# Artificial intelligence – The Federal Government's AI Strategy

A 2



The Federal Government adopted its Artificial Intelligence Strategy on 15 November 2018. It was drawn up following an online consultation procedure jointly implemented by the BMBF, BMWi and BMAS. The high importance the Federal Government ascribes to artificial intelligence and associated technologies is demonstrated by its plans to set aside some €3 billion for the implementation of the strategy by 2025.

**Definition, applications and development**

The term artificial intelligence (AI) denotes procedures, algorithms and technical solutions that make it possible to transfer complex tasks once performed by humans to machines and software capable of learning. There is, as yet, no universally accepted definition of AI.[62] Even today, AI procedures can be successfully deployed in the fields of image and voice recognition, to control autonomous systems in domestic and industrial settings, to perform medical diagnostic tasks[63] and, increasingly, to create autonomous vehicles. Despite their impressive ability to perform specific tasks, these systems remain a long way from matching human intelligence. Nevertheless, AI still holds significant economic importance. In its 2018 Report, the Commission of Experts explored the fields of smart home, industrial production, autonomous vehicles and hostile environments.[64] Artificial intelligence is a key technology for such autonomous systems.

The development of AI is supported by various scientific traditions. One recent contribution makes a distinction between so-called symbolic AI and neural AI.[65] Neural AI has gained major significance since 2012.This is demonstrated by the number of publications for the two forms of AI (cf. figure A 2-1).

Triggers for the rapid development of neural AI include breakthroughs in improving the precision and speed of image recognition algorithms.[66] These and other successes have cleared the way for neural AI to triumph in a variety of applications.

Countries around the world have seized upon the impetus behind neural AI to differing degrees. In Germany, the Federal Government persevered with almost exclusive support for symbolic AI for a long time. It only championed neural AI at a later stage in 2017, as part of the call for tenders for Machine Learning Competence Centres – despite such methods becoming increasingly prominent since 2012.[67] In this contest, the locations of Munich, Berlin, Tübingen and Bonn/Dortmund were each allocated funding in the amount of around €2 million per year.[68]

Classifying the publications depicted in figure A 2-1 according to country and AI approach produces interesting contrasts (cf. figure A 2-2). China and the USA record the highest numbers of publications. However, Chinese research in recent years has primarily concentrated on neural AI. The United Kingdom, Germany and France are the leading European counties in terms of the number of publications. Taken together, EU member states enjoy a good starting position in the field of AI research; however, this aggregation would only be justifiable if all friction was removed in the European Research Area and the Single Market.

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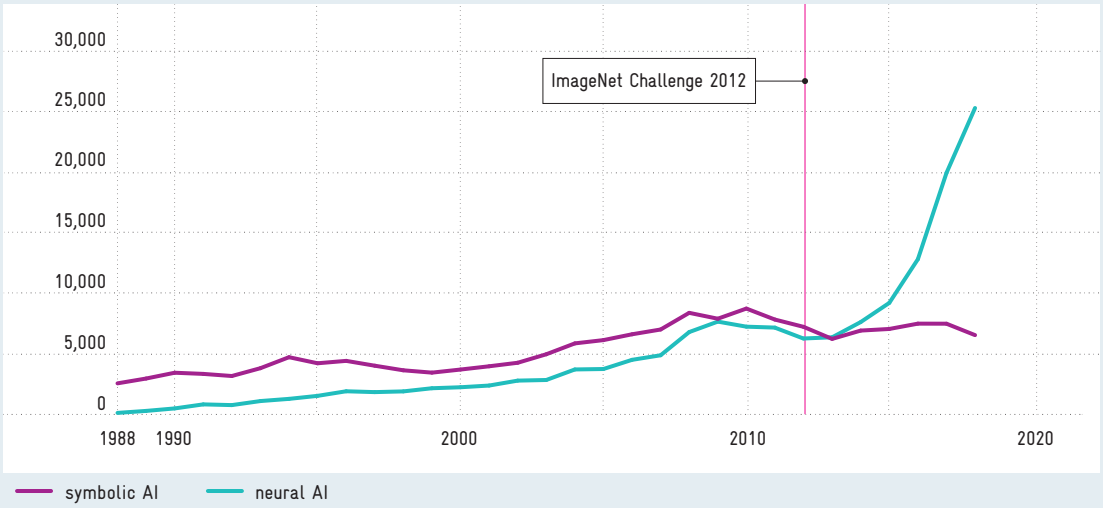
Fig. A 2-1

Download data

**Number of publications in the fields of symbolic and neural AI 1988–2018**




The ImageNet Challenge is a contest for image recognition. In 2012, the winning team used neural AI; the enhanced methods enabled them to markedly improve image recognition performance. This success instigated a wealth of further research in the field of neural AI.
Source: own calculations based on Scopus data. API query with keywords based on Cardon et al. (2018).

### Economic and societal significance of artificial intelligence

Many economists consider AI a technology that can be deployed in almost all sectors of the economy and which has the potential to enhance productivity considerably. At present, there are still no reliable scientific studies into the economic impact of AI.[69] Nevertheless, consultancy firms have identified effects on a very significant scale.[70] In its role as a location for innovation, Germany simply cannot afford to neglect AI's value-added potential.

AI also holds considerable societal significance. In the first instance, this is due to its potential impact on labour markets. Learning systems will become increasingly able to carry out tasks that at present only humans can perform. Despite this, concerns that workforces will be made redundant en masse are without firm scientific foundation.[71] Other important issues for society include the ethical discussion of which decisions people should delegate to machines, which rules should be applied to form algorithmic decisions and how intelligent systems can avoid distorted and unfair decisions.[72] In addition, there are – quite justifiably – demands that decision-making processes be transparent.[73] Ethical considerations of AI have wide-ranging consequences for the regulation, authorization and certification of AI as well as for issues relating to liability. The Commission of Experts expressly welcomes the fact that, as suggested in the EFI Report 2018, a Bundestag Committee of Inquiry named "Artificial Intelligence – Social Responsibility and Economic, Social and Ecological Potential" has been set up, tasked in particular with discussing social and ethical aspects of the use of AI processes. It is hoped that the committee's work can provide crucial momentum to stimulate a societal discussion of AI in Germany and Europe.

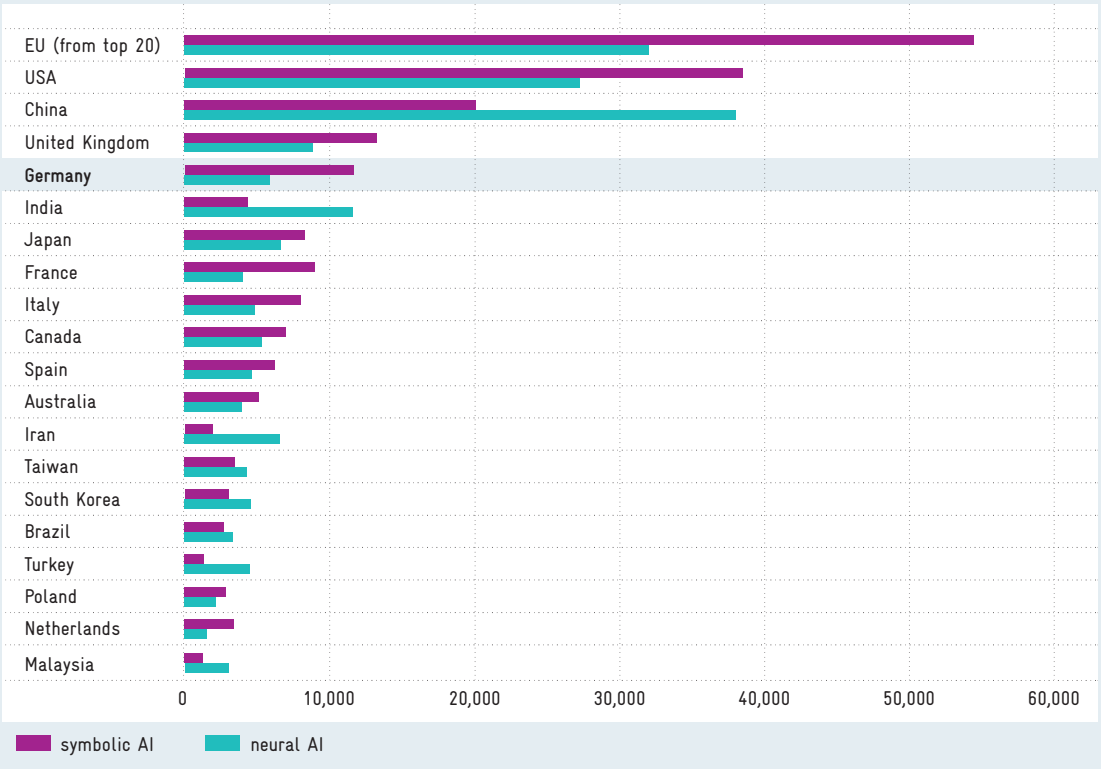
### The Federal Government's AI Strategy

Political discussions surrounding the importance of AI were primarily inspired by a report produced by the Obama administrated in late 2016 containing recommendations for US scientific and economic policy.[74] National AI strategies have since been drawn up by China, France, the United Kingdom, Finland, the European Union and various other countries.[75] In Germany, the topic was referenced in the coalition agreement[76] concluded between the CDU, CSU and SPD in early 2018. The coalition agreement emphasizes the crucial significance of AI technology and sets the target of making "Germany a world-leading location for research into artificial intelligence". The Federal Government again

Fig. A 2-2

Download data

## Number of publications in the fields of symbolic and neural AI by country (top 20) 1988–2018




Listed in order of total publications in the fields of symbolic and neural AI.
Source: own calculations based on Scopus data. API query with keywords based on Cardon et al. (2018).

demonstrated the importance it ascribes to the topic with its AI Summit in April 2018.

In its strategy paper, the Federal Government specifies three overarching targets. It aims to make Germany a leading location for the development of AI technologies and ensure the country's competitiveness. The second target in the paper is to secure responsible development and use of AI for the common good. Finally, the Government aims to embed AI in German society through a broad societal dialogue and active policy work. The AI Strategy also describes the technology's current situation in Germany. However, this view is not backed up with data. It then names a series of fields of action on which the Federal Government hopes to focus.[77] In its 2019 budget, the Federal Government made an initial sum of €500 million available for 2019 and the following year. The Federal Government plans to make around €3 billion available for implementation of its AI Strategy by 2025. In making these commitments, the Federal Government hopes to achieve high leverage effects and expects that business, science and the Länder will at least match the funding from federal level.

To ensure that research and business remain competitive and serve the common good, the AI Strategy also comprises a series of AI-specific measures. For instance, in order to support young scientists, research and teaching in the field of AI, the strategy foresees recruitment of at least 100 new professors to ensure AI has a solid foothold in universities. In addition, existing competence centres for AI research are to be developed across regions in order to create a national network of at least twelve centres and application hubs. The Federal Government also hopes to establish a virtual Franco-German research and innovation network together with French institutions and further develop cooperation across Europe. Moreover, it plans to reinforce support for small and medium-sized enterprises in the field of AI through the Mittelstand 4.0 competence centres.[78]

The Federal Government has also emphasized the importance of responsible development and use of AI to serve the common good. Several AI-specific measures have also been proposed in this regard. Among others, these include establishing a German artificial intelligence observatory. The working population's AI skills are to be developed as part of a national training strategy and the skilled labour situation is to be monitored. In addition, 50 lighthouse AI applications will be pushed forward for the benefit of the environment and climate.

The Federal Government has also stressed the need to initiate a wide-ranging societal dialogue around the political design of framework conditions for AI. The measures include a round-table of data protection authorities and trade associations on AI issues, as well as activities to explain and clarify AI and support privacy.

Despite the protracted nature of the process to develop the Federal Government's AI Strategy, it now represents an important basis for AI research, transfer and applications in Germany. The Commission of Experts explicitly welcomes the fact that, by publishing its AI Strategy, the Federal Government has laid the foundation for measures that will enable Germany to improve its competitive position, accompany the societal discussion and offset pending changes to labour markets – and even exploit such changes to benefit workers. The funding set aside for these measures, which totals €3 billion (by 2025), appears appropriate.[79]

The fact that an interdepartmental strategy has been undertaken is also a positive development; in principle, it can now be used as the basis for collaboration between the ministries involved. The Commission of Experts also praises the work to consider social and ethical aspects of AI. Doing so makes it possible to create a holistic response to these novel challenges.

## Need for further development and recommendations

There is considerable need to further develop the current edition of the Federal Government's AI Strategy: it remains vague in many aspects and, at present, fails to describe the envisaged measures in concrete terms. The Commission of Experts therefore makes the following recommendations:

- A reliable, quantitative analysis of strengths and weaknesses should be conducted to facilitate Germany's development as an AI location. No such analysis has been carried out to date. Instead, the starting situation is described without evidence or data.
- An AI implementation plan is urgently required: it should provide a schedule for the individual AI Strategy measures (including milestones) and specify the envisaged resource requirements. The Commission of Experts recommends formulating specific timescales and implementation paths for the various measures.
- To date, no metrics have been specified which can be used to evaluate the success of the proposed measures. The Commission of Experts recommends defining these assessment standards as a matter of urgency. Initial deliberations in this regard are already underway.[80]
- The Commission of Experts views the Federal Government's intention to establish at least 12 AI competence centres with scepticism. The Federal Government should use the proposed €3 billion to reinforce existing AI locations and to create productive and internationally visible AI ecosystems.
- The labour market for AI experts is currently overheated. With that in mind, it is doubtful whether it will be possible to achieve the target of recruiting 100 new, high-calibre professors. It would appear prudent to stagger this funding over a longer period of time and use it to support both permanent professorships and those awarded through tenure track procedures. The Commission of Experts also recommends that the BMBF award 1,000 international doctoral scholarships over the coming five years in order to attract additional talented and internationally mobile young scientists to Germany. The BMBF should support efforts to recruit talented young scientists with international information resources.These proposals should be coordinated with existing plans for international graduate programmes such as ELLIS and Claire.[81]
- The Commission of Experts advises that monitoring of AI Strategy measures is implemented by an independent body with international comparisons in order to ensure the maximum degree of objectivity and transparency.
- At present, the AI Strategy contains numerous indications of generic measures such as funding for start-ups, consultancy for newly founded companies and public funding schemes in the

field of venture capital and venture debt. It is the view of the Commission of Experts that these elements dilute the Strategy as a whole.

– The AI Strategy includes the announcement that AI is to be a key focus of the proposed Agency for Disruptive Innovations. This thematic requirement contradicts the target set by the Government itself to give the agency considerable free reign. The Commission of Experts warns that the agency will only be able to fulfil the expectations placed upon it if it can act independently of political specifications (cf. chapter A 1).
– To date, the AI Strategy only refers to vague notions of collaborative endeavours with French institutions. These ideas must be substantiated forthwith. The Commission of Experts also emphasizes that – in light of British research efforts (cf. figure A 2-2) – the potential for cooperation with institutions in the United Kingdom should not be ignored.
– In principle, a European collaborative endeavour can either be established at EU level or through intergovernmental collaboration agreements between individual EU member states.[82] The European Molecular Biology Laboratory (EMBL)[83] represents a successful intergovernmental organizational form that already exists and which could also be used in the field of AI research. Such a structure would also make it possible to realize intensive, post-Brexit collaborations with research institutions in the United Kingdom.
– At present, standard machine learning procedures require large sets of training data. This affords AI research in countries such as China and the USA an advantage. In these countries, companies have been able to collect large volumes of data – and continue to do so – thanks to relatively weak data protection requirements. This currently results in a geographical disadvantage for European players, in particular those involved in R&D relating to deep learning. To begin with, therefore, the Federal Government should implement measures to improve data availability in general – such as by improving the conditions for creating data pools. For another thing, promotion efforts must place greater emphasis on specific benefits of Germany as a location for AI. These include the high availability of machine-related data and relatively high-quality datasets. In addition, the Federal Government should examine the potential of non-data-intensive AI.

The measures vaguely described by the Federal Government in its AI Strategy[84] must be further clarified as a matter of urgency.