Invitation for industrial/service partner participation

EU Call DT-FOF-11-2020: Quality control in smart manufacturing (IA)
Quality Control in Smart Manufacturing

Contents

- Management summary
- Expectations of the EU Call
- State-of-the art in manufacturing quality control approaches
- Academic partners
- Open industrial / service partners
- First key question to production partners
- Contact
Research proposal: Quality Control in Smart Manufacturing (QCiSM)

Management Summary

**Approach**

- **Prescriptive quality analytics and control:**
  - Digital Twin & Machine Learning enables quality monitoring, control & optimisation

- **Research programme:** EU Horizon 2020 – Digitising and transforming European industry and services (DT) – Factories of the Future FOF
- **Type of Action:** Innovation action (IA) (Focus on application, testing, optimization, validation)
- **Deadline:** 5 February 2020 17:00 (Brussels time)
- **Project volume:** EUR 8-10 million; distribution according to work load of research-, technology- and applications partner
- **Duration:** 30 months; **Project start:** Q3/2020

**Increase of degree of**

- Digitalization, Actuality, Autonomy, Forecasting Accuracy, Integration
- Decision Support, Dynamisation, Optimization, Demonstration

**Targeted KPIs**

- Product quality
- Production performance
- Process stability
- Equipment productivity
- Rapid error localisation
- Production amount and quality deviations
- Time-to-market
- Ramp-up time
- Scrap %
- Waste and by-products
- CO₂ emissions

**Your Benefits**

- **Funding with 70%:** personnel costs, material costs (EUR 0,5-2,0 million per partner)
- **Main result:** OPTIMAL MANUFACTURING QUALITY
  - Data reliability solutions, sensors, actuators and instruments used at various levels of integration in the manufacturing process
  - Up-to-date interactive and self-learning process control using modelling and simulation approaches together with data fusion techniques
  - Certification, regulatory and standardisation of AI systems for manufacturing
- **Implementation on TRL 7:** Final solution through orchestration of several technologies
EU Call: Quality control in smart manufacturing (QCiSM)

Overview

<table>
<thead>
<tr>
<th>Call Facts</th>
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<tbody>
<tr>
<td>Topic</td>
<td>Quality control in smart manufacturing (IA)</td>
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<tr>
<td>Topic identifier</td>
<td>DT-FOF-11-2020</td>
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<tr>
<td>Deadline</td>
<td>5 February 2020 17:00 (Brussels time)</td>
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<tr>
<td>Deadline-Model</td>
<td>single-stage</td>
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<tr>
<td>Type of action</td>
<td>Innovation action (Focus on application, testing, optimization, validation)</td>
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<table>
<thead>
<tr>
<th>Project Organisation</th>
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<tbody>
<tr>
<td>Initiator</td>
<td>Fraunhofer Austria Research GmbH (FhA) &amp; Institute for Computer Science and Control of the Hungarian Academy of Sciences (SZTAKI)</td>
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<tr>
<td>Contact</td>
<td>Dr. Zsolt János Viharos (<a href="mailto:viharos.zsolt@sztaki.hu">viharos.zsolt@sztaki.hu</a>) &amp; Viola Gallina (<a href="mailto:viola.gallina@fraunhofer.at">viola.gallina@fraunhofer.at</a>)</td>
</tr>
<tr>
<td>Working title</td>
<td>Predictive and prescriptive quality analytics: A Digital Twin enabling quality prediction and control</td>
</tr>
<tr>
<td>Proposal lead</td>
<td>Science Institute For Computer Science and Control of the Hungarian Academy of Sciences (SZTAKI)</td>
</tr>
<tr>
<td>Project and consortium lead</td>
<td>Science Institute For Computer Science and Control of the Hungarian Academy of Sciences (SZTAKI)</td>
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<th>Partners and Budget</th>
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<tr>
<td>Planned number of project partners</td>
<td>Ca. 10</td>
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<tr>
<td>Planned project budget</td>
<td>Total EUR 8-10 million; each partner between EUR 0,5-2 million (depends on work load and technologies)</td>
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<tr>
<td>EU funding rate</td>
<td>70% (except non-profit 100%)</td>
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<td>Indirect cost</td>
<td>Unique flat rate of 25%</td>
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<tr>
<td>Project duration</td>
<td>Ca. 2,5-4 years</td>
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EU Call: Quality control in smart manufacturing (QCiSM)
Aspects to be addressed in the proposals

- Integrate intelligent, cognitive, adaptive and cost-effective instruments and systems of sensors/actuators for process monitoring and control (e.g. virtual sensors and digital twins) into existing production or pilot lines
- Showcase real-time data validation within an actual production line, and incorporate data integrity strategies based on, e.g., distributed ledger (blockchain) technology
- Demonstrate how distributed, time stamped and persistent solutions for automated collection, storage, analysis and use of production data can lead to an integrated approach to zero-defect manufacturing
- Develop strategies for rapid line qualification and reconfiguration based on large pre-existing data sets and related open protocols
- Certification, regulatory and standardisation activities related to the proposed solutions should be included in the proposal
- Proposals submitted under this topic should include a business case and exploitation strategy
EU Call: Quality control in smart manufacturing (QCiSM)

Expected impacts

- Increased **equipment productivity** through rapid error localization (10%)
- Reduction of **ramp-up-time** (>15%) using smart sensors/actuators and existing production data sets
- AI-driven instrumentation stimulating the transformation towards **smart and fast processes** leading to decreased **time-to market** (time reduction > 10%)
- Significant increase in **quality of manufactured products** leading to a **reduction of scrap** of at least 50%
EU Call: Quality control in smart manufacturing (QCISM)

Technology Readiness Level

“Activities should start at TRL 5 and achieve TRL 7 at the end of the project.”

(EU Call Scope)

- **TRL 5**
  - Component and/or breadboard validation in relevant (simulated) environment

- **TRL 6**
  - Major transition from research and experiment to real life implementation and commercialization
  - Individual technologies and stand-alone elements are not a matter of discussion any more
  - A representative model, prototype or system must be tested in a relevant environment
  - Several (or many) new technologies are integrated into the demonstration of an operational environment

- **TRL 7**
  - Orchestration of several components and technologies in order to generate a “final solution“
  - Demonstration/Pilot: Actions aiming to validate the technical and economic viability of a new or improved technology, product, process, service or solution in an operational (or near to operational) environment
State-of-the-art
Maturity level of Quality Strategies

- **Maturity level 1**: Subsequent analysis

- **Maturity level 2**: IoT / SPS driven real-time analysis
  - Reactive Quality-Strategy
    - Recording of data offline and mostly manual
    - Delay of data processing and analysis
  - Real-time Quality-Strategy
    - Acquisition of data via sensors online and in real-time
    - Short reaction time with low delay time

- **Maturity level 3**: Big-Data driven predictive analysis
  - Predictive Quality-Strategy
    - Model development and prediction of quality deviations via Big-Data technologies
    - Future forecasts with deposited probabilities

- **Maturity level 4**: Artificial Intelligence aided decisions and control
  - Prescriptive Quality-Strategy
    - Automated decision derivation due to forecasts and machine learning
    - Use of prescriptive quality strategy for global optimization of PPS, maintenance, material logistics, facility management, etc.

Use and Future Orientation
## Research proposal QCiSM

### Scientific Partners

<table>
<thead>
<tr>
<th>Nr</th>
<th>Name</th>
<th>Town, Country</th>
<th>Role</th>
<th>Competences</th>
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<tbody>
<tr>
<td>1</td>
<td>Institute for Computer Science and Control (SZTAKI)</td>
<td>Budapest, Hungary</td>
<td>Lead, Data Scientist, Quality experts, IT experts</td>
<td>Business intelligence, production informatics, machine learning, quality specialist, IT development</td>
</tr>
<tr>
<td>2</td>
<td>Fraunhofer Austria Research (FhA)</td>
<td>Vienna, Austria</td>
<td>Business Analyst, Data Scientist</td>
<td>Production management, process optimization, digitalization strategies, application of AI</td>
</tr>
<tr>
<td>3</td>
<td>Fraunhofer Institute for Manufacturing Engineering and Automation (FhG IPA), Fraunhofer Institute for Production Technology (FhG IPT), Fraunhofer Institute for Production Systems and Design Technologies (FhG IPK)</td>
<td>Stuttgart, Aachen, Berlin, Germany</td>
<td>Business Analyst, Data Scientist, Technology Experts, Standardization Experts</td>
<td>Robotics, quality assurance, optimization, environment detection, Quality assurance, process optimization, machine learning, big data specialist, Data security and assurance, standardization</td>
</tr>
<tr>
<td>4</td>
<td>Budapest University of Technology and Economics (BME)</td>
<td>Budapest, Hungary</td>
<td>Technology Experts</td>
<td>Technology know-how, quality specialist</td>
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Research proposal QCiSM

Key enablers: Digital Twin

**Digital Twin**
- e.g. real-time visualization

**Digital Shadow**
- e.g. mathematical model

**Digital Model**
- e.g. mathematical model

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**Working Title**
*Predictive and prescriptive quality analytics: A Digital Twin supporting quality prediction and control*

- Bidirectional, fully integrated and automatic data flow
- Digital representation of the current (physical) system status
- Digital objects acts as control and optimization instances
- Assessment and monitoring of production system performance, quality and key parameters
- Reconfiguration of the real system according to the digital computed optimization results
Research proposal QCiSM

Use-case possibilities, expectations for Innovation & Service and Manufacturing partners

- **Innovation & service partners**
  - **Data Reliability Hardware / Software providers**: Real-time data validation within an actual production line, and incorporate data integrity strategies based on, e.g., distributed ledger (blockchain) technology
  - **Sensor/Actuator producers/integrators**: intelligent, cognitive, adaptive and cost-effective instruments and systems of sensors/actuators are to be integrated into existing production or pilot lines
  - **Certification partners**: Certification, regulation and standardisation is addressed through ideally a large, well-known partner

- **Use-case requirements for manufacturing partners (not necessarily all for an individual use-case)**
  - A **manufacturing process-chain** is planned to be analysed with **heterogeneous machines** incorporating some machines, maximum a complete production line but not a plant or a complete supply chain
  - **Production flow with various process parameters/set-ups** that can **affect the product quality** and **can/shall be set/changed** during the production process
  - **Sensor systems with process monitoring / data collection solutions** and some first or advanced **simulation and/or data analysis/reporting systems** are expected (~TRL 5 – see slide 7)
  - **Production process chain/line (physical or logical) reconfiguration and qualification** aims are in interests
  - **Dealing with Certification /standardisation** activities
  - **Business case** and exploitation strategy (a simple one) has to be prepared
  - **Improvements in the prescribed KPIs** (Equipment productivity, Ramp-up-time, Time-to market, Reduction of scrap)
Typical, short term questions
For manufacturing partners

- List of actual TOP 3 quality issues
- List of actual TOP 3 quality issues that could be supported by the proposal
- Possible production lines / parts of the production line to be improved in the current collaboration
  - Setting parameters and quality measures for managing the selected line
  - Available sensing / monitoring solutions connected to this process-chain
  - Is reconfiguration of the system an issue (physical and/or logical)?
  - How production line qualification is ensured?
  - Are there any simulation / digital twin solutions of the line available?
  - Are there any Business Intelligence / Reporting / Dashboarding solutions connected to the line?
- Data Reliability expectations and TOP 3 Data Reliability challenges available
- How certification / standardisation is handled?
- See: Prescribed key KPIs and expected improvements (Slide before about Expected impacts)
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