Fact sheet on Smart Industrial Components

The Co-FACTOR project performed a survey among experts of production from all over Europe

Three different application levels were addressed, namely:

- Smart production lines/ systems
- Smart cells and equipment
- Smart sub-machine parts

This grouping has been chosen in accordance to the well-known production pyramid. The perspective of a quite strict hierarchical order within production from Shop-Floor to Manufacturing Network seems already outdated in the present and will for sure be irrelevant in future scenarios: the boundaries and strict definition of functionalities is becoming more and more fuzzy. In this new context several questions arise:

- How do new, advanced, smart technologies fit into the picture?
- What makes conventional devices smart devices?
- What are major opportunities and main obstacles for smart industrial devices?

Functionalities of smart XXX

- Communication capabilities
- Self-Awareness
- Self-Description
- Self-Optimization

Standardization

- Key for interoperability
- Reference architectures and models as a starting point
- Commonly defined communication protocols

Technology Readiness Levels and business opportunities

- Majority of the approaches between TRL 4 and 6
- Some solutions (especially on component level) almost TRL 8
- Cost-performance ratio still to be clarified

Data and Information

- Upmost priority is given to the security of data
- Rather smart data than big data! Means: Aggregation on lower levels

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Summary of facts about “smartness” on different level

The resulting must, should and could requirements range from easy to be defined network up to highly sophisticated self-optimization capabilities, utilizing the ability to control and re-adjustment based on models and self-awareness even at component and equipment level.

Smartness at production system level could be described as the capability of communicating with others by sharing complex and even aggregated/analyzed data. A common understanding is that the communication skills and capacity to collaborate in networks would perform the basis of smartness. The content of information goes beyond the current set of static data towards intelligent, aggregated data and being generated by smart components themselves (such as self-description documents).

On equipment level, smartness is seen in the capability of preventing the system from malfunctions as well as the ability to be able to describe and adapt itself to new situations. Although the diagnostics / prognostics seem to be well-defined (at least all reporters could state an exact TRL, which is only feasible if they exactly know what is meant), the list of expected features is quite extensive.

The definition on smartness at component level differs in accordance to the special field of operation. The only common ground can be seen in the fact, that all projects are considering hardware components like electronic components, control systems and special actuators. This includes complex systems themselves being assembled based on mechanical and electrical spare parts. A clear distinction between smart components and smart sub-machine parts could have not always been made. Smart sub-machine parts at least have some kind of self-awareness, being able to describe themselves and communicate with others. Some of the projects even go a step beyond this common “definition” while adding automatic detection of sub components or degradation determination. Standardization not only has been mentioned as a key-enabler, but with the already proposed German Reference Architecture and Model Industry 4.0 (RAMI 4.0) being also one of the most discussed approaches to adapt the interrelationship among all players in the field of manufacturing along the whole supply chain. As well as along the whole life cycle of production and products has been named multiple times.

This new paradigm of production architecture includes also changes in required functionalities for every component within, from sensor up to Manufacturing Execution Systems and further IT services, trying to aggregate and analyze data and transform it into application-specific and user-oriented information. The major target lies on optimized industrial processes via technical developments such as Plug & Play, auto-configuration, self-optimization, adaptivity, co-operation, self-description, virtual representation or interoperability. This non-conclusive list also shows the hurdles smart technologies are facing.

Conclusion

Smart components are seen as key enabler, building blocks and atomic elements serving as provider of the technical basis for future manufacturing systems and related factories. At component level, they are seen as a kind of advancement to embedded systems as it integrates sensor/actor systems with computing resources. They are described with properties such as capability to sense/act/elaborate any information.