Transforming Traditional Production Systems into Smart Production Systems

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Abstract

This minitrack will address scientific and technical research on how traditional production systems are transformed into next generation smart production systems.

It comprises a mix of presentations from leading industries (automotive and aircraft) as well as from well-known research institutions (Fraunhofer society, Germany) and universities (Brandenburg University of Technology Cottbus-Senftenberg, University of Bergamo, Aalborg University).

The minitrack will foster discussions concerning the strategies companies are adopting for managing such transformation, the need for new competences for sustaining it, the implementation of new digital technologies and their impact on the existing production systems.

1. Introduction

The exponential growth in digital technologies provides manufacturing companies with an increasing number of new possibilities for the development of new products, processes and services – many of these with the potential of being disruptive.

The expected benefits related to the implementation of these new digital technologies range from the improvement of operational efficiency to the enabling of new value creation possibilities, catalyzed by new product capabilities as well as by entirely new business models.

However, to operationalize the transformation of a production system into an integrated, digital and smart production system remains a challenging task. There are number of reasons for this. To mention a few:

- the systems are complex and the technological development moves very fast. This means that companies must learn new technologies and develop new products, processes and services with ever-increasing frequency.
- the nature of many of the solutions involves multi-disciplinary activities involving experts, which may not be present in the companies (in particular true in SMEs).
- it is difficult for many companies in advance to quantify the benefits of the new technology. This puts a natural stop to any investments into the area.

2. Minitrack Topics and Themes

This minitrack will bring together researchers from different disciplines who are conducting research on how production systems are transformed into integrated, digital and smart production systems.

The minitrack will have a mix of presentations from leading industries (Automotive and Aircraft Engine Manufacturer), Fraunhofer Institute for Factory Operations and Automation as well as from well-known universities (Brandenburg University of Technology Cottbus-Senftenberg, University of Bergamo, Aalborg University)

It will contain contributions, which will address aspects as:

- How can companies benefit from novel digital technologies?
- How can companies integrate the novel digital technologies into existing production environments?
- How does digital transformation impact and change businesses and organizations?
- How is digital transformation process managed over time
- how do staff members have to be qualified further?

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3. Papers presented at the mini-track

As co-chairs of this HICSS Mini-Track, we are pleased with the quality of the papers submitted to the minitrack. We have accepted five papers that highlight various important aspects of this emerging area:

Paper 1: Digital Transformation Strategies for Achieving Operational Excellence: a Cross-Country Evaluation

The industrial digital transformation, considered as the new competitive lever for manufacturing companies, has been progressively embraced by most manufacturers and supported, through national industrial policies, by most of the European governments. However, companies located in different countries adopted diverse strategies in order to be able to successfully manage their digital transformation. The paper investigates, through a cross-country evaluation (Italy and Denmark), what are the exogenous factors characterizing diverse national contexts (e.g. industrial policies) and what are the endogenous factors characterizing the internal digital transformation strategies of four large manufacturing companies, observing eventual patterns and dependencies.

Paper 2: Transformation towards Human Workforce 4.0 through the Qualification Model LTA-FIT

Smart production systems are depending on the qualification of the humans involved. Methods and technologies in order to support learning, training and (workplace) assistance, the LTA processes, plays a paramount role in the factory of the future. This presentation describes how to attract staff awareness at the shop floor level and how to realize tailor-made qualification concepts regarding content and communication channels. Here, state-of-the-art visualization technologies are an essential element. The paper concludes with experimental validation of this so called LTA-model in real environments and a discussion about further steps.

Paper 3: Train-the-Trainer Concept for the "Industrie 4.0-CheckUp"

There are various capability maturity models available supporting the transformation of Industry 4.0 or Industrial Internet of Things in SME companies. A major prerequisite is the systematic analysis and evaluation process of the automation and digitalization levels paired with a methodology for self-reflecting the human factors. This paper describes the unique approach of the Fraunhofer Institute for Factory Operation and Automation (IFF) in Germany, which incorporates the Industrie 4.0-CheckUp. Based on significant results from performed Check-Up´s a novel Train-the-Trainer concept was developed and launched, which enables a seamless follow up transformation strategy in a process-oriented rather than a function-oriented representation by SME´s own staff members.

Paper 4: Creation of an Experimental Engineering Toolbox for the Digital Transformation of Manual Jet Engine Assembly

Modern aircraft engines are complex systems that require high knowledge and expertise of design and manufacturing. This is even more important, as the production of aircraft engines are dominated by manual operations. In order to introduce smart production systems, this presentation focus on design and implementation of human-machine-collaboration in aircraft manufacturing. Technological examples are human-robot collaboration in assembly and quality assurance tasks. Results obtained will be presented and discussed.

Paper 5: Advances in Automated Generation of Convolutional Neural Networks from Synthetic Data in Industrial Environments

Smart factories play a major role in future automotive manufacturing. High variants and product versatility collide with high capital and operational costs of automation and robotics solutions. This paper presents the development and realization of visually guided robotic systems based on convolutional neural networks (CNN). The training time and effort of the CNN is significantly upgraded by the use of synthetic CAD data, which will lead to a smart reconfiguration process coping with the aforementioned challenges. Experimental results are presented and discussed.

4. Conclusion

We believe this mini-track has a great potential to foster a holistic discussion on how to enable a successful transformation of manufacturing systems into next generation smart factories.