Production technology is facing great challenges. There is a trend towards individualizing products and, hence, towards smaller batch sizes. Innovation cycles are shortened as is the time from the product idea to the industrially manufactured product. The products to be manufactured become more complex in terms of design, materials used, and functions. Customers prefer short delivery times, but sometimes request product modifications until just before delivery. They want the product to meet higher quality requirements and expect lower prices. With this, they increase the pressure on manufacturers in worldwide competition. In order to meet all requirements, manufacturers do not only have to control production processes, but also need to deploy latest production equipment and facilities. Both, technologies and the production facilities have become increasingly complex; yet they have to be controlled by the users flexibly at any time. Consequently, production equipment providers have to react to these resulting challenges. When implementing production equipment the necessity to meet higher requirements, aspects of operation and control as well as of plant and process monitoring have to be addressed. Industry 4.0 technologies, in particular artificial intelligence (AI) methods, can supply humans with the information needed for assessing the situation and support decision-making. Due to the increasing use of Industry 4.0 technologies, e.g. sensors in production plants, numerous operation- and product-specific data are collected today already. Further data are available from product development, work preparation, and quality control. However, identification, processing, evaluation, and use of the available plant- and technology-relevant data for optimizing production plants and processes are still inadequate and
inconsistent. In view of the smaller batch sizes the question arises, whether interpretation of historical data would be sufficient for a sound understanding of plants and processes or whether collection of further specific data becomes necessary. German production technology is characterized by remarkable domain knowledge. It is a challenge to maintain and extend this knowledge by the use of modern technologies, such as AI. At the same time, plant manufacturers and operators have to create or strengthen unique selling propositions on the world market. This call for proposals fits into the funding activities of different government departments relating to the topic of Industry 4.0. It aims at further developing and testing methods and models of AI in a close-to-production application. It is a major goal to accelerate the use of AI technologies in production by development, test, and prototypical implementation of learning production technology.

1. Funding Goal, Funding Purpose, Legal Basis

1.1 Funding Goal and Funding Purpose

Within the research program “Innovations for Tomorrow’s Production, Service, and Work,” the Federal Ministry of Education and Research (BMBF) funds cooperative, pre-competitive research projects to strengthen manufacturing industries in Germany. Manufacturing companies in particular shall be enabled to quickly respond to changes in global competition and to actively shape the required change. Research at and with small and medium-sized companies (SME) is one focus of the program.

This call for proposals aims at enhancing the capacity and functionality of machines and production resources and tools by the increased use of AI, e.g. machine learning. AI potentials in manufacturing are to be identified and deployed more quickly. For this purpose, AI methods and tools shall be designed or further developed and solutions shall be implemented and tested under close-to-reality conditions at and within machines and production resources and tools.

The results of the funded projects are expected to deliver:

- significant simplification and improved transparency of machine operation and use and of process flow;
- further development and improvement of human-machine interaction;
- enhanced productivity of manufacturing processes;
- shorter ramp-up times;
– enhanced safety and stability of production processes;
– increased product quality;
– enhanced machine and process reliability; and/or
– improved resource efficiency.

The research and development work to be funded should significantly contribute to increase the economic efficiency of the complete added value chain for the manufacturing of products. Using modern AI technologies in combination with the already existing vast production technology know-how of developers, manufacturers, and operators of manufacturing plants, shall deliver and facilitate a competitive edge in the relevant international market.

2. Subject of Funding

Funding will be granted to cooperative, interdisciplinary R&D projects contributing to a substantial improvement of production processes by the use of AI technologies at and within machines and production resources and tools. The development of production processes will be funded if and to the extent to which it is required for the R&D work on machines and production resources and tools needed for the use of AI.

By the use of AI, in particular of machine learning, machine users shall be enabled to make safe and secure decisions and interventions required for an optimum execution of the manufacturing processes.

Wherever reasonable and necessary, processes shall be automated and users shall be released from routine, dangerous and stressful work by the use of AI in machines and production resources and tools.

Funds will be granted to R&D work on machines and production resources and tools for the following processes: Forming, cutting, joining, coating, and modifying material properties. In addition, R&D work on machines and resources and tools for additive manufacture will be funded.

For example, funding will be granted to R&D projects in the following areas:
– Methods to identify a reasonable scope of use of machine intelligence and autonomy, taking into account the impact on the added value chain;
control structures for an easy integration of AI methods;
learning strategies for machines and training and qualification of operators to evaluate and implement them;
strategies for sensor integration into machines and production resources and tools for AI use;
preparation, interpretation, processing, and use of data, taking into account domain knowledge and user-friendly expert systems;
ensuring data sovereignty and data security as well as access to the data in close collaboration with the customers;
actions when changing machines states, technical parameters, or component properties during manufacture in real time, if possible;
new operation concepts and human-machine interfaces (e.g. interaction between operator and machine, recognition and processing of human gestures) and their acceptance.

Potential applications are, among others:

- Digital assistance systems for the work planner and machine operator;
- plant controls;
- quality assurance and control;
- maintenance.

Implementation of the R&D results relating to the introduction and use of AI and reaching of the goals defined in Section 1.1 have to be proven by a demonstrator in the form of a production machine or production resource and tool in a real application scenario under close-to-production conditions.

For assessing whether the proposed R&D work can be funded, at least one application scenario has to be described for the expected project results. The same shall apply to the potential introduction of new business models based on the expected project results. Of particular interest are scenarios and business models that have not yet been feasible by conventional means or other Industry 4.0 technologies without the use of AI methods.

Application of project results shall focus on the production of small and medium batches.
The expected impacts of the R&D activities envisaged on the complete added value chain and its economic efficiency shall be outlined and assessed.

Results, such as methods, tools, procedures, models, regulations, guidelines, and concepts shall be presented such that a benefit is obtained across projects and branches.

Use of AI in production technology touches on aspects of work and service research as well as on legal and ethical aspects. The corresponding R&D work will only be funded, if it is needed for reaching the funding goals listed in Section 1.1.

It is assumed that the use of data will play a major role in the R&D work. To generate wide acceptance of the solutions envisaged in business and society, legally compliant and responsible use of process, customer, and staff data is indispensable. Use data, patterns, and routines must be recorded and supplied in a way that data protection and data security requirements are met and privacy and property rights are observed. Protection of the company-specific know-how must be ensured along the added value chain.

Funding will be granted to risky and application-oriented industrial joint projects that require interdisciplinary cooperation of companies with universities or research institutions. The collaboration projects must be coordinated by companies. Cooperative projects of institutes and single beneficiary projects will not be funded.

Work relating to standardization is welcome.

Appropriate technology transfer measures are to be developed to achieve a broad impact of the project. Hence, partners transferring the R&D results to application upon project completion should be involved in the project.

Priority will be given to collaborative projects with a major participation of small and medium-sized enterprises.

Active participation of a partner having vast expertise in the development and implementation of AI in the R&D project is considered necessary.

3. Special Prerequisites for Funding

One fundamental prerequisite of funding is the joint action of several independent
partners solving joint research problems (joint projects) clearly exceeding the state of the art. The projects should define focus areas according to the R&D aspects mentioned under No. 2 above.

The projects should be business-driven and trigger continuous innovation processes in the companies and, where possible, not exceed a term of three years.

Projects proposed should be distinguished by their model function and reference Character, especially in strengthening small and medium-sized enterprises. Only joint projects will be funded to which partners contribute that develop new ways of holistic development methodology in Germany and quickly take them to broad-based application without further funding. Interdisciplinary research approaches and holistic solutions should be implemented so as to include the respective technical and scientific disciplines. Participation of small and medium-sized enterprises is a factor of considerable importance in this regard in meeting the preconditions for receiving grants.

Only those proposals will be taken into account which foresee implementation of the tentative solutions in the participating companies along the lines of models during the term of the project and after the end of the project and make transferability / use of the results probable in large areas of business in Germany or the European Economic Area (EEA). Cooperation with competent agents of implementation is therefore a factor of major importance. Significant broad effects are expected, especially with a view to SMEs.

Applicants must show their willingness to accept interdisciplinary cooperation with other funded joint projects and initiatives in this field. They are expected to participate actively in intense intercompany exchanges of experience in the pre-competitive area while protecting their business secrets, and will contribute to BMBF public-relation...
measures (e.g. meetings organized by BMBF, representation at fairs, innovation platforms).

Also, in their own interest, applicants should familiarize with the EU Framework Program for Research and Innovation in the ambit of the intended national project. They should examine whether the intended project has specific European components, thus allowing exclusive EU funding to be organized. Moreover, it should be examined to what extent a supplementary funding application could be filed with the EU in the environment of the intended national project. The outcome of these examinations should be briefly explained in the national funding application.

European cooperation in research for production such as EUREKA is desired. EUREKA offers the possibility to German consortia to integrate foreign partners where it may be advantageous or necessary in the interest of the subject matter in order to supplement research in an international way. Funding of German partners is possible according to the provisions in this Announcement. Foreign partners can be funded by their respective countries.

Moreover, transnational ERA-NET MANUNET consortia can be funded. Foreign partners are funded by their respective country or region. Support is given by the national contact office of the relevant ERA-NET MANUNET (www.manunet.net).

It should be borne in mind that distinct deadlines apply in this context which can be found on the internet pages referred to above. In that case, the Project Coordinator has to contact the responsible Project Management Agency.
4. Procedure

4.1. Operation with a Project Management Agency, Application Documents, Other Documents, and Use of the Electronic Application System

At the present time, the BMBF commissioned this Project Management Agency (Projektträger, PT) to handle the funding measure:
Projektträger Karlsruhe (PTKA)
Karlsruher Institut für Technologie
Hermann-von-Helmholtz-Platz 1
76344 Eggenstein-Leopoldshafen
Germany

Central contacts are

Mr. Michael Petzold
Phone +49 (0)721/608-31469
Email: Michael.petzold@kit.edu

and

Mr. Alexander Mager
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Email: dorothee.weisser@kit.edu

The “easy-Online" electronic application system must be used to draft project outlines and formalized funding applications. (https://foerderportal.bund.de/easyonline).

4.2. Two-stage Procedure

The application procedure consists of two stages.

4.2.1. Presentation and Choice of Project Outlines

In the first stage of the project, the Project Management Agency commissioned must be submitted project outlines initially in writing or in an electronic format


For joint projects, the project outlines must be submitted in agreement with the Joint Coordinator envisaged.

This date of presentation is not to be considered as a time bar. However, project outlines received after that date may perhaps no longer be taken into account.

Project outlines should be addressed to

Projektträger Karlsruhe (PTKA)
Karlsruher Institut für Technologie
Standort Dresden
Hallwachsstraße 3
01069 Dresden
Germany
under the code name of “ProLern“.