and systems will have implications for the armed forces and is therefore an important issue to be taken into account for the future of the Bundeswehr. As in other fields of application, the Federal Government will undertake a comprehensive analysis of the benefits and risks involved.

The Federal Government seeks to identify suitable areas for the security authorities and further the

use of AI in a way that promotes an agile and practice-oriented development.

In the field of security, the use of AI-based systems plays an important part in ensuring Germany's digital sovereignty, and by extension in ensuring public security and the security of German business. AI-based analysis methods can be considerably more efficient than conventional analysis methods, even though these methods are currently no more than an additional method for big data analysis that can be used in accordance with the Basic Law by combining it with other (including conventional) technologies. In this context, AI is used to provide information for decision-making that cannot be gathered without the use of AI within an adequate time period. This includes the recognition of persons through big data analysis, even though the appraisal of this information by police, intelligence and military authorities and the decisions made based on this information will continue to be conducted by the staff of the authorities. In addition to this, AI can be used in law enforcement/emergency response for protecting citizens and for coordinating the deployment of police forces. Other areas where AI may be used include predictive policing (under certain conditions and safeguarding personal rights), the protection of children and young people against sexualised violence on the internet and combatting and prosecuting the dissemination of footage depicting abuse, and social media forensics for profiling.

3.8 Making data available and facilitating its use

With regard to methods of AI and machine learning, the availability and quality of data are central preconditions and determining factors for the quality of outcomes. At the same time, the security of a useful data basis is of essential importance. However, access to data is restricted in many cases – partly for legal reasons, and partly due to the fact that the de-facto control of the data rests with public-sector and private-sector bodies. In order to achieve the goals set out in this strategy, the quantity of useful, high-quality data must be significantly increased without violating personal rights, the right to control one's own data or other fundamental rights.

One of the main goals is to considerably increase the amount of high-quality data that can be used in research and development, by businesses and civil society whilst protecting European values enshrined under constitutional law such as the fundamental rights – including personal freedom and the right to control one's own data – and the principles of the rule of law, the welfare state and democracy. In order to keep up with the potential offered by the amount of data available in other parts of the world, the conceptual work and actions need to take place directly at EU level. The European Science Cloud (EOSC) serves as a good initial starting point here. From a European point of view, machine-generated data from industrial and B2B contexts and domain-specific data are particularly important, as the scope of future AI applications will be quite broad. If this data involves personal data, data protection rules need to be respected.

We will assess the demand for a data and analysis infrastructure and the necessary willingness of the public and the private sector to work together.

For companies, process and product data are among their most important assets and often involve confidential business information or trade secrets. Companies will only agree to share this data with others if they can trust the infrastructure and the institution managing it. The consultation process and the expert forums found that there is a strong need for cooperation between the public and the private sector in this area. We will therefore consider establishing and managing a centralised, national, trustworthy, openly accessible data and analysis infrastructure and building a cloud platform with upgradable storage and computing capacity on which this infrastructure can be run. The goal is to ensure technological sovereignty and to raise Germany's and Europe's profile as powerful economic and research hubs for the use of artificial intelligence by establishing a joint venture including representatives from business, science and the public sector based on open and interoperable standards. This kind of data and analysis infrastructure can be used as an independent basis for building digital ecosystems, particularly by small and medium-sized enterprises and start-ups.

We will work closely with the European Commission to help implement and continue the initiative on building a European data space.

As part of the Digital Single Market strategy, the European Commission has adopted a number of initiatives designed to strengthen the European data economy and the establishment of a European data space, and these are supported by the German government. These include linking up European initiatives seeking to ensure that more data is shared in conformity with data protection law with national initiatives. In addition, the targeted provision of high-value data sets for areas that hold particular potential for commercial and social use will be included under the most recent review of the EU's Public-Sector Information Directive, which is about to be implemented.

We want to set incentives and create an environment that makes it easier to share data voluntarily and in a way that is in line with data protection rules.

It is of fundamental importance to strengthen data exchange between stakeholders that generate no or little data themselves, in particular for using self-learning systems. This is because training these systems requires particularly large and high-quality datasets.

We will consider the building of data partnerships between companies and research institutes.

Exchanging and pooling data in industrial processes where large amounts of data are being generated and analysed holds great economic potential. The Federal Government is looking into the possibility of encouraging the establishment of data partnerships between companies, for example by increasing the visibility of existing data platforms such as the International Data Space (IDS).

This may lead to cases where exchanging data as part of a data partnership could be incompatible with competition law. As a general rule, the Bundeskartellamt (Germany's national competition authority) takes a positive view of cooperation projects that improve efficiency and help create better and more affordable products and production processes. Exchanging and gaining access to data is of great importance for the partners involved in such cooperation projects.

We want to provide incentives and create the environment for researchers to build an infrastructure that makes it easy to gain access to data from a central location and process decentrally collected data.

Most of today's research data is generated or stored in a variety of different locations. In order for this data to be made available centrally so it can be used in AI systems, it needs to be standardised and transferred and stored in one central location. In order for this data to be processed, adequate high performance computers are needed, both centrally and locally. We will enter into negotiations with the Länder as soon as possible in order to drive forward the expansion of the research networks, cloud storage and computers needed for this in Germany. The Federal Government and the Länder have already announced plans to build a national research data infrastructure (NFDI). The goal of the NFDI is to systematically collect and make available the R&D data that is currently stored locally, temporarily and in a project-related manner for the German academic community and to help promote standardisation.

Commission on Competition Law 4.0

The work of the Commission on Competition Law 4.0 will focus on issues surrounding data access. It is to propose guidelines, from a competition law angle, for a new data governance that takes account of the need for cooperation and data access as well as new risks of collusion without undermining the protection of the fundamental rights enshrined in the constitution, including in particular people's right to privacy and to control their personal data.

We are developing criteria for building "data partnerships" in a way that is compatible with competition law..

The Bundeskartellamt has already published information on the assessment of data pooling and data cooperation under competition law. The Bundeskartellamt serves as a port of call for companies and can work with these to develop criteria for building "data partnerships" in a way that is in line with competition law by looking at specific projects. Based on the recommendations provided by the Bundeskartellamt, the Federal Government will assess how it can help companies gain more clarity on the competition-law context of such cooperation projects based on past decision-making. The Federal Government will make use of sector-specific dialogues to assess what kind of specific support is required by the sectors that have the greatest demand for data exchange.

We will assess whether it is possible to make available datasets that have been generated by government-financed research projects to third parties whilst ensuring data protection interests.

This includes assessing existing requirements for making data available for research purposes in a publically available database following the completion of the research project.

We seek to provide high-performance infrastructure to improve the accessibility of Earth observation data, so it can be analysed and evaluated using AI-based procedures.

In order to achieve this, we are driving forward the expansion of high-performance computing resources, storage and network capacity in order to allow for data transfer speeds of 100 gigabits per second. We will also take into account interoperability with other data systems and the integration of additional geodata – for example data generated by the public sector, through citizen science or social media.

We will explore providing targeted funding for open training data sets that are compatible with data protection rules.

Insufficient access to datasets suitable for training self-learning systems can be a barrier, not least for users who do not generate data themselves. We will assess whether there is a need for funding in this area and also take this into account in open data policy (cf. 3.7).

We will encourage the provision of targeted funding at EU level for research and development in the areas of anonymisation, use of synthetic data and "small data", and explore possibilities to provide funding for this at national level.

In a number of specific fields, synthetic data are a highly promising option to use data in a way that is in line with the Basic Law, for example for training purposes. Research approaches in this area should receive targeted funding.

Apart from approaches geared towards increasing the amount of data that can be used in line with data protection rules, methods designed to reduce the required amounts of data for training and using AI systems in a way that conforms with data protection rules are of strategic importance. Data quality, data security and data curation are horizontal issues and, therefore, targeted funding needs to be provided across all sectors.

Suitable non-personal public-sector data in particular can be provided as open data. And help create a level playing field between SMEs and start-ups that do not generate any data themselves and competitors that do.

> *In addition, we will assess the need for additional funding for data management across public authorities at federal level.*

This will help increase the availability and quality of the data that is used by the public sector, and, indirectly, for research, business and other purposes. We will assess whether the advisory office set out in Section 12a of the eGovernment Act needs to be further expanded.

Data is a key enabler, for example for the digitalisation of mobility. In the last few years, the Federal Government has considerably facilitated access to data – particularly public-sector data – and established several data portals (e.g. www.mCLOUD.de, www.MDM-portal.de). The different activities are to be further expanded and combined into a harmonised approach that makes it possible for mobility data to be accessed from one single source and allows not only data from the federal ministries to be included but also data from private-sector providers.

Mobility

Mobility is a sector that holds tremendous possibilities for using AI in all modes of transport. AI can detect dangerous situations more swiftly and respond to these more reliably than human beings and can therefore help to dramatically reduce the number of traffic accidents. Going forward, it will be possible to use AI to control traffic flows in a way that prevents congestion and delays. Looking for a parking space will soon become a thing of the past as AI-based connected cars learn to identify the nearest available space. AI-based logistics systems will help optimise logistics capacity in a way that reduces the number of unladen transport vehicles on the move.

AI systems will also play a crucial role in implementing autonomous driving. Complex road networks, both in cities and in rural areas, are a key challenge here. AI is an indispensable part of our vehicles – whether it is for the merging of sensor data, object recognition or the planning of driving manoeuvres.

As the security standards governing the automotive sector are particularly high, it is of fundamental importance for AI technology to be secure. In order to achieve this, gathering a sufficient amount of training data and establishing the necessary databases is key. In addition, new procedures, methods and quality standards need to be developed, also with a view to future vehicle type approvals.

This means that automotive companies need to work together when it comes to the generation/recording, management and analysis of driving and sensor data. Companies will only be able to survive in global competition if they work together on the implementation of AI systems for autonomous driving and on ensuring that these are secure.

We want to leverage the full potential of AI in order to make mobility safer, more environmentally friendly, more efficient and more affordable. In order to achieve this, we will make sure to provide high-performance, digital infrastructure, to make our transport infrastructure fit for automated and connected driving and to provide the best-possible access to mobility data.

The statements made on the Key Points Paper included requests for specific support to be provided for using AI systems in line with data protection rules. In addition, interoperability of the data formats was named as another requirement for data use.

We will invite data protection authorities and business associations for a round table and work together to develop joint guidelines for developing and using AI systems in a way that is compatible with data protection rules and to highlight best practice examples.

Methods and procedures that ensure anonymisation and – wherever this is compatible with data protection rules – the use of pseudonymised and synthetic data are key for increasing data availability and should be provided with targeted funding. At the same time, there needs to be as much legal certainty as possible on how data protection rules are to be applied, particularly in the area of new AI technologies. Organising a regular dialogue on specific AI use cases between businesses, scientists and data protection authorities can help achieve a better technical understanding on the one hand and obtain investment security on the other (see also field of action 3.1 on privacy-enhancing technologies).

We will strengthen and expand research on the exchange and interoperability of industrial data.

Although, generally, no personal data is being generated in the areas where AI is used for industrial purposes (B2B transactions), data on production processes and commodity flows is, from a business perspective, just as sensitive for companies as personal data is for individuals.

Introducing more rigorous technical standards on data formats, rights of use, interfaces and decentralised data infrastructures and architectures are of particular interest (see also field of action 3.10 on standardisation).

We will provide funding for the development of standards for data formats and interfaces and encourage cooperation at EU level.

The Federal Government has already commissioned a project to draft a standard governing the creation of metadata and open data for a number of selected formats. The project aims to help data providers make available and publish high-quality data and make it easier for distributors to find and disseminate the data. This will give users easier and more targeted access to higher-quality data. Existing standards will be taken into account.

Healthcare is a sector where data analysis can provide particular added benefit.

We will provide targeted funding for using AI systems in the healthcare sector.

As digitalisation picks up speed, more data is being generated that can be used for managing healthcare processes and the structures underlying these processes in the healthcare sector. We therefore need to make sure that the data that is being generated in health care provision and billing processes can be used consistently and in formats that can be processed by self-learning systems in a way that is compatible with data protection rules for the benefit of the patients. Going forward, we need to seek to use data in a way that is in line with data protection rules so we can detect correlations and identify new methods for better detecting illnesses and risk factors and starting treatment more swiftly. Using health care data is considered to be particularly sensitive; therefore, control of one's personal data, patient rights, sensitive patient interests and ethical aspects will be respected for the benefit of the patients involved.

The Federal Government will develop formats ensuring that data can be better integrated and better exchanged between healthcare providers and researchers in a way that is compatible with data protection rules in order to tap the potential of big data and AI technology for healthcare provision and help German companies compete successfully in this sector.

Healthcare

The Federal Government is already funding a wide range of projects by building on the work that has been done in the context of the funding strategy for medical IT, which focuses on university hospitals and on pooling the data that is generated across different research and health care provision facilities in a way that conforms with data protection rules and on making this data available – in conformity with data protection rules – for big data technologies and AI applications in hospitals and practices.

3.9 Adapting the regulatory framework

In the future, AI applications will be used not only for pattern recognition and analysis, but also will help with everyday decision making or the processes underlying such decision making. This has implications for the discussion of political, legal, cultural and ethical questions. The Federal Government will seek to ensure that the use of AI technology will not undermine the fundamental values underlying the democratic order of the Federal Republic of Germany nor the fundamental rights enshrined in the constitution – including in particular the general freedom of action, the protection of privacy, and control of one's personal data.

The Federal Government advocates using an "ethics by, in and for design" approach throughout all development stages and for the use of AI as the key element and hallmark of an 'AI made in Europe' strategy. This includes conducting research on, developing and producing AI, and also the deployment, management, monitoring and governance of AI-based applications.

Our existing regulatory framework already provides a sound basis and high standards for this. The Federal Government will review whether our legal framework covers all aspects related to algorithm-based and AI-based decisions, services and products and, if necessary, adapt it in order to make it possible to verify whether there is any undue discrimination or bias.

As AI is more widely used and the amount of human-machine interaction increases, it needs to be ensured that the development and use of AI is governed by the highest security standards. Ensuring cybersecurity is one of the most important preconditions for making sure that AI applications and AI-based products are secure. The current approach, which is to focus on the operators of critical IT infrastructure, for example in the IT, healthcare and energy sectors, will no longer be sufficient. This means that we need to start asking hardware and software producers for adequate commitments that respect the principle of security by design.

The consultation and participation process underlying the development of the AI Strategy has been marked by two conflicting lines of argument: on the one hand, there is concern that more stringent regulation could potentially hamper investment, on the other, there are calls for regulation to address non-transparent AI decisions and copyright-related issues in text and data mining (TDM). Among the measures proposed as part of the online consultation process, we regard as most important the request to review and, if necessary, adapt the legal framework governing the use of data and AI technology and the request to ensure that AI systems are transparent, predictable and verifiable.

The following measures will be taken:

> *The Federal Government will review the legal framework governing the use of data for AI-based applications.*

The Federal Government will promote the application of the European and national legal frameworks governing personal data and verify whether there are loopholes for algorithms or AI applications. The Federal Government will also review, and if necessary adapt, the legal framework governing the use of non-personal data and AI technology. The recommendations made by the Data Ethics Commission will be taken into account. The Commission has stated

that the use of data and AI algorithms needs to be documented in a transparent manner. The Federal Government is committed to ensuring that data is used in line with the provisions in the constitution such as non-discrimination and the right to privacy protection.

In order for high-quality AI applications to be developed, which will prove the prowess of German and European AI developers and users, AI applications require high-quality datasets. In cases where personal data is used, it also needs to be ensured that the data is processed in a way that conforms with the law – i.e. legal quality – by respecting personal rights, the right to control one's own data and other fundamental values. With the EU General Data Protection Regulation having entered into force in May 2018, the EU has adopted high data protection standards, providing a universal legal framework governing the processing of personal data within the EU. The Federal Government will explore as to whether the current legal framework will allow personal data to be used as an opportunity for economic development on the one hand, and ensure the right to control one's own data on the other, taking into account new AI-based technologies.

The Federal Government is engaging in dialogue with national and international bodies, including the Data Ethics Commission or the EU Commission's High-Level Expert Group on AI and will take into account the recommendations of these bodies as it develops standards on ethical aspects at German and European level.

> *The Federal Government will assess how AI systems can be made transparent, predictable and verifiable so as to effectively prevent distortion, discrimination, manipulation and other forms of improper use, particularly when it comes to using algorithm-based prognosis and decision-making applications.*

It needs to be possible to use AI in a way that effectively prevents discrimination, manipulation and other forms of improper use. People will only trust using algorithm-based systems for the preparatory stages leading up to a decision or an autonomous decision-making system if the use of AI is made transparent. In cases where automated decision-making processes require the processing of personal data, the GDPR sets out far-reaching information requirements and a right for the individuals whose data is being processed to have an automated decision reviewed by a human being whenever the decision is taken completely autonomously. This is to ensure transparency. In order for the individuals whose data has been processed to be able to challenge undue discrimination, they need to be given the possibility to examine the basis – the criteria, objectives, logic – upon which the decision was made. In addition, information about the personal data used in the decision-making process needs to be made accessible. Further, information rights as well as labelling and publication obligations should be drawn up in plain language and be made easily accessible. Aspects that could lead to discrimination or abuse of a particular system in the global context should also be taken into account, including the discrimination of disadvantaged population groups in developing countries. As a general rule, the transparency, predictability, non-discriminatory nature and verifiability of AI systems need to be ensured in the development, coding, introduction and use of AI systems (including training and application data). This requirement should be implemented in particular for automated processes that prepare decisions or draw conclusions that are implemented directly without any human interaction. But even in cases where AI systems do not use any personal data for making a decision – for example in robot journalism – transparency and protection against distortion, discrimination and manipulation are essential. Ethical requirements and the rule of law should be the principles guiding the entire development process and the use of AI – and should safeguard the hallmark of 'AI made in Europe'. This includes conducting research on, developing and producing AI, but also the deployment, management, monitoring and governance of AI-based applications. All stakeholders, including industry, should be involved in the development of procedures designed to monitor and retrace algorithm-based decisions.

The Federal Government examines the possibility to establish and/or expand government agencies or private-sector auditing institutions that verify algorithmic decision-making in order to prevent improper use, discrimination and negative impacts on society. In order to achieve this, auditing standards are to be introduced and impact assessment standards developed. It should be possible to require companies to disclose all elements of the AI / Algorithmic Decision-Making (ADM) process to the monitoring bodies without these companies having to disclose any commercial secrets.

The Federal Government is providing funding for the development of innovative applications that support self-determination, social inclusion, cultural participation and the protection of citizens' privacy.

The Federal Government will drive forward the development of innovative applications that promote self-determination (particularly the right to control one's data), social inclusion and citizens' privacy. In order to achieve this, we will use existing funding instruments – in the context of their respective purposes – for example consumer protection instruments, and look into the possibility of expanding these. We will also make sure that all parts of the population have a justified level of confidence in AI-based products and services, the skills to use them, and the possibility to use them in a way that ensures legal certainty.

This holds particularly true for cases where AI systems provide professional support for skilled staff in their everyday work, for example in the area of education and nursing care. In this area, we need to make it easy for skilled staff to be able to verify and, if necessary, correct the work of an AI system.

We advocate engaging in a broad discussion to develop a joint definition of the goals for 'decent work by design', which will be further specified and integrated into a 'digital bill of rights', by taking into account the needs and challenges of the information society.

The Federal Government will adapt the legal framework governing copyright in order to make it easier to use text and data mining (TDM) as a basis for machine learning both for commercial and non-commercial purposes. A fair balance will be struck between the interests of both copyright holders and users.

Text and data mining (TDM) is a key enabling technology and forms the basis for machine learning. In cases where content is protected by copyright, smart regulation for TDM is needed, both for commercial and for non-commercial purposes, if there are potential implications for copyright. In cases where licensing models cannot provide satisfactory solutions, a combination of legal permissions and remuneration rights help strike a fair balance and ensure that the rights of all parties are duly respected. Also, the following principle should apply: "The right to read is the right to mine."

3.10 Setting standards

Those who set the standards determine the market. Global standards help to reduce technical barriers and to open up markets, thus making businesses more competitive. Standards help make applications more user-friendly, provide a high level of product quality and security and ensure comparability and interoperability. They are therefore the basis for public confidence in technical systems and processes. Standards also help ensure an adequate and flexible regulatory framework.

The Federal Government sees it as its duty to set the national regulatory framework for business and therefore to advocate the development of standards at national, European and international level by the national standardisation organisations (DIN /DKE). However, developing standards is primarily up to the private sector, not the state. Business representatives therefore need to adopt a more active role within standardisation bodies. Important questions include in particular the standardisation of AI terminology and classifications (degrees of automation, self-learning ability, AI-related risks) and ethical standards ("ethics by design"). In addition, existing standards need to be reviewed as to whether they are "AI-compatible". It would also make sense to agree on a standardisation roadmap at European level. In addition, we should look at the possibility to introduce binding standards in the healthcare sector.

The Federal Government is looking at the possibility to provide funding for experts, particularly from SMEs and start-ups, so they can take part in international standardisation processes.

This would help German interests to be better represented. Developing a funding tool – similar to our trade-fair programme – could help promote the participation of young innovative companies in AI standardisation and therefore improve the way the specific interests of SMEs are taken into account.

> *The Federal Government advocates the standardisation of AI terminology and classifications (including degrees of automation, self-learning ability, AI-related risks).*

The Federal Government will pay special attention to ethical aspects, particularly in the standardisation of AI technology to be used in autonomous machinery and vehicles ("ethics by design"). We will also take these aspects into account as we look at the possibility to establish structures and processes required for auditing the development and use of AI (also see field of action 3.5).

> *The Federal Government will work with the German Institute for Standardization (DIN) to develop a roadmap on standardisation in the area of AI.*

This roadmap will also set out a requirement to review existing standards as to whether they are AI-compatible. Standards that can be read and interpreted by machines are of fundamental importance, particularly for self-learning systems.

> *The Federal Government will launch an initiative designed to better represent European interests within international standardisation bodies by working with the business community, academia and standardisation organisations.*

This will not only be about technical issues, but also ethical ones. The Federal Government will introduce input provided by the Data Ethics Commission into the debate. The goal is not to "blockvote" – which is impermissible – but to improve coordination so we can better enforce European values at global level.

3.11 National and international networking

In the long term, horizontal technologies like AI will touch on all fields of science, commerce, culture, media, administration and the day-to-day lives of citizens. This is a global development, and so policymakers need to think and act globally. In addition to the measures set out below, please also refer to the cross-border cooperation projects mentioned in action fields 3.1, 3.2, 3.3 and 3.5.

We are seeking to:

> *Coordinate the measures set out in the AI strategy with other activities undertaken by the Federal Government.*

This AI strategy needs to be considered in the wider context of other strategies and measures undertaken by the Federal Government (including the Federal Government's High-tech Strategy, the Federal Government's digitalisation implementation strategy, the German Sustainability Strategy, the establishment of a Data Ethics Commission within the Digital Council, Plattform Industrie 4.0, the national platform on the future of mobility, digitalisation in healthcare, mobility 4.0, the protection of children and minors from harmful media, the federal IT consolidation project, the Federal Office for Information Security, the Central Office for Information Technology in the Security Sector, the Geoinformation Strategy and action in the areas of the future of work, cultural and media policy, climate change mitigation and other sectors). This particularly includes measures on digitalisation as well as those launched under the Federal Government's High-Tech Strategy 2025 that are wider in scope, but include AI. In particular, one of the twelve missions set out in the High-tech Strategy 2025 is "Rolling out AI".

The measures set out in this AI strategy are not only being coordinated with the strategies adopted by the Federal Government and the federal ministries, but also with the Study Commission entitled Artificial Intelligence – Social Responsibility and Economic, Social and Ecological Potential set up by the Bundestag on 27 September 2018.

The ministries responsible for the activities outlined above are to regularly assess the impact that the progress made on AI development has on other policy areas and sectors and what implications this will have for their own activities. In order to detect and prevent undesirable developments at an early stage, systematic analysis and observation as well as a regular dialogue between the responsible ministries is required. Whilst, in some policy areas, AI can help achieve a particular goal, it can pose a potential risk or danger in others, which will need to be addressed. One area where AI has a beneficial or reinforcing effect is the implementation of the sustainable development goals (SDGs) set out under the United Nation's Agenda 2030, as AI technology can help boost the efficiency of energy installations, improve medical diagnosis methods and enhance design measures geared towards adapting to climate change. Potential risks include the use of AI technology in way that violates personal freedoms, the right to control one's own data, privacy and data protection, the use of loopholes in security systems (cyber-attacks) and various forms of discrimination.

> *Work more closely with the EU institutions, particularly with the European Commission and the Member States on developing the framework governing the use of AI on the Digital Single Market and for implementing the European AI strategy.*

The further integration of the European Single Market will have a direct impact on the availability of data, the business models based on this data, and on European standards governing data use. The European Commission will work with the Member States to develop a coordinated action plan on the use of AI technology by the end of 2018. This plan will set out a wide range of measures to be implemented both at national and European level. The Federal Government will provide input for this process at an early stage and assess – on the basis of the principle of subsidiarity – at what level action should be taken and where synergies between EU institutions and the Member States can be leveraged. This includes, for example, developing, establishing and connecting digital hubs, integrating the national centres of excellence into a European network of centres of excellence, coordinating European and national research programmes and promoting dialogue and cooperation between national and European experts on the regulatory and standardisation aspects linked to the use of AI. In the period up until 2027, this will have implications for the EU's Horizon Europe Programme, Digital Europe, and the European Social Fund, which include AI-related action for which in some cases considerable funds have been earmarked. The Federal Government will encourage the EU to provide funding for artificial intelligence under the aforementioned programmes. As a general rule, it should be reviewed as to whether existing tools and regulations can be adapted/enhanced to include AI technology, before new tools or regulations are developed.

> *Engage in dialogue and if possible reach agreement on joint guidelines with other leading regions and economic areas.*

We will expand international, bilateral and multilateral cooperation on AI, for example within the G7 and the G20. International cooperation has long been a key feature of cutting-edge research projects, and most scientific communities – including the AI community – are already very well connected across borders, as they share common research interests. This cooperation and these networks are to serve as the foundation for European research facilities to engage in further cooperation projects and develop outstanding solutions that will be successful internationally. We need to work with the nations leading this field – for example the US, Canada, Israel and some Asian countries – to conduct joint bilateral and/or multilateral R&D activities on the development and use of AI. This also includes cooperation between companies from different countries which are part of the same global value chains. German diplomatic missions and the German Houses of Research and Innovation can be used for this type of cooperation. Germany Trade & Invest GmbH (GTAI) will actively disseminate the importance attached to AI in Germany as part of its foreign trade and investment efforts. This will help improve the visibility of German providers of AI solutions and make foreign companies aware of the opportunities for investment and cooperation that exist in Germany.

When it comes to developing common guidelines, we advocate taking a multilateral approach by using existing forums such as the OECD, G7, G20 and the United Nations. We seek to establish AI observatories at the European and international level (field of action 3.5) and support developing countries in the creation of bespoke guidelines under the Global Pulse Initiative. Based on our values governing the deployment and use of AI systems, we will take into account the results achieved by the relevant national commissions – including the Data Ethics Commission and the Study Commission – and feed these into the relevant working groups and/or negotiations on guidelines and ethical standards on AI. This is an approach that is shared by other European Member States such as France and Finland. Germany advocates taking a European approach to the use of AI.

Establish capacities and knowledge about AI in developing countries in the context of economic cooperation so that economic and social opportunities can be utilised there.

The Federal Government stands ready to work with developing and emerging economies on relevant areas such as education, training and economic cooperation, wherever these countries so desire, in order to help them use AI technology for economic and social development in the context of their technological, societal and social conditions. As AI is a global key enabling technology, we need to ensure that these countries are not left behind. This includes building and developing the required scientific and technical expertise in education and training, the commercial use of AI technology, the provision of support through open-source and open-data approaches, and space-based infrastructure that is connected by satellite to the communications and data flows of the industrialised countries. It is important to ensure that AI applications developed by industrialised countries are not discriminatory or unsuitable for users in developing countries, for example because training data is incomplete or inadequate, or due to a more restrictive regulatory framework. In countries that do not have any, or insufficient, data protection guidelines / protection mechanisms, there is also increased potential for abuse. We therefore need to help these countries develop an adequate policy framework governing the use of AI.

Equipping individuals and institutions with the right skills and the capability for critical reflection in the information society.

Different forms and types of information and technology are being rolled out at an unprecedented speed, transforming our society and our private lives. They are changing the social interaction patterns and debates that are required to ensure our democratic order. There is a constant need to deal with AI as the development of fields in which the technology can be used picks up speed. The profound and diverse changes that are taking place are of fundamental importance not only for personal development, but also for social cohesion and create a need for a debate that places greater emphasis on freedom and democracy. This means that we need to create an environment that allows our citizens and institutions to acquire the digital and media skills they need and to critically reflect on the use of new technology. Such skills are a key requirement for a fact-based and differentiated public debate that can help build public confidence in the use of AI.

Possibilities to promote the acquisition of digital and media skills and the ability to critically reflect include launching campaigns designed to disseminate factual information (for example by explaining real-life scenarios of AI use), teaching digital skills in schools and adult education, and introducing and promoting technology for implementing and enforcing the law and ethical principals in a technology-driven world. The media and institutions regulating the media also play a key role in this context. Their role includes not only making society aware of new technologies and critically reflecting on technological progress, but also providing new forums for debate.

Investment in technological impact assessment needs to be commensurate with the uptake of technologies such as AI in our society. Research and development activities are to be driven forward in a way that takes account of data portability, interoperability and consumer enabling technologies – in this context, this means AI applications that focus on helping consumers make decisions in their day-to-day lives. In addition, the government's responsibility to design a trust-inspiring framework and to ensure that this framework is complied with, as well as the freedom, autonomy and responsibility of the users and other persons affected by new technologies, have to be balanced against the need to control the market and competition, and we need to discuss and shape these aspects within society, taking into account the changes that are taking place. The fact that the companies that are leading the development of AI are becoming ever more powerful must not lead to scientists and civil society becoming ever more dependent on obtaining financing from these companies. The government needs to enable scientists and civil society to provide independent and skills-based contributions to this important public debate.

As modern technologies and AI continue to develop, relieving human beings of certain tasks, people will not only acquire new skills, but also lose existing skills. This means that we will need to discuss our responsibility towards future generations to preserve and develop a number of particular skills and a certain degree of independence. We also need to discuss the definition of and requirements for social sovereignty.

(based on the recommendations of the Data Ethics Commission)

3.12 Engaging in dialogue with society and continuing the development of the framework for policy action

At present, AI is the subject of a contentious debate in wide sections of the populace. If we are to make Germany a world leader in terms of research, development and the application of AI, AI needs to be viewed, desired and shaped as an opportunity. This requires intensive societal dialogue, participatory processes and possibilities to help shape the future. The aim is to anchor AI in society in cultural, ethical, legal and institutional terms. The opportunities afforded by AI to each individual and to society in general must be flagged up just as prominently and credibly as the possibilities for social and inclusive technology and measures to analyse and safeguard against any potential risks. We will place the societal dialogue on AI in the context of a comprehensive and longer-term campaign on digital information, education and participation which embraces new technologies like AI. In this process, we will involve all groups in society and pay particular attention to those, such as the elderly, who manifestly still make less than average use of digital services.

The need for comprehensive information and education measures and dialogue processes is stressed in almost all the comments received in the online consultation process. A lack of knowledge and acceptance on the part of the general public could impede the development and dissemination of the technology in Germany and hamper investment. Further to this, it is important to use the experience available in civil society as a driver for innovation. This is another reason why there is a consensus that there is a need to disseminate knowledge and develop media and technology skills in terms of new technologies both in general and in specific fields of application. Finally, the relevance of AI development for society should be ensured via appropriate participatory measures. Here, civil society actors in particular are opposed to public relations efforts which are merely intended to foster public acceptance, and prefer active inclusion and involvement in the process of shaping the future.

Many comments highlight the need for an interdisciplinary scientific dialogue, not merely on the technology and its specific potential applications, but also on socio-economic and socio-cultural interactions and a transdisciplinary approach to shaping the technology. In this context, calls are made for increased financing of research projects in the field of societal effects of AI, the transdisciplinary dialogue and the assessment of the national and global impact of the technology.

Such comments are addressed both to the Federal Government and, in many cases, to existing institutions and organisations, such as educational facilities, from schools to adult-education institutions and academies, and universities, cultural institutions like museums, initiatives and centres, and relevant centres of excellence, communities and portals. The comments are also addressed to the Länder and the municipalities.

The point is also made that the discussion on the ethical limits to the use of AI is not a one-off, clearly defined process, but rather must be an ongoing process in view of the dynamic developments in technology and must equally embrace technical and natural sciences and the humanities and social sciences.

> *The Federal Government will establish a Digital Work and Society Future Fund (Zukunftsfonds Digitale Arbeit und Gesellschaft) to get the message out and to promote multidisciplinary social technology design.*

The Federal Government understands the need for a comprehensive, nation-wide information and policy campaign in the field of digital technologies like AI and blockchain. By establishing a Digital Work and Society Future Fund, it is creating a nation-wide centre of excellence that organises, supports and promotes overarching and inclusive measures in the field of participatory social shaping of technology. The Future Fund is tasked with initiating and moderating an interdisciplinary scientific dialogue on the social shaping of technology and with encouraging innovation which fosters a human-centric development and use of AI. In this process, it will initiate and support dialogues between science, business and civil society on various technologies and individual fields of application and their impact on the world of work and on society. It will identify and promote flagship projects on various technologies and their applications, and hold competitions on ideas for the social shaping of technology. It will develop and administer funding programmes to support dialogue-oriented education projects, innovation spaces and shaping/co-creation projects in the field of education, culture, administration, businesses and civil society initiatives. Further to this, it will support, advise and assist municipalities and regional institutions and organisations in the design and establishment of citizens' labs, innovation spaces and pilot projects based on new technologies. In order to achieve a trusting and legally secure use of AI-based services by all groups in society, funding will be available for tailored educational services for the various groups, e.g. on (data) security, the legal framework, and the ability to engage in critical reflection. The Future Fund will run dialogue-based information and education campaigns to promote the active shaping of a digital commonweal and will particularly encourage the involvement of groups representing the interests of individual target groups.

AI in the cultural and media sector – inspiration in the creative process

The Federal Government believes that a key task in the field of cultural and media policy is to establish a policy environment in the AI era which creates and maintains diversity and guarantees the necessary scope for the development of cultural and media freedoms.

The Federal Government will also pay attention to the possibilities and impact of AI in the cultural and media sector. This is due to the fact that, in the AI era, the freedoms of a democratic society will still primarily be measured in terms of cultural and media diversity and the independence of the media. It is therefore necessary to uphold them. At the same time, the diverse potential of AI should be leveraged in the cultural, media and creative industries. Whilst AI cannot replace human creativity, it can be an additional instrument to deliver inspiration in the creative process and open up fresh ways to express art and culture. It is important to make use of these possibilities in the interest of freedom of opinion, information, the media and art – but with an awareness of any ethical limits and dangers to our free, democratic society. Also, the principles of transparency and non-discrimination must also apply to AI applications in the field of the media and culture so that free, individual and public opinion-formation remains possible

The Federal Government will further develop the Plattform Lernende Systeme into an Artificial Intelligence Platform that hosts a dialogue between government, science and commerce with civil society.

The Plattform Lernende Systeme brings leading experts from science, commerce, politics and civil society organisations together in the field of learning systems and AI. Numerous comments from the scientific and business communities propose a further development of the Platform, and the structures should also be developed further in terms of their representative character and possible participatory measures.

The Platform will create thematic working groups to discuss opportunities, challenges and the legal framework for the development and responsible use of learning systems. The findings will feed into scenarios, recommendations, policy options and roadmaps. The intention is that the Platform will develop application scenarios which can also help to clarify ethical and legal issues.

The Federal Government will support dialogues between the social partners on the sustainable integration of AI into the world of work.

As AI applications are introduced into the world of work, it is very important that the process is backed by the social partners. Dialogues between the social partners will be supported by the Federal Government in the form of expert forums in the Labour Ministry and via the New Quality of Work Initiative (INQA). In this context, the introduction of in-company innovation spaces (cf. 3.5) and the rapid transfer of findings to the world of work is planned. Further to this, the Future Fund (Zukunftsfonds Digitale Arbeit und Gesellschaft, see above) will also provide funding for sectoral dialogues between the social partners.

The Federal Government will set up a communications strategy for AI.

We will set up a communications strategy with the following objectives: the highlighting of the human-centric approach to technology and the orientation to the common good, awareness-raising of existing support services, comprehensible explanations of AI for commerce, administration and society, and the improvement of Germany's image in the field of AI around the world.