eScop

Embedded systems for Service-based control of Open Manufacturing and Process Automation

EXECUTIVE *summary*

Embedded systems for Service-based Control of Open manufacturing and Process automation, or eScop, develops a core of the Manufacturing Execution System that overcomes current problems of system integration from shop-floor control to factory management levels by merging the power of knowledge representation, service orientation and embedded systems.

CONTRIBUTION *to SRA*

eScop contributes to the following SRA high-level targets:

> Reference designs and architectures; reference architecture with kernel module connecting to several service applications in order to develop an innovative solution allowing the supervisory and command capability of production systems in a new open manner allowing easy system configuration.

> Seamless connectivity and semantic interoperability; careful consideration of components interoperability in order to assure implementation quality.

> To close the design productivity gap between potential and capability, eScop will:
  ○ educe system design cost by 15%
  ○ reduce development cycles by 15%

○ manage a complexity increase of 25% with 10% effort reduction
○ reduce the re-validation and re-certification time and effort by 15%
○ achieve cross-sectorial reusability of embedded systems

MARKET INNOVATION *& impact*

eScop project results will impact the entire value chain of the production automation industry. The role of a stakeholder is shifted towards knowledge user/creator. Companies that require high productivity can certainly benefit from the project improvements on efficiency and transparency of shop floor information, furthermore, other important beneficiary/customers for eScop results are companies that need to work with low volume of different type of products, generally realized with job-shop production systems. Target customers, typically SMEs, need:

> flexible use of equipment and capability to integrate a processes (a machines)

> fast combination of different processes and adaptation of the plant to a new production

> smart and easy re-configuration activity

eScop improves competitiveness and sustainability, creating new market opportunities for industry, especially end-user SMEs.

RELEVANCE & CONTRIBUTIONS *to Call Objectives*

eScop is positioned within the application context of *Industrial Systems* and addresses the ARTEMIS Sub-Programme ASP4: Embedded Systems for manufacturing and process automation and focuses on two fundamental industrial priorities: *Reference designs and architectures and Seamless connectivity and semantic interoperability*. eScop addresses the following key ARTEMIS challenges:

> Composability by defining reference architecture supporting the smooth integration of independently developed components aiming at integrating different existing software tools

> Dependability and security by standardization of equipment interfacing, thus reducing commissioning effort and ramp-up time, whilst enhancing context-awareness, maintainability, modularity, re-usability, safety and versatility of manufacturing and process production systems

> Interfacing to the environment by providing intuitive ways for humans to interact with the technical system, including interface auto-configuration depending on target users

> Interfacing to the internet of services by using service-oriented architecture enabling the interaction with third party service provider

> Certifiable operating systems by providing service oriented middleware suitable for different application domains, besides it is made of micro-kernels that can be distributed and composed, and are able to support dynamic reconfiguration

> Opportunistic flexibility by taking advantage of innovative solutions for flexibility such as cloud manufacturing for improving the quality of services provided dynamically

R&D INNOVATION *and technical excellence*

The central concept of eScop is to combine the power of embedded systems with an ontology-driven service-based architecture for realizing a fully open automated manufacturing environment. The true innovation of the proposed solution is the merge of the power of knowledge representation and SOA approaches with embedded systems throughout factory shop-floor and management. eScop methodology suggests representation of production-related knowledge in self-descriptive form of ontologies. Collaboration of semantically rich services requires less coordination efforts at the moment of development enabling more flexible and dynamic integration. Embedded systems can enable such semantically rich services on shop-floor device level seamlessly including them to factory ecosystem. The methodology also considers outsourcing of the computational processes to public/private clouds.

eScop realises a methodology for the capture, extraction and representation of production knowledge by ontologies, to be used as the backbone of the reasoning process. The result is a modular, fully open solution for the operational control of manufacturing equipment allowing:

> easy and fast commissioning of new plants

> achievement of "plug & produce" inclusion of new equipment

> replacement of traditional control based on hierarchical hardware architecture, by a single level cohort of embedded systems and semantically described interoperable expandable set of services

In order to achieve these goals eScop plans to integrate different existing software tools for developing an innovative solution that allows supervisory and command capability of manufacturing systems in an open manner.

The eScop hardware and software platform will bring the following innovations:

> support the flexible re-configuration and knowledge update of newly plugged or unplugged equipment

> reduce the time and cost wastes related to conventional manual reprogramming

> facilitate the human-to-machine and machine-to-machine interactions

> facilitate the introduction of new products with short-life cycles without the need of total restructuring of the production system, as well as allowing the manufacture of customized products

> facilitate the integration of new functionalities or legacy systems

PROJECT *partners*