Key points for a Federal Government Strategy on Artificial Intelligence

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The Federal Government is currently drafting a Strategy on Artificial Intelligence (AI), which is to be completed by November and publicly presented at the 2018 Digital Summit in Nuremberg in December. The following key points that will underlie this Strategy build upon recommendations from the Specialist Forum for Autonomous Systems – a sub-group of the High-Tech Forum (responsible for implementing and developing the Federal Government's High-Tech Strategy) – published on 20 March 2017, the hearing of experts with the Federal Chancellor on 29 May 2018, and preparatory work undertaken by the federal ministries. The Federal Government plans to conduct additional hearings of experts on, for example, specific fields of applications and the regulatory framework, as well as with social issues. Furthermore, there will be a consultation process involving associations, organisations and institutions operating nationwide. The key points serve as a basis for the Strategy's development process, and provide orientation for defining goals and fields of action for the Strategy and for the measures to be introduced by the federal ministries leading up to the adoption of the Strategy by the Federal Cabinet.

1.   Goals

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

b.   The Federal Government sees it as its duty to drive forward the responsible use of artificial intelligence in a way that serves the good of society, doing so together with science, business, the public sector and civil society. We want to raise the potential of the new technology upon the basis of European values, such as the inviolability of human dignity, respect for privacy and the principle of equality.

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

d.   We want to broaden Germanys strong scientific basis for AI and to 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 within different areas of society.

e.   We want Germany to build upon its excellent position in AI research, in cooperation with European partners and leading developers of technology, and become a world leader in this area. We strive to be

an attractive research and business location 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.

f. We want to create value from applications of AI, to focus our efforts on developing the benefits of AI for our citizens – both at an individual, personal and at societal level – and in particular to minimise the risks associated with change, to make systems verifiable and to prevent unlawful discrimination.

g. With regard to the use of AI in the world of work, want to ensure human-centric development and use of AI applications. We want to ensure that the development of AI is centred on the labour force: allowing for the development of skills and talents, enabling self-determination, providing security and protecting health.

h. We want to use the potential of AI to continue to improve security, efficiency and sustainability to the benefit of our citizens in fields of application of particular importance whilst also promoting social participation, freedom of action and self-determination for each and every citizen.

i. We want our specific data stock to be used to the benefit of our society, the environment, business and country, and for AI-based business models to be developed in Germany and to become new top exports.

j. By expanding the infrastructure for real-time data transmission in the gigabit society, we are creating a central basis for AI applications. This is also to benefit public administration and the network infrastructure of the Federal Government.

k. We want to ensure that the 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.

l. We want to raise awareness among developers and users of AI technology about the 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.

m. We will act on the recommendations of the Data Ethics Commission as we develop and implement the Strategy.

2. Current situation

Over the past few years, artificial intelligence has matured considerably and 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 face up to the risks it poses. The Federal Government is seeking to actively shape AI in all areas of policy. The current progress 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. German research institutes have long been among the best in the world.

AI is now finding its way from research into an increasingly broad base 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. In addition, AI technologies are increasingly penetrating sectors of industry, business and aspects of daily life. Successful use of AI depends on access to data, the systemic embedding of AI technologies in complex products, services and business models, and a well-founded trust for the new technology among the general public which is based on transparency of the processes used and an understanding of how it works and why it is beneficial. To continue to use AI in Germany, it is also vital that we develop and expand the country's digital infrastructure.

AI can furthermore be used to gain new insights into the emergence and spread of diseases, to recognise these more quickly, and to be able to better tailor treatments towards the individual. In the long term, the use of AI can help not only to further improve our healthcare industry, but to also stimulate the economy and employment by opening up new business processes and applications.

AI-based applications can also assist citizens with their financial investment and purchasing decisions, as well as help to mitigate climate change and to protect the environment.

In the field of security - not least the protection of national 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. For example, using AI to assist in the analysis of case-relevant data, , can enable emergency services to be better deployed, can optimise investigation processes, help detect unknown patterns in data or activities, and can assist with investigations or recognise deliberate misinformation.

Over the past few years, , American and Asian companies have gone on to achieve global dominance in the field of linking user data, gaining a lead over German and European companies which is currently providing them with competitive advantages in the future use of AI technologies. However, when it comes to the commercial use of business, process and product data from complex chains and the linking of this data to hybrid services – which will go on to form a considerably larger market – competition is only just beginning. Germany has a particularly favourable starting position here thanks to its economic structure – with a considerable share of manufacturing industry, a leading global position in the field of logistics and very highly trained specialists. It also has, not least, a lead in certain key areas of AI such as Industrie 4.0 and mobility. There are major opportunities for Germany in these areas.

The challenges faced by Germany, as in other countries, are linked to the structural changes taking place in business, the labour market and living conditions, as well as the strong increase in international competition for technologies, data, investments and the top talents. At the same time, the ascent of AI means that decisions concerning sustainability and further training for skilled workers need to be taken now. There is also the challenge involved in transferring the new AI technologies across SMEs. However, this complex transfer process and the exchange of data, especially between SMEs, also provide the greatest potential for value creation. There is an urgent need for action in these areas. The technological development is also accompanied by societal changes and the potential need for the legal framework on the use of AI to be adapted, and for a basic knowledge base around AI to be created in order to make public debate around AI more informed. The Strategy of the Federal Government is also intended to help boost an 'AI made in Germany', a special and specific approach to technology that focuses on creating benefits for the country and society.

Certain countries have already recognised the special potential of AI and have presented their own strategies (e.g. USA, China). The European Union has recently presented an overall strategy for the EU as well as a series of measures to raise investments in AI in Europe, to prepare for the socio-economic transformation being brought about by AI, and to improve the legal and ethical framework for its continued development going forward. The Federal Government expressly welcomes this EU strategy and will work to ensure that Horizon Europe and Digital Europe are given an adequate and sustainable financial envelope, as was also set out in the Joint Declaration signed between Germany and 23 other Member States and Norway on the occasion of the Digital Day held on 10 April 2018.

The General Data Protection Regulation (GDPR) provides a reliable legal framework for innovative technologies and applications in the field of AI. It contains provisions on the protection of natural persons with regard to the processing of personal data and on the free movement of such data. The revision of the ePrivacy Regulation is to complement and complete this.

Considerable steps have already been taken in Germany: recommendations for action in the field of AI have been developed within the context of the Federal Government's High-Tech Strategy, dealing with mobility, health, autonomous systems, production and smart home (the areas of particular relevance to Germany). The Industrie 4.0 platform has successfully improved networking and cooperation in the field of Industrie 4.0, earning global recognition for this work and setting standards. Artificial intelligence is already being used in parts of the federal administration, e.g. by the German Patent and Trademarks Office. For a long time now, the Federal Government has also been funding projects in the field of AI as part of its funding for basic research and applied research. These measures will now be strategically bundled, expanded and supplemented by others.

3. Fields of action

In order for these goals to be achieved, business, science, government and civil society must all work together. Measures need to be taken both in individual sectors of the economy or supply areas (vertical) as well as cross-sector (horizontal). Over the next few months, the Federal Government will join with experts to discuss the necessary fields of action in detail. The measures lie within the responsibility of the respective competent ministries and all (additional) funding requirements will be (counter-)financed by these ministries within their own budgets.

Based upon this, the Federal Government places a priority on the following areas of action:

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

We will considerably expand AI research in Germany. This is taking place through the funding of additional Centres of Excellence for machine learning and the networking of already existing federal and Länder centres and research institutes for AI and big data as part of our efforts to create a national research consortium. The basic principle behind this work is that diversity in research is vital in order to achieve diversity on the market later on.

- Enabling supra-regional Centres of Excellence for AI to offer internationally attractive and competitive working conditions and remuneration.
- Assessing existing funding procedures as to their applicability for research on AI as well as implementation of the findings of AI research. A key aim here is to establish special funding measures for the use of AI within existing instruments, such as SME funding, or to develop quicker or new funding formats.
- Supporting the linking of software and processor development as a systemic approach.
- Developing structures for cooperation between research and external stakeholders from the public sector, civil society, business, and the fields of data privacy and information security.
- Supporting the development of structures for cooperation on AI research together with other partners from the European Union. As a first step, Germany and France will drive forward the development of a Franco-German research and development network that is based on existing structures and the particular skills possessed by each of the two countries. Key areas of cooperation here will be basic research, the transfer of research findings to business, the focus on innovation, and the continued development of regulatory approaches and ethical standards.
- Increasing the stock of data held by research institutes in Germany and across Europe which is used for AI-based generation of knowledge, taking into account the legitimate interests of the general public and the individual, and developing the structures necessary for this.
- Capturing data on diagnosis and treatment in the healthcare sector from scattered sources as a basis for the use of AI in health research, taking into account the legitimate interests of patients in their data.
- Responsible use of the potential generated by linking AI with key technologies, such as biotechnology or environmental technology.
- Research and development of AI-based technologies for use in civil security.
- Promoting the development of safety and security procedures and the explainability of forecasting and decision-making systems based on algorithms.
- Promoting technologies that protect privacy and consumers and therefore provide each individual with control over how their personal data is handled and in what circumstances (self-determination).
- Feeding regulatory expertise into research and development activities from early on due to the fact that – like in the field of healthcare – R&D results in AI must meet high regulatory requirements in order to successfully enter the markets.

3.2. Transfer to business

We need to ensure that a greater proportion of the expertise developed at German research institutes is actually transformed into value creation in Germany and Europe. One of the priorities guiding our action will therefore be on the transfer of research findings and AI methods to business. In this context, we see the following possibilities for action:

- Strengthening transfer activities in the field of AI and creating an overarching strategy for technology transfer that draws these activities together, taking into account the transformation taking place in the world of work. This strategy must be based on a ecosystematic approach so that it covers all parts of the value chain.
- Creating transparency with respect to the whole breadth of AI applications based on continuous technology monitoring.
- Providing support to improve SMEs' access to AI technologies, computing capacities and cloud platforms and creating platforms for data exchange, e.g. modelled after the mCLOUD, including assistance for companies in this stratum. This could be run over the SME 4.0 Centres of Excellence which we have set up around Germany over the past few years.
- Fostering the formation of regional-level clusters, similar to the cutting-edge clusters and AI ecosystems already in place. This could involve the use of existing structures such as the Digital Hub Initiative or the national or bilateral Centres of Excellence.
- Initiating joint projects between science and business in various fields of application in Germany, working together with our European partners wherever possible.
- Setting up special short-term programmes that foster exchange between science and industry in order to improve networking between innovators and the demand side.
- Establishing living laboratories and test fields and providing support for modelling for the use of AI in order to test new technologies and business models in practice and to identify areas in which the regulatory framework needs to be adapted.
- Promoting 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.
- Examining whether an Important Project of Common European Interest (IPCEI) can be created for AI.

Due to the variety of business models and production processes typically used in different sectors of the economy, each sector starts the process of digital transformation from a different position. It is therefore imperative for the Strategy to take these different characteristics into account. Relevant sector-based dialogues will therefore be held in advance.

3.3.   Innovation competitions

If Europe is to continue to offer the best possible conditions for the development of groundbreaking innovations, it must ensure better use of existing potential for breakthrough innovations. An initiative to foster breakthrough innovations could be set up that places a key focus on artificial intelligence as one of the central priorities in innovation development. A further instrument serving to push breakthrough innovations and attract talent is innovation competitions, known as 'challenges'. Existing innovation competitions therefore possibly also need to be adapted to increase their focus on innovation in AI.

3.4.   Fostering the founding of start-ups and leading new businesses to success

For new businesses, access to venture capital is a key resource, especially when it comes to mastering the difficult growth phase. In order to boost the development of new AI-based business models and products, incentives must be created for investors and targeted support provided for spin-offs from research institutes. Based upon this, the Federal Government sees the following options for action:

- Enabling the scientific Centre of Excellences for Big Data and Machine Learning to found their own spin-offs.
- Setting up more comprehensive advisory services and funding for start-ups.
- Establishing, i.a., a TechGrowth fund.
- Topping up the funding available in the EXIST programme for university-based business start-ups.
- Fostering cooperation between start-up entrepreneurs and established companies, especially SMEs, as part of the Digital Hub initiative and other programmes.

3.5. World of work and labour market: shaping structural change

AI will lead to a new phase of revolution in our work – significantly different to the transformation brought about by automation and digitisation. It also means that long-term employment forecasts and scenarios will need to be scrutinised and that strategies for designing the way in which we work, including an ongoing focus on the human factor, will require readjustment. In order to develop AI and use it in a positive way, we need to adopt a human-centric approach to it. The world of work will change, particularly in terms of skills, jobs, the organisation of work, and labour relations. We not only need to invest in technology, but also in the labour force and its skills sets. Companies and their workers need to prepare for the changes to come and to handle the transformation process together. In this context, we see the following means of action:

- Developing an international and European framework for AI in the world of work, with the involvement of the ILO and the OECD.
- Setting up AI observatories at international and EU level to undertake regular, comprehensive assessments of current developments and to research the possible effects of AI on employment and the world of work as well as potential knock-on effects.
- Establishing European and national institutions to systematically monitor the effects of new applications in the world of work on employment, technical design, human-machine interfaces and data privacy etc.
- Initiating a transatlantic and a European exchange (particularly between Germany and France) on the human-centric design of technology.
- Developing and implementing a comprehensive strategy for skilled workers as part of the Partnership for Skilled Workers that brings together the Federal Government and social partners.
- Developing a "National Further Training Strategy" together with the social partners to find answers to digital transformation in the world of work in general as well as to the transformation brought about by AI technologies in particular, and which also develops a broad-based set of instruments for providing advice across the labour force and fostering skills sets.
- Establishing a programme to fund firm-level innovation spaces to test AI applications in the world of work.
- Assessing and, where necessary, developing opportunities for staff to co-determine the introduction of AI applications in their work.
- Organising a comprehensive transfer of knowledge to HR managers, works councils and staff based on the Initiative New Quality of Work, establishing future centres to develop skills, particularly in staff and works councils.

3.6. Boosting vocational training / attracting skilled workers and experts

Germany needs to become an even more appealing country for the world's best AI scientists and to attract talent from around the globe. In this context, we see the following possibilities for action:

- Funding, within the scope allowed by the Basic Law, for new professorial chairs for AI at selected places in Germany.
- Boosting the attractiveness of pay and working conditions for young scientists from Germany and abroad.
- Expanding the offers available for young scientists and early fostering of young people's understanding of AI by providing opportunities to "grasp" and join in.
- Funding for initial and further training programmes, taking into account the specific features of individual sectors, such as healthcare or the food supply chain.
- Creating a policy environment for AI specialists which permits incentives to tackle the brain drain and to foster a brain gain.
- Anchoring basic AI knowledge as a firm element of curricula, not just in computer science, but also in other natural, social and engineering sciences and integrating it into initial and further vocational training where this makes sense.

3.7 Utilising AI for public-sector responsibilities and adapting the skills offered by the administration

The use of AI offers the public administration the possibility to deliver information and services to citizens and companies in a more targeted, more tailored and lower-threshold manner. Security aspects of AI also play a role in terms of maintaining the national security. The use of AI will change the demands on, policy context of and possibilities for the state and the administration, and this triggers the following need for action:

- Reviewing the possibilities to use AI in public administration.
- Transparency, traceability of data processing, data privacy, protection of basic rights, and freedom from discrimination must be ensured.
- It is necessary to rigorously build up the AI expertise of the public administration. Where AI is deployed, citizens must be able to understand decisions taken by the administration and thus enjoy effective legal protection.
- The Federal Government will play a pioneering role in the use of AI and help to improve the efficiency, quality and security of administrative services.
- It is necessary to take account of security aspects and the potential of AI in terms of ensuring national security

3.8. Making data available and usable

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 data rests with public-sector and private-sector bodies. 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 basic rights. Under these premises, we envisage the following steps:

- Data from the public sector and academic communities are opened up more for AI research, and their commercial and non-commercial use is made possible via an open data strategy.
- A further realisation of the European data space in order to make it easier to use the data which are available in Europe and to facilitate the upscaling of data-based services in the EU.
- A study of whether and to what extent the rules governing access to and use of data should be revised, particularly regarding sector-specific rules. The goal is to have a clear legal framework. Special consideration will be given to access to and use of data in the context of the forthcoming revision of competition law.
- The networking of private-sector and public-sector stakeholders to optimise processes with the aid of AI, and support for data cooperation between the state and the private sector along the lines of a public-private data pool.
- Review of the possibility to support mutual "data partnerships" between companies.
- Expansion of the activities to create interoperability between data systems in the health sector.
- Support for the interoperability of data platforms, e.g. via the International Data Space (IDS).
- Expansion of the necessary infrastructure in the field of hardware / computing power and cloud services, taking into account energy efficiency and with a view to the fight against climate change.

3.9. Revising the regulatory framework and ensuring legal certainty

The increasing use of AI may necessitate changes to the regulatory framework in order to give providers investment security and legal certainty and to establish a basis for justified trust and acceptance on the part of users. Here, the following points need to be observed:

- Review and, if necessary, revision of the regulatory framework for the use of data and the application of AI technology, and in particular clarification of the legal relationship between the parties. We will take account of proposals by the Data Ethics Commission.

- Ensuring transparency, traceability and reviewability of AI systems to permit effective protection against distortions, discrimination, manipulation and other abuses, particularly where algorithm-based forecasting and decision-making systems are used.
- Promotion of the development of innovative applications which bolster self-determination, social inclusion and privacy of citizens.
- Strengthening of the social partnership in the integration of AI into the world of work.
- Adaptation of the copyright rules in order to make it easier to use text and data mining (TDM) as a basis for machine learning for both commercial and non-commercial purposes. Here, a fair balance should be struck between the various interests.

3.10. Setting standards

Those who set the standards determine the market. Shared standards help to reduce technical barriers and to open up markets, thus making businesses more competitive. Joint standards can boost the user-friendliness of applications and permit interoperability. For this reason, Europe needs to exert appropriate influence in international standardisation processes. To this end, we will work with experts from science and business to examine the following options:

- Launch of an initiative to do more to jointly represent European interests in international standardisation bodies.
- Greater commitment to the development of open and international standards.

3.11. National and international networking

Sooner or later, horizontal technologies like AI will touch on all fields of science, commerce, administration and the day-to-day lives of citizens. The development is global, and so policymakers need to think and act globally. In response, we are planning the following:

- Coordination of the measures of the AI strategy with other activities of the Federal Government, such as the Data Ethics Commission, the Industrie 4.0 Platform, digitalisation in the heath sector, Mobility 4.0, protection for children and young people from harmful publications, the consolidation of federal IT systems, the Central Office for Information Technology in the Security Sector (ZITiS), and with measures relating to the future of work and the welfare state, and measures to combat climate change.
- Greater cooperation with the EU institutions, particularly with the European Commission and other Member States, on questions relating to the policy environment for the use of the Digital Single Market and other measures of the AI strategy. Promotion will require an effective system of complementary and coordinated instruments at national and European level, taking into account the principle of subsidiarity and including existing instruments.
- Dialogue and if possible agreement on joint guidelines with other leading regions and economic areas. We are open to international cooperation in the field of AI and will seek bilateral and multilateral cooperation for this, e.g. in the G7 and G20 context. German missions abroad and German Science and Innovation Houses can be used for this type of cooperation. In this process, we will base our approach on the values we apply in terms of use of AI systems.
- Building up capacities and knowledge about AI in developing countries in the context of economic cooperation so that economic and social opportunities can be utilised there. Developing and emerging economies must not be cut off from technological change.

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

The development of AI is progressing dynamically, meaning that the implementation of the AI strategy must involve ongoing feedback from representatives of science, commerce, government and society in order to establish an AI culture in Germany that fosters trust and innovation. To this end, we intend the following:

- Organisation of societal dialogues involving civil society about the handling of AI and its specific regulation in different fields of application. Here, we will discuss aspects like the social and spatial effects and ethically relevant issues.
- Further development of the Learning Systems Platform to become the Artificial Intelligence Platform hosting a broad-based dialogue between government, science and commerce and the dialogue with society. In the context of the Platform, we will develop application scenarios which can help to clarify technical, ethical and legal issues. These should illustrate the benefits of AI, the challenges and ethical and legal limits to usage, and possibilities to shape the policy environment.
- Expansion of multidisciplinary research into the impact assessment of AI technology.
- Organisation of an interdisciplinary dialogue between sciences as a basis for a societal dialogue about the handling of AI and its specific regulation and user orientation in different fields of application.
- Support for dialogues between social partners about the sustainable integration of AI into the world of work.

4. Immediate action by the Federal Government

Corresponding priorities will be set in the field of AI, particularly in the implementation of funding for research and innovation. Another top priority, extending across programmes and policies, is the attracting and retaining of AI experts in Germany. The networking and expansion of the Centres of Excellence with France will be implemented without delay. Further to this, work will begin on setting up thematic Centres of Excellence. The action to be taken immediately includes the expansion of infrastructure. The Federal Government will implement the relevant measures in line with these principles in the course of ongoing programmes and the 2018 budget.