EUREKA PRO-FACTORY-PLUS

Distribution of German Calls to Generate PRO-FACTORY-PLUS Proposals

Federal Ministry of Education and Research

Call for Proposals
within the Framework Concept
"Innovations for Tomorrow's Production, Services, and Work"
Relating to the Topic

Assembly Competence – Collaborative and Capable of Change (KoMo)

dated April 2015

The new high-tech strategy of the Federal Government is aimed at advancing Germany on the way towards worldwide innovation leadership. Good ideas are to be translated rapidly into new products and services. Efficient and inexpensive implementation of innovative ideas in production processes is a big challenge for German companies. The necessary conditions are generated by the cooperation of science and industry in German production research. Under the high-tech strategy and the funding program "Innovations for Tomorrow's Production, Services, and Work", the Federal Ministry of Education and Research (BMBF) initiates competitions of ideas and launches research programs to further develop innovations for tomorrow's production for the benefit of society.

In Germany as a major industrial nation, a very high share of value added in the gross domestic product is reached by the assembly of industrial goods. In addition, Germany is one of the leading suppliers of assembly and handling technology equipment.

Assembly is the last step of adding value in the production of complex goods and needs a high capability of change due to increasingly volatile markets and new process requirements resulting from e.g. Industry 4.0. Depending on the product and company, highly individual, customized solutions have to be found. In this process, close cooperation between assembly users and assembly suppliers, which has grown over many decades, plays an important role.

It has made Germany reach a leading position in the development of complex automation solutions worldwide.

Many complex piece goods made in Germany are still produced mainly by manual assembly due to small batch sizes and varying product numbers needed. Increasing the degree of automation in manual assembly by adding an automation component is referred to as hybrid assembly. It may result in cost and efficiency advantages for the mostly small and medium-sized enterprises. In spite of high salaries and the worldwide highest industrial safety standards, employment in Germany is secured and enhanced.

Suppliers of assembly systems and components in Germany possess vast competence in systems business. On the world markets, automation technology is presently focusing on the production of medium and small series rather than on large series. In the future, far less standardized solutions will be needed on the production world market. Customer-specific problem solutions will have to be capable of change. This will open up good export chances for German mechanical engineering companies.

1 Purpose of the Call

With the framework concept “Innovations for Tomorrow’s Production, Services, and Work”, the Federal Ministry of Education and Research (BMBF) supports cooperative pre-competitive research projects to strengthen production in Germany. Producing enterprises are to be enabled to quickly respond to changes and to actively design this change. In particular, research in and with small and medium-sized enterprises (SME) is funded.

Within the framework of the present call for proposals, medium-sized producing enterprises shall be supported in developing, implementing on a prototype scale, and economically validating innovative system solutions.

The solutions shall be introduced gradually at the participating companies. The companies are to be enabled to independently and sustainably optimize these solutions even after the completion of the research projects. Securing innovation leadership of German enterprises in the development and operation of assembly facilities and in the use of innovative assembly in Germany shall be the paramount objective. Increase in productivity and resource efficiency shall be in the focus.

2 Subject of the Call

Funding is aimed at developing, designing, and introducing innovative systems solutions for the assembly of complex piece goods at producing companies. The systems solutions shall be specific, application-oriented, and exemplary solutions considering the interaction between the lifecycle of the product to be assembled and the economically optimal degree of automation. Projects relating to two different fields of work may be executed and funded:

(a) Collaborative assembly systems

(b) Assembly facilities capable of change

To effectively reach the objective defined, a joint project should cover one of the two fields of work – either a) or b) – only. These two fields of work shall now be specified in detail:

(a) Collaborative Assembly Systems

Contrary to automatic systems, manual assembly systems need a far smaller capital investment and, hence, are associated with a far smaller investment risk. Considering the lifecycle of the product to be assembled, manual assembly systems have a high capability of change in case of a high variant diversity and small batch sizes and, hence, are capable of managing the increasing volatility on customer markets. Due to the demographic development in Germany as a high-wage country, however, this capability of change will reach its limits in case of staff shortage and high order peaks. This problem is to be solved by automation components that are directly available in case of short-term capacity fluctuations.

This will result in hybrid assembly systems with novel production assistants for small batch sizes. They will be suited for assembly processes that so far have been impossible to execute with classical industrial robots due to their lacking sensitivity, complex programming expenditure, and high investments.

Revision and reorganization of the standards relevant to industrial robots gave rise to the new field of collaborating robots. For the first time now, the safety guards needed so far to protect persons in the working environment against mechanical impacts and, hence, injuries by quickly moving robot parts can be removed under certain conditions.

Workplaces in the assembly sector can be designed for use either by people or by robots or by both at the same time. Integration of collaborating robots into a workplace that has been

optimized for man so far results in new requirements that still remain to be met. A participative and acceptance-enhancing implementation process is indispensable. The following research and development topics will be funded:

(a.1) Innovative concepts for the design of collaborative assembly systems

- Concepts and tools to assess automation potentials in assembly environments, the automation of which has not been economically efficient so far.
- Development and validation of simple, SME-suited processes to determine the economic efficiency and use of the automation solution over the entire lifecycle of the product to be assembled.
- Development of generic approaches to selecting suitable assembly activities for robots/production assistants.

(a.2) New collaborative assembly systems

- Design of the man-robot interface. It is not only required to consider the capability of the robot of managing the assembly tasks, but to also take into account the influence on the working conditions of man. To ensure a holistic approach, the assessment also has to consider industrial safety regulations and ergonomics findings. Work contents have to be analyzed in their entirety. Apart from the physical relief of man by the robot, new physical stresses and hazards may be caused by unusual work environments (e.g. noise, movements) and acceptance problems. In addition, new qualification requirements resulting from the specific interaction of man with the robot have to be considered.
- Development and testing of new methods for commissioning and first programming as well as for dynamic programming of robots by the workplace actors in case of changing tasks.
- Development and adaptation of sensor technology to the respective assembly environments and of the safety requirements to the tools, grippers, and workpieces handled in the assembly process.
- Optimization of assembly logistics, materials supply, feeder systems, and palletizing, if applicable, required for the design of collaborative assembly systems.

(a.3) Introduction strategies and implementation approaches

- Concepts and strategies for the early integration of the workplace actors into the planning process to reach a high acceptance of the new workplaces (participative planning).
- Development and testing of introduction strategies for stepwise migration and appropriate concepts to communicate changes at the enterprises.
- Development and testing of training concepts for company decision-makers and executive staff as well as for work planners, master craftsmen, and staff members working at the new cooperative workplaces and, if necessary, inclusion in curricula for vocational education and advanced training.

All requirements (a.1) to (a.3) listed above shall be considered by exemplary project activities. The work funded is to focus on application at companies with highly fluctuating assembly outputs. At least three representative man-robot cooperations in manual assembly shall be tested within the framework of one joint project. The specific research needs of robot and component manufacturers shall not be in the focus of support. Robot and component manufacturers are expected to concentrate on safety aspects as well as on facilitating operation and installation.

The participating users shall demonstrate the benefit associated with the new assembly concepts by tests and validation of the research results.

(b) Assembly Facilities Capable of Change

Ideally, an assembly facility should be designed in line with the lifecycle of the product to be assembled. However, this lifecycle depends on demand and is hardly known to the user as a rule. When commercializing the product, sales figures mostly are small and manual assembly often is the cost-effective solution. When demand is expected to increase, automated assembly facilities are purchased. This investment, however, is associated with a high risk for the user, if his sales market does not develop as expected. This risk can be reduced by assembly facilities capable of change. They allow for a gradual scaling of the degree of automation, cycle time, and output quantity.

Assembly facilities with stepwise scalability require inexpensive and rapid integration of partial systems with various degrees of automation. This means that manual, semi-automatic, and automatic components may be combined easily in one assembly system. The individual plant components, consisting of various transport systems and process stations,

have mechanical, electric, and control interfaces with the entire system. Reconfiguration of the facility is a mechatronic development task requiring interdisciplinary communication during construction and with the operator of the assembly facility.

The following research and development topics will be funded:

(b.1) New concepts for the design of assembly facilities capable of change

- Methods of model-based product development in the early phase of development of the product to be assembled (e.g. object-oriented modularization) taking into account the modularity and reconfigurability of the facility.
- Further development of system kits and program libraries at the assembly equipment supplier; mechatronic interface standardization (e.g. for communication between sensors, buses, etc.).
- New planning methods (e.g. simulation and virtual-reality methods for an optimum design of assembly facilities) for managing the complexity and for the economic evaluation of continuous change management during plant development.
- Methods for the economic assessment of the scalability and reconfigurability of assembly systems by the manufacturer with the help of demand scenarios over the complete product lifecycle.

(b.2) Assembly facilities capable of change in the dimensions of modularity, reconfigurability, scalability, universality, and mobility

- Plug & produce concepts and systems solutions for automated assembly facilities capable of change.
- Increase in the degree of automation and capability of change by new measuring equipment, automatic exchange and retrofitting processes, self-optimizing components, and an open, integrated plant control.
- Integration of other fabrication processes into assembly; design and adaptation of new universal workpiece carrier concepts and automatic part feeder systems.

Both requirements (b.1) and (b.2) listed above shall be considered by exemplary project activities. The work funded is to focus on cooperation of manufacturers and users of assembly systems in the early phase of product development. Within the framework of one

cooperation project, at least two applications are to be tested. Work should focus on the assembly of complex, mechatronic piece goods.

The following prerequisites have to be fulfilled in both areas of work (a) and (b):

Risky, industrial collaborative projects requiring sharing of work and multidisciplinary cooperation of companies with universities and research institutions will be funded. Maximum participation of small and medium-sized enterprises in the collaborative projects is expected. The work funded is to focus on research and application. Suitability of the solutions is to be demonstrated on a prototype scale by demonstration and pilot applications at the companies. Tests shall be validated by appropriate SME-suited economic assessments. If the business models and service concepts required for this purpose are still lacking, they may be developed in parallel. The results shall be processed generically. The solutions proposed shall have model and reference character for strengthening small and medium-sized enterprises. Transferable project results, such as methods, tools, regulations, guidelines, and concepts for implementation in areas that are not funded, are expected. Their use is to be assessed and evaluated economically. This will foster wide exchange of experience and knowledge and produce economic benefits.

3 Beneficiaries

Beneficiaries may be producing enterprises in Germany, in particular small and medium-sized enterprises (definition by the European Commission: http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/sme-definition/index_de.htm, http://ec.europa.eu/enterprise/policies/sme/files/sme_definition/sme_user_guide_de.pdf), universities or non-university research institutions. Research institutions that are granted basic funding by the Federal Republic of Germany and the federal states may be granted funds for their additional expenditure under certain conditions only.

4 Funding Prerequisites

The prerequisite for funding is the cooperation of several independent partners for the solution of joint research tasks (collaborative projects) that by far exceed the state of the art. Several of the research and development aspects mentioned above in section 2. must be in the focus of these joint projects. The projects are to initiate innovation processes and shall not exceed a duration of three years, if possible. Funding will be granted to joint projects exclusively, the partners of which produce the new products and production systems in

Germany and ensure their rapid wide application without any further funding. Interdisciplinary research approaches and holistic solutions shall be implemented by the respective disciplines in cooperation.

The partners, who are granted funding, are expected to actively participate in an extensive exchange of experience in the pre-competitive area, with their business secrets being observed. They are to support the interdisciplinary innovation platforms possibly established for coverage of the individual research topics.

In their own interest, applicants are to familiarize with the EU Research Framework Programme covering the intended national project. Applicants shall check whether the project planned contains specific European components and, hence, exclusive funding by the EU is possible. It also has to be checked whether additional funding of the national project might be applied for with the EU. The results of these checks are to be reported briefly in the national proposal.

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It is also possible to fund international cooperation projects on the topics given above. Cooperation will be supported, if a clear value added will be achieved by the joint investigation of the problem and entire branches and research fields will profit from this value added rather than single enterprises. The advantages of integrating international partners shall be outlined. The shares of the foreign partners shall be funded via the corresponding national programs.

European cooperation in research for production under e.g. EUREKA is desired. German consortia have the possibility to integrate foreign partners, if this is advantageous thematically or if research work has to be complemented by contributions from other countries. Funding of German partners is subject to the conditions of this call. Foreign partners can be funded by their respective country. Support is rendered by the PRO-FACTORY-PLUS Working Group. Future EUREKA projects will be included in the EUREKA umbrella PRO-FACTORY-PLUS. Further information is available at http://www.produktionsforschung.de.

6 Outline Proposal to be Submitted

German partners in PRO-FACTORY-PLUS consortia are referred to the complete German text of the call under www.produktionsforschung.de for them to take into account all requirements to be complied with by their outline proposal.

The call will be open until: **14.08.2015**

Additional information may be obtained from

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In a first step, a project outline of about 10 pages has to be submitted.