European Office

Artificial Intelligence in Mechanical Engineering - Perspectives and Recommendations for Action

Recommendations for a Political Strategy for Artificial Intelligence in Europe and Germany

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I. Mechanical engineering: user and multiplier of AI technologies

In politics, media and industry, "artificial intelligence" (AI) is high on the agenda. Big expectations are raised, but risks and possible political measures are also discussed.

Mechanical engineering companies are primarily users of AI technologies, but as provider of industrial solutions they play also a central role in the dissemination and application of AI in industrial value chains. Machines and equipment bring AI-technologies as embedded AI to a variety of customers and industries. Mechanical engineering builds on its experience in efficient technology integration and in responsible design of human-machine cooperation - for example in robotics, automation or sensor technology.

It is a necessity for the VDMA to support its member companies in the use of AI technologies. But it is also important for us to contribute to a fact-based and rational debate in politics and society with a view to create broad acceptance and to shape the societal framework.

For mechanical engineering, AI is above all an opportunity to maintain worldwide leadership. AI helps to increase efficiency and to develop new business models. Production processes can be optimized and the machines and services are extended by intelligent functions through embedded AI solutions. AI will be a decisive factor in the future competitiveness of mechanical engineering products and processes. In this context, good AI builds on expertise both in existing technologies and in the application area. Building upon this, mechanical engineering plays a key role in the development and use of cross-industry and cross-divisional AI.

This not only good for mechanical engineering companies and their customers, but also holds considerable potential for using materials and energy more efficiently, taking better decisions and mastering challenges such as scarcity of resources and climate change. If, on the other hand, industry does not succeed in exploiting the opportunities offered by AI, the leading role of European engineering companies will certainly be lost to competitors from other technology world regions. The integration of AI into mechanical engineering is therefore an absolute must for companies, research and policy makers.

Mechanical engineering also faces up to the responsibility associated with the introduction of new technologies - whether as a guarantor of machine safety or as a dialogue partner for social aspects. From the point of view of the VDMA, however, AI is not a new, independent policy field, but a key technology with horizontal significance. It must not only be seen in the context of other digital topics such as data management, digital platforms, cybersecurity or IT infrastructure, but also in the context of "classic" industrial spheres of activity such as product and machine safety, the design of the working environment and standardization. For example, also machines using AI are already covered by legal requirements for product safety and EU harmonization regulations.

In order to take these diverse aspects into account, to use the opportunities and analyse the risks objectively, a fact-based social dialogue with the participation of users in mechanical engineering and industry is necessary.

II. „Artificial intelligence" between utopia and application

If the term "artificial intelligence" is used a synonym for an infinitely autonomous, human-like system, it is inappropriate as a leitmotif for a pragmatic and concrete digital policy. The distinction between general AI (Artificial General Intelligence) and narrow AI is therefore important for a factual debate: The idea of general AI stands for the attempt to imitate a human-like intelligence - with abilities such as planning, making decisions in uncertainty or pursuing complex goals. But it is

completely open and disputed when this might happen or whether it is possible at all. Narrow AI, on the other hand, is already being developed today for concrete applications - e.g. for speech and pattern recognition or error analysis. This "AI" is limited by the intended use, the specifications of the developer and last but not least by legal requirements. In addition, physical processes, operational requirements and technical standards set clear limits for the application of AI in industrial processes. In addition, machine manufacturers have a vital interest in having control over all functions of the machine, in particular the functions generated or modified by AI. The term AI can therefore only serve as a basis for a realistic political debate in its current form as a narrow AI - with limited autonomy within concrete applications, but without human-like intelligence. In this paper, "AI" is therefore understood as narrow AI.

"Machine Learning" as a form of narrow AI is already a reality and allows a concrete and objective evaluation. It is based on statistical algorithms and enables software applications to learn independently based on pattern recognition. In current applications in industry and mechanical engineering, machine learning is already being used to answer specific technological or economic questions. Machine learning is used, for example, to inspect surfaces or textures in quality assurance using image processing methods and has a high potential to make image processing more efficient. Another example is the process optimization of complex machines: Here, sensor-data-based machine learning can provide valuable information to shorten commissioning times and discover unknown sources of error. The successful use of algorithms in predictive maintenance, i.e. the evaluation of data with the aim of making operation, maintenance and repair processes more efficient, is almost standard. KI can also contribute to the optimization of internal production structures and processes, for example by evaluating ERP data. It can help to improve development and product management, for example when products provide data during the usage phase and thus information for innovations and improvements. In sales and planning, AI tools for the intelligent configuration of machines can leverage considerable business value potential.

These examples show that the diverse use of AI in industrial applications offers many opportunities and promises considerable benefits. This use cases also show, however, that the - in many cases absolutely necessary - discussion about ethics is not equally relevant for every application scenario and that such questions often play only a minor role, especially in industrial use. The debate on AI ethics must therefore not lead to drawing quickly undifferentiated red lines. Otherwise, the scope for innovation for new AI applications will be prematurely or unnecessarily limited and it will not be possible to bring AIs rapidly into promising applications.

III. Political fields of action and core messages

1. Industrial and economic policy: harnessing AI in industry, defending leadership

In order to succeed in the international competition, only a coordinated European approach can be competitive. The EU internal market, a success story of the EU, plays a central role in this. Only in a harmonized market with cross-border initiatives the necessary scaling effects can be achieved and the framework conditions for investments can be created. It is essential to avoid a patchwork of national initiatives or even national legislation. Research initiatives also need to be European or coordinated to avoid overlaps, generate a critical mass of economic and political importance and bring together the best brains from science and industry. The VDMA therefore fully supports the EU Commission's initiative on these aspects of AI.

At the same time, however, it is also necessary to take a global perspective and keep an eye on international competition. Europe must rise to the challenge and not just pursue a defensive

strategy. This includes developing an industrial policy vision that builds on the strengths of Europe and uses the unique domain knowledge and industrial competence. Even if competitors in the B2C sector may be ahead of Europe, industry and mechanical engineering can play a pioneering role in the B2B sector if the right course is set now.

A "European Approach" for AI, as proposed by the EU Commission, is the right way forward. On the other hand, however, a Eurocentric approach must not lead to a demarcation from international markets and a climate hostile to innovation. In this context, the role of international standardization, for example, must be taken into account, in whose international bodies and platforms the discussion on AI and the necessary standards must be continued. It is also important to work towards an international digital "level playing field" and to anchor digital policy in trade agreements.

2. Research and innovation: unleashing the power of innovation

In order to exploit European strengths and tap the potential of AI for competitiveness and efficiency, AI research must not only be horizontal basic research, but must above all be geared to concrete applications in business and industry. It is not only about the development of algorithms, but also about their useful adaptation to specific problems. The basis for this is the context-dependent acquisition, selection and quality assurance of data. The use of AI in highly developed industrial technical systems also requires compliance with high standards in terms of safety, process reliability and quality.

Priority should be given to those applications and industries that promise rapid diffusion and effective leverage effects - such as industrial production, the use of AI in product development and design or in new business models. AI is an interdisciplinary field that requires intensive cooperation between data/AI experts and representatives of other disciplines. Priority should therefore be given to approaches that promote cooperation and do not stop at national borders or within disciplines. For this reason, EU research in particular is called upon to use its strength, cross-border and cooperative research, also in the context of AI.

However, classical research funding alone will not be sufficient to create sufficient dynamism and broad AI competence. It will be important to tap the innovative power and creativity of small and agile companies. Framework conditions must be created to unleash these forces and instruments must be provided to respond to the dynamics of start-ups and innovative SMEs.

3. Accelerate transfer to industry

AI can only become a real European success story if the EU succeeds in bringing the technology to a wide range and number of SMEs and industrial mid-caps. It is therefore important to ensure efficient technology transfer and low-threshold access to technologies, projects, results and networks. A basis for this can be to use test and competence centers - such as the Digital Innovation Hubs - in which processes and business models can be tested in practice - provided they are located in an industrial environment and offer lean and practice-oriented formats. It is also important to make the necessary expertise available to companies in the most productive form possible and to counter the shortage of IT-experts with efficient approaches and instruments. Not every company will be able to employ data and AI experts. Concepts such as "AI self-service" or "guided analytics" can help to facilitate the use of AI by the domain experts in the companies. It is important to enable companies to define requirements and evaluate solutions together with - possibly external - AI experts with tailor-made transfer and training offers.

Standardization, in which the state of the art is written down and the possibilities for implementation are described, also plays a role in broad-based transfer.

4. World of work: AI demands people

The discussion about Artificial Intelligence is again fueling fears that human labor could be replaced by machines. On the other hand, it is expected that new business opportunities will arise, that productivity increases, that the Europe as a production and technology location is safeguarded and that new jobs will be created. From the point of view of the VDMA, both effects will take place - a loss, but also the creation of new jobs. The ratio between these developments is hardly foreseeable at present and is controversially predicted in a large number of studies - from full compensation for job losses by new jobs to the scenarios where entire job profiles become obsolete. A look into the past shows, however, that an optimistic view is justified: despite the high robot density in Germany, more people are working there than ever before.

How employment will develop will depend on a large number of factors not yet known today. But one factor will definitely be who wins the race for AI: All industrial regions of the world are working on artificial intelligence. If Europe does not participate in this development, jobs will be lost or created in other countries.

Looking at the technological reality, it becomes clear that AI technology will not work without the human factor. AI is a powerful, highly productive tool, but still only a tool. AI-supported analyses only provide forecasts and probabilities, but no human-type of decisions. People will continue to have to assess conflicting goals and weigh up different aspects - and ultimately make the important decisions and assume responsibility. So far, the introduction of data processing has also made it possible for intelligent functions to be solved automatically. But it has also been shown that information technology can create space for more human creativity.

However, content of jobs and requirements will change. Cooperation with AI systems requires employees more than ever to coordinate processes, communicate effectively and make decisions on their own responsibility. Much will depend on whether the legal, employment and education policy framework conditions are adapted to the requirements of the future. In some areas, a moderate development of the existing framework is necessary. This includes in particular a modern labor market policy with a correspondingly modern labor law. But there is no need to reinvent the wheel. Proven instruments can be used and, if necessary, further developed.

An exaggerated and emotionally view that AI could soon make people obsolete or even dominate them has no technological basis. Policy makers should make every effort to use a sober analysis as a basis for further decisions. The right approach for policy is therefore to monitor actual technological and societal developments. Under no circumstances may the use of AI be impeded or hindered by hasty legal measures. Horizontal regulations or superficial approaches such as a "robot tax" cannot be a solution. AI should be rather a reason for the legislator to reconsider the subsidiarity principle and only intervene directly in market processes if solutions cannot be achieved by those directly involved. For example, it is important to open up significantly more scope for design at company and individual level.

5. A master plan for training and education

Even if no massive job losses might occur, it seems to be clear that the labor market will change fundamentally. AI and automation will change tasks and require new skill profiles. It will therefore be important not only to promote cutting-edge research and teaching and to train IT specialists, but also

to invest massively and broadly in training and education and to offer low-threshold, application-oriented courses.

The already big importance of training and education is increasing once again in the context of AI: because the use of methods of machine learning (such as "supervised learning" or "reinforcing learning") does not replace people, but requires them as trainers or managers: AI systems are complex analysis tools that demand the corresponding skills from developers and operators. AI-competence is therefore not only required by IT specialists and programmers, but also by employees of all functions, levels and departments in which AI solutions are to be applied. In order to meet this challenge, a coordinated master plan for digital qualification must finally be developed.

6. Avoid patchwork in digital and data policies

AI is part of digitization and requires suitable framework conditions for connectivity and data exchange - for example, for sharing machine data. One of the central prerequisites for the successful use of AI in industry will be to increase confidence between business partners, but also in a reliable political framework.

AI requires a holistic view of digital policy. In particular, it is important to avoid contradictions, blockages and legal uncertainties that can arise from isolated approaches. It is already evident that existing or planned legislation is interfering with the use of AI in different and not always successful ways (GDPR, platforms, cybersecurity, copyright, e-privacy).

Data and data exchange are of particular importance for the development of AI applications. Here, too, only a European, cross-border approach is sustainable. The VDMA therefore supports the efforts of the EU for a European data area that is as free as possible. AI will provide greater benefits at the macroeconomic level if data can be shared as widely as possible and are not hidden in isolated or proprietary models. The VDMA therefore supports efforts to facilitate and promote the exchange of data - for example through open data approaches in publicly funded research ("as open as possible, as closed as necessary") or through data governance models which - based on an interplay of technical and contractual provisions – facilitate data use on the one hand and the protection of investments and intellectual property on the other.

As a matter of principle, however, the legislator should refrain from hasty intervention in developing data markets. Particularly in the B2B context, the diversity and dynamics of business models and applications require the greatest possible flexibility and legal certainty, which can ideally be achieved through contractual regulations. The principle of contractual freedom should therefore be further strengthened and any rules restricting that freedom should be reviewed. Only if market failures or concentration tendencies - which are currently not discernible - lead to unfair negotiation situations could a review of the fairness of contractual conditions or a discussion of access rights based on competition law be necessary.

7. Regulatory Framework: Start with freedom, not with limits

For the acceptance and successful us of AI technologies, it will be essential to shape the human-machine cooperation. The call for "human-centered AI" is one possible approach, but might lead to the idea that humans needs to be protected from AI. However, man, machine and progress are linked: People build and use machines to improve or simplify life. In this sense, AI is just another step in making machines better. In principle, VDMA therefore advocates a view that seeks the opportunities and analyses risks objectively. However, misuse and incorrect application are - as with other technologies - not excluded. AI carries the risk of a intransparency, discrimination or manipulation. A discussion on transparency and comprehensibility is therefore necessary.

However, this must not lead to undifferentiated requirements or regulations. It is essential to weigh up the objectives and interests of all those involved. For example, a certain traceability (e.g. to clarify liability issues) is desirable. On the other hand, the transparency of algorithms and background knowledge can also reveal intellectual property and violate rights. It is important to effectively avoid unwanted know-how transfer.

The review of the regulatory framework should also carefully consider the extent to which existing laws already cover AI applications. Even if machines with artificial intelligence no longer work just with fixed programmed sequences, the degree of autonomy is still limited - by the functionality and the limits defined by the developer. In particular, the AI embedded in physical products acts only within the framework of defined safety concepts of the manufacturer and the intended product characteristics. Under the above conditions, it can therefore be assumed that the existing regulatory framework is in general fit-for-purpose and can cover the effects of AI. The regulations on product safety cover all functions of a product that run within the limits set by the manufacturer. AI, which is used today and for the foreseeable future, works exactly within these limits.

The safety and health regulations that have been applicable to machinery for many years are not invalidated by AI. The safety and health protection requirements are formulated as technology-neutral protection goals and must be respected by the manufacturer. There is a legal obligation to apply the state of the art (documented in harmonized standards) in order to meet these protection objectives. Functions of the machine that are influenced, modified or even generated by AI must be taken into account by the manufacturer during the conformity assessment procedure in a holistic way. An AI machine must not enter an uncontrolled state which would pose a danger to the operator or to third parties. Therefore, the existing regulations for the product safety of machines are fit for the future and the introduction of new technologies, including Artificial Intelligence.

In addition, the current Product Liability Directive provides a practical framework in which AI-based problems can also be solved. It creates the necessary and uniform legal framework for liability claims both for damage caused by a defective conventional product and for damage caused by a robot or other automated system.

8. Standards as instruments of change

Standardization will play a crucial role in the implementation of AI. It not only brings new findings to a broad spectrum of applications and markets as the state of the art, it also helps to keep the regulatory framework flexible and innovation-friendly. Standards define the state of the art that must be observed when meeting the legal requirements. Furthermore, the legal requirements are tailored to specific product groups by means of standards. This dual approach, consisting of legislation and standards, makes it possible to identify the risks of new technologies in good time. Standards are also essential to address the issue of interoperability and data use. Standardization is an economically driven transparent process. For practical implementation in the context of industry 4.0, the VDMA advocates a successful interaction of consensus-based standardization and consortium standards.

Conclusion:

Artificial intelligence is a key technology for mechanical engineering to maintain its worldwide leadership and to stay competitive. Europe and Germany must build on their strengths, increase the speed of implementation and, above all, promote the use of AI in industry and SMEs. The political debate on the design of the regulatory framework must be based on the real opportunities and risks - not on dystopian future scenarios. For a successful start, freedom is more important than new borders.

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