

Implementation of EMon on GF AgieCharmilles Machine Tool

One of the main goals in FoFdation is to address sustainability in the factory, the shopfloor, and on the machine tool. Work package 5 (WP5) is aiming for a new generation of Manufacturing Execution Systems (MES) to supervise the productivity and sustainability indicators to meet the triple bottom line corporate objectives - economic, environmental and social.

Optimization activities are based on real-time manufacturing data. This data must be further handled and analyzed in order to reveal indication for optimizations which is addressed by work package 6 (WP6). For the realization of the developed ideas in WP5 and WP6 a solution for data acquisition and handling on machine tools is required and will be further implemented in the Use Case 4 (UC4) at Georg Fischer Agie Charmilles (GFAC) – the FoFdation Energy Monitor (FoF-EMon).

EMon is an energy- and resource consumption acquisition tool, able to collect all relevant informations related the energetic machine tool behavior, e.g. power consumption of all subcomponents during various machine tool modes, and used resources, e.g. electricity, compressed air, cooling fluids or process gases, on the machine tool or production system. The data collection is based on the ISO 14955 standard and guarantees a foundation of all relevant data towards any macro- and micro optimization activities (WP5 and WP6).

This simulations-based approach reduces the implementation cost for continuous energy- and resource monitoring, in line with ISO 14955 and ISO 50001, and proofs the interoperability of this concept. The main benefit of machine tools equipped with EMon is the full energetic detailed picture of a machine tool that further enables the users to be able to calculate performance indication, apply adaptive control, perform cost assessments and support users in the service and maintenance. This is based on a low additional investment.

As machine tools are complex mechatronic systems and individual, the final architecture of EMon bases on a multichannel measurement. Based on this detailed data a customized EMon architecture can be revealed. In the case of GFAC the EDM machine tool cut 300 was chosen.

A detailed machine tool analysis (Figure 2) shows that most of the subsystems can be modelled by reading out of the PLC states or revealed by direct control data readout. The measurements show that the energetic behavior depends on parameters that can be taken from the machine tool PLC or can be directly assessed through the machine tool control.

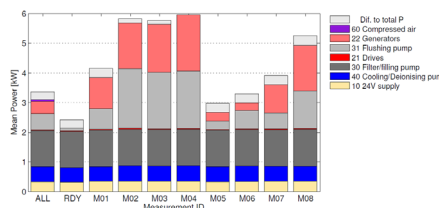
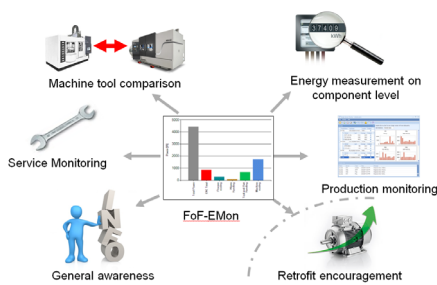


Figure 2 Machine tool measurement throughout different machine tool states

Based on the performed measurements the machine tool models will be implemented. Further the type and quantity of additional required sensors will be defined. In the next steps it is planned to set up interfaces between EMon and MES/ ERP solutions, as well as the GFAC-internal eTracking software.

The implementation and validation for this prototype solution is planned in the beginning of 2014 and will be done by ETHZ and GFAC. The future rollout to the market and industrial distribution of this solution is planned by the ETH startup SIGMAtools in cooperation with implementation partners.

Currently the Federal Institute of Technology (ETHZ) and GFAC are working on the implementation of FoF-EMon on the EDM machine tool for the Innolab. Innolab represents a demonstration hub for the research results and is also allocated at GFAC in Geneva. Contrary to the already shown and patented EMon solution by ETHZ at the Centro Recherche FIAT (CRF) the new EMon implementation at GFAC is even more based on simulations and proofs the concept on a different machine tool setting and process.

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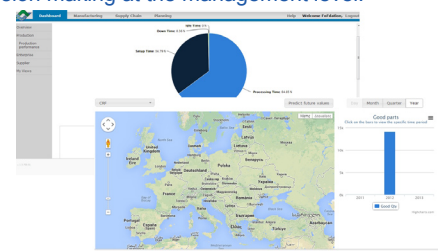
Welcome to the fourth quarterly newsletter of the FoFdation project!

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FoFdation News

Smart Enterprise Content Management (SECM) through a Dashboard information system

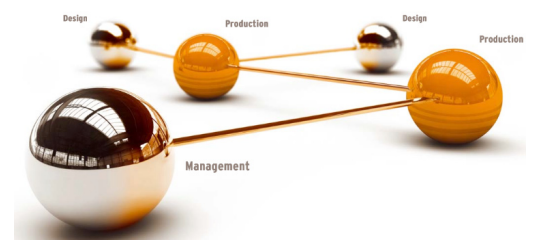
SECM is a new concept based on prototype software proposed in the project which addresses sustainability issues through the visualisation and processing of production data. A sustainability Dashboard allows the visualization of sustainability indicators, supporting decision making at the management level.



Dashboard sample screens

Information must flow - ARTIS at EMO 2013

ARTIS is continuously active in research associations working on the optimization of information flows in production processes and attended EMO 2013 to promote improvements in process monitoring.



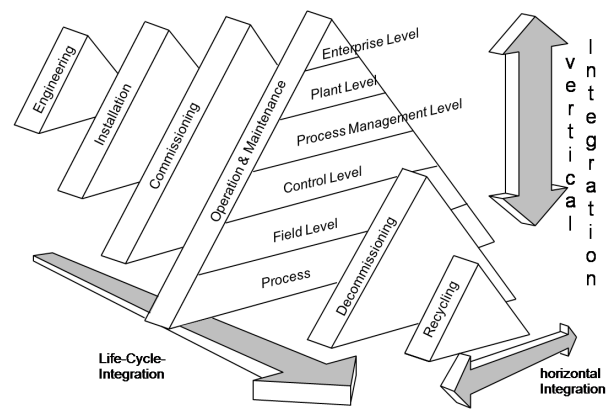
Optimizing information flow in production processes

Cyber-Physical Systems: Uplifting Europe's innovation capacity

The FoFdration project was one of the projects attending the Cyber-Physical Systems (CPS) in Manufacturing and Production Workshop, held in Brussels on 30th October, moderated by Prof. Martin Wollschaefer. CPS refers to ICT Systems embedded in interconnected physical objects providing applications and services. Digital data is at the heart of competitive manufacturing mainly of highly complex products.

- Interoperability of data/information (versus compatibility) and robustness (application scope is dynamic and will continuously change as business and technology requirements change over time)
- Integration platform for different temporal-decision scale data (realtime, near-time, anytime) and multiple data sources
- Integration of the real and the virtual data-information towards a predictive model for manufacturing

FoFdration is directly contributing towards increasing the competitiveness of European manufacturing by developing an end-to-end and interoperable digital manufacturing model to enable CPS, that can be adapted from and adapted to anywhere, to lead to a predictive factory. Decision making at the field level (real-time), the factory plant level (near-time), and the corporate management level are much more informed and can be made much more easily. The Management Information Pipeline (MIP), currently being developed



TU Dresden, Industrial Communications

within the project will combine these four innovative elements:

- Smart Manufacturing Controller (SMC)
- Smart Manufacturing Optimizer (SMO)
- Smart Enterprise Content Management (SECM)
- Smart Manufacturing Execution System (SMES)

interlinking to ensure a complete dashboard of accurate and up-to-date information.

FoFdration Partner Profiles



ARTIS is global leader in the areas of tool, process and machine condition monitoring and Adaptive Control. They been developing, manufacturing and distributing various hardware and software components for these areas for 25 years. ARTIS monitoring systems are designed to analyse, secure and optimize production processes with the aim of increasing productivity, ensuring quality and reducing costs. Their engineers and application technicians have many years of interdisciplinary experience in all the important areas of processes in metal machining as well as NC, PLC, drives, bus systems, tools, clamping devices, machine structures, machine components, workpiece materials, additives, emulsions and cooling lubricants.

For the FoFdration project, ARTIS is involved in work package four: SMO, which stands for Smart Manufacturing Optimizer. In this work package, ARTIS brings in its full knowledge of manufacturing optimization, which is based on 15,000 installed monitoring devices CTM in manufacturing machines worldwide.



IK4-Tekniker is a non profit research organization located in the North of Spain founded in 1981 with nearly 250 employees. It has traditionally

been a recognized centre in the field of Manufacturing Technologies applied in several sectors. However, IK4-Tekniker's expertise covers a wide range of technologies that provide its services to many different sectors (automotive sector, machine-tool and accessories, aeronautics and other space applications, petrochemicals, energy, assistive technologies, etc.) and to develop a great variety of products.

Within the FoFdration project, IK4-Tekniker is involved in the optimization of the sustainable manufacturing. For that purpose, an existing Manufacturing Execution System (IT system that manages manufacturing operations in factories) is extended to incorporate sustainability monitoring, control and analysis features. Sustainability approach in FoFdration has been focused on the three axes of the Triple Bottom Line, i.e. economic, environmental and social, with a special emphasis on energy efficiency.

Common report on standard KPIs for sustainable manufacturing

FoFdration has collaborated with two FP7 projects to create a common report on standardisation of KPIs for sustainable manufacturing. The idea was first proposed by KAP and PLANTCockpit in the imagineFoF workshop in May 2013. A first approach on content for the report was agreed in a 2nd workshop in September 2013 in the context of the 11th Global Conference on Sustainable Manufacturing, where FoFdration decided to join the effort. After some weeks of work, the document was completed and released in December 2013.

This document is not intended to be a final statement on KPIs for sustainable manufacturing, but is instead intended to be used by European and international standards bodies to inform their work in the area of sustainable manufacturing. The report includes a plan for standardisation of KPIs for sustainable manufacturing. For that, related standardisation activities have been identified in order to interact and collaborate with them. The final purpose is the implementation of a standardisation proposal which will be completed beyond the projects timeline.

Coming soon...

- General Assembly at ECN - 12th-13th February
- Participation in the next Industrial Technologies 2014 & GA in Athens

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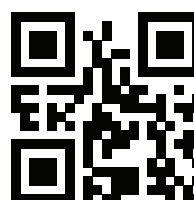
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