Federal Ministry for Education and Research
Announcement
within the Framework of the
"Innovations for Tomorrow's Production, Service and Work"
Research Program
Guideline
promoting projects on the subject of
"Managing the Complexity of Sociotechnical Systems
- Contribution to Advanced Systems Engineering for Tomorrow's Addition of Value (PDA-ASE)"

dated February 11, 2019

Excerpt from the Announcement

Domestic industry is faced with the fundamental problem of organizing tomorrow's generation of digitized market services so that Germany as a high-wage country can continue to act successfully also in the future. This depends on the development of a new school of model-based design of tomorrow's technical systems.

In this connection, a technical system is generally considered a complex technical product and product - service system, respectively, inclusive of its digital image (model).

Tomorrow's technical systems more than ever will be based on the joint action of a large number of different technical disciplines, such as engineering, informatics, sociology, labor science and economics as well as business administration. Innumerable aspects must be taken into account and harmonized in the establishment of such systems, such as feasibility of production, userfriendliness, connectivity, security and safety, and sustainability. Success in innovation will be achieved in the long run only where businesses are enabled to develop technical systems of this complexity professionally, where necessary jointly with suppliers and customers.

Within the "Innovations for Tomorrow's Production, Service and Work" research program, the future competences, "Design and Produce Complex Systems," and "Manage Complex Products and Services," are put into effect in an integrative consideration of the areas of production, service and work design so as to create technological, service-oriented and social innovations for adding value in Germany.

One major purpose of this Announcement is to create new, innovative solutions in the development of technical systems for small and medium-sized enterprises enabling them to manage the complexity of a system and its generation.

Two aspects are in the foreground of interest:

(1) The use of new methods of product generation, especially in “Advanced Systems Engineering[1],”
(2) the design of a new form of interdisciplinary cooperation of all developers and parties, respectively, along the entire product lifecycle in a modern world of work.

In this way, innovation partnerships of science and industry can be achieved in a flexible way across subjects.

This Announcement is part of the series of funding activities by various departments of the German federal government about the subject of Industry 4.0. The Announcement also contributes to advancing methods and models of artificial intelligence (AI) ready for application.

1. Objective of Funding, Purpose of Grantgiving, Legal Basis

1.1. Objective of Funding and Purpose of Grantgiving

BMBF, in its “Innovations for Tomorrow’s Production, Service and Work” research program, supports cooperative pre-competitive research projects strengthening manufacturing industries in Germany. In this way, especially manufacturing enterprises are to be enabled more effectively to respond quickly to changes in global competition and actively take part in bringing about the necessary change. Research in and with small and medium-sized enterprises (SME) is particularly eligible for funding.

This Announcement is to enable small and medium-sized manufacturing enterprises to work out interdisciplinary methods and tools for holistic development of technical systems which can be introduced, step by step, in a business and into cooperation among businesses, respectively. In this development, the growing connectivity of production systems and relations adding value as well as the effects on work design

[1] “Advanced Systems Engineering“ focuses on user-oriented investigation of a holistic system for the development of technical systems by means of model-based connectivity of information.

must be borne in mind. Not included in the funding scheme are exclusive or predominately research and development (R&D) activities in software engineering.

Securing the leadership in innovation of German companies in model-based development of technical systems is the primary purpose. The results of the projects funded therefore may be used only in the Federal Republic of Germany or the EEA and Switzerland.

2. Subject of Funding

Funding serves to develop and implement as models transferable methods, tools, approaches, and models in the development of technical systems for and with companies. Complexity must be made manageable through interdisciplinary cooperation. The challenge lies in harmonizing all parties to innovation according to their knowledge, abilities and key qualifications in various locations and different periods of development. Special attention must always be devoted to the interaction of persons, technology, and organization.

The increasing connectivity of products, services, production systems and various types of organization can be managed in complex technical systems development only by designing a new innovative world of work.

Challenges as well as potentials of these development approaches can be found in numerous industries, such as plant and machine building, electrical industry, medical technology, automotive and vehicle design and construction, aerospace technology, consumer goods industry, or the services sector.

2.1 Main Funding Items

The Announcement serves to allow complexity in the development of technical systems to be managed by system-oriented design. An application-oriented development systems, so-called Advanced Systems Engineering, offers a possibility to put tomorrow’s product generation on a new holistic base. In product generation, this comprises strategic product planning, product, service, production systems development and the associated design of work in a vertical and horizontal system of adding value. The focus in this case is on the activities adding value, namely designing, planning, validation, simulation, backing, verification and release. These aspects are

to be advanced consistently and employed in businesses as models so as to allow new and effective cooperation among the players. For this purpose, holistic approaches must be developed to describe product and service lifecycles under industrial conditions as well as new interdisciplinary development methods.

The focus is on creating a generally valid development framework for Advanced Systems Engineering. Technical points are, in particular, (a) systems-oriented development, (b) systematic development of business models, (c) design of processes in interconnected development work, and (d) intensification of interdisciplinary knowledge work. Solutions are to be accompanied by sustainability considerations.

These research and development efforts are funded:

(a) Generation of solutions for systems-oriented development of technical systems

- Development of new approaches to model-based engineering of technical systems, for instance, to ensure semantic interoperability of the models, describe the ability to communicate, interact and act.
- Provision of information relevant to development in the early phases of systems design, for instance, by forecasting developments of markets and technologies, capture and processing of data from the entire product lifecycle, and the development of new techniques of specification.
- Specification of open systems architectures for flexible connectivity and digital continuity, respectively, of technical systems, for instance for explaining complex situations, providing suitable neutral data formats to model relevant properties.
- Development of new approaches, also by including AI methods, for virtualization (digital twin) and systems integration, verification and validation, for instance, by simulation, new services, assistant systems, review and test methods.
- …

(b) Systematic development of innovative, data-driven and platform-based business models

- Development of new approaches to building up and systematic modeling of a business strategy focused especially on harmonizing potential market performance and a newly generated business model.

- Development of new approaches enabling a business to establish systematically new, innovative, data-driven and platform-based business models.
- New approaches to strategic alignment, management of objectives, creation of promised uses, identification and definition of core technologies and added-value potentials.
- Development of new approaches backing the development of business models by sustainability considerations and assessment.
- …

(c) Process design in interconnected development

- Development of new approaches, also those including AI methods, for process design in the interdisciplinary design of technical systems.
- Development of new approaches to dynamic operationalization of corporate strategies so as to ensure transparency and participation in decisionmaking processes for all parties by new forms of organization.
- Development of suitable implementation strategies ensuring sustainable systems launches and cultural change, respectively, in cooperation.
- Structure and design of work organizations in the course of processes of product and service generation on the basis of Industry 4.0 and AI
- …

(d) Strengthening creative, interdisciplinary, interactive knowledge work

- Developments strengthening interdisciplinary cooperation by application and specific expansion, respectively, of standardized models and formats.
- Development of cross-domain solution patterns for methodological support of knowledge management in a business.
- Buildup of a systems-oriented competence development with appropriate measures of implementation for qualification of developers and all parties involved, respectively, and buildup of new concepts promoting collective creativity and autonomy.
- Design and establishment of working environments promoting learning and implementing new formats and types of learning.
- …

Research findings must be translated into specific applications in harmonized cooperation among research institutions and businesses. The success on the market of a complex technical system decisively depends on the quality of transfer from the idea for an innovative product or package of achievements to an economically profitable application on the basis of new business models.

2.2 Design of Integrative Joint Projects

The focus of this Announcement is integrative cooperation in joint projects of various experts from production, service and work research in an effort to manage new socio-technical systems and their respective complexity.

It is assumed that the interdisciplinary project consortia will define specific problems relating to the establishment of holistic development of technical systems and arrive at application-oriented solutions. Research and development work is to support small and medium-sized enterprises in tapping the potentials of model-based development of technical systems.

Every joint project must take into account at least one of focal points (a) or (b) mentioned under 2.1 above as well as the two focal points, (c) and (d), as integrative parts of project planning. The project must be managed systematically and jointly by businesses, research partners and, if necessary, other relevant players.

Funds are made available to high-risk and application-oriented joint industrial projects requiring division of labor and interdisciplinary cooperation of businesses with universities and research establishments, respectively. Coordination and control of the joint efforts should be handled by user companies. In particular, different domain-based knowledge from engineering, informatics, sociology, labor science and economics as well as business administration is to be interconnected in building up a socio-technical system along the lines of Industry 4.0. Associations only of institutes and individual projects are not eligible for funding as a matter of principle.

Consortia should be composed in such a way as to accommodate a larger number of applications and broad coverage of types (industry, size of company, type of manufacturing, level of automation, etc.) so that research findings may be transferred. Work serving for standardization is desired expressly. Measures implementing technology transfer should be developed in a suitable way so as to achieve the broadest possible effect. Partners must be involved which will utilize the research and

development findings after termination of the project. Associations involving significant numbers of small and medium-sized enterprises will receive preferred treatment.

Projects should reveal clear progress over the current state of the art and, by providing innovation, make a significant contribution towards ensuring Germany's position as an industrial center. Project findings which can be expected to be transferred are methods, tools, approaches, models, guidelines, instructions, and concepts of introduction and implementation which will be demonstrated as models in various specific application scenarios. The meaningful use of existing and established standards and norms must be borne in mind in this case, just as interoperability with systems and components to be newly integrated. Results should be processed so as to be generally valid and generate benefit also across specific industries.

Proposals should be characterized by their model function and reference character, in particular strengthening SME. Proposals are expected which demonstrably achieve considerable enhancement of competitiveness of businesses by development, introduction, and use of a systems-oriented solution. Results must be validated by means of specific demonstrators in pilot areas with reference character. The specific benefit arising to the business in question must be described in qualitative and quantifiable terms. Usability and transferability of results must be presented on the basis of several specific applications. Utilization of the findings by the respective companies must be ensured.

In order to achieve broad acceptance in industry and society of the solutions sought, an explicit way, conforming to law and a spirit of responsibility, of handling process, customer and employee data is indispensable. Data security and data protection, personal rights and property rights must remain protected. In this respect, user data, patterns and routines must be collected and prepared in such a way that boundary conditions of data protection and data privacy are observed. Protecting company-specific know-how along the value chain in small and medium-sized enterprises must be taken into account. Where applicable, also ethical aspects must be included adequately in concepts to be elaborated.

3. Special Prerequisites for Grantgiving

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 make the R&D aspects mentioned under No. 2 above identifiable as focal areas.

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 therefore is a factor of major importance. Significant broad effects are expected especially with a view to SME.

To avoid critical situations as a result of personnel switching while the project is running, annual HR expenditure per project partner should not be less than 12 person-months, if possible.

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 the respective countries.

Moreover, transnational ERA-NET MANUNET associations can be funded. Foreign partners are funded by the respective country. Support is given by the national contact office of the relevant ERA-NET MANUNET (www.manunet.net). It should be borne in mind that special periods of time apply in this context which can be found on the internet pages referred to above. In that case, the Project Coordinator must establish contact with the responsible Project Management Agency.

7. Procedure

7.1. 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 especially of parties wanting to file a project outline are

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

7.2. Two-stage Procedure

The application procedure consists of two stages.

7.2.1. 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

no later than by May 17, 2019.

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
Hermann-von-Helmholtz-Platz 1
76344 Eggenstein-Leopoldshafen
Germany

under the code name of “PDA_ASE“.