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Editorial

Introduction to the special issue “Concurrent Engineering”

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1. Introduction

Developed in the late 80ies, the Concurrent Engineering (CE) approach is based on the idea that different phases of a product life cycle should be conducted concurrently and initiated as early as possible within the product creation process (PCP). The primary goal of CE is to increase the efficiency of the PCP and to reduce errors and, subsequently, unnecessary changes in the late phases of the PCP. While starting with a design-manufacturing alignment, gradually the CE way of thinking has been extended to incorporate more lifecycle functions together with a stronger focus on and involvement of both customers and suppliers. In the past two decades CE has become the substantive basic methodology in many industries (automotive, aerospace, machinery, shipbuilding, consumer goods, process industry, environmental engineering, service industry) and has been also adopted in the development of new services [1]. CE was also included in the engineering education.

In the meantime the initial, basic CE concepts have grown up and have become the foundations of many new ideas, initiatives, approaches and tools. Generally, the present CE concentrates on enterprise collaboration and its many different elements, from integrating people and processes to very specific complete multi/inter/trans-disciplinary solutions. Current research on CE is driven again by many factors like increased customer demands, globalization, (international) collaboration and environmental strategies. The successful application of CE in the past opens also the perspective for applications like overcoming of natural catastrophes and sustainable mobility concepts with electrical vehicles. CE was also a powerful driver for development on new IT concepts and tools.

With the increasing size and complexity of development projects at large companies and organizations in the aviation industry, CE and integrated aircraft design has become of crucial importance in the design process of new products. In order to remain a competitive position and achieve a customer driven approach, aspects of the product’s life cycle should be adopted at an early stage in the design process. These aspects include, among others: the overall cost performance, the ability of new system integration, challenges

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related to process parallelization and multidisciplinary design, involving the exchange of knowledge and information throughout the design process, exploitation and maintenance [2].

With this issue, we address various areas of Concurrent Engineering research [3]: integral product-service development and its transformation to high-reliability service, approach for Federative Interoperability Framework in an aerospace enterprise, management of risk in the introduction of new technology in products, recent advances in ECAD-MCAD integration, and modularization potential for the early phase of product development.

This special edition primarily includes invited papers selected from contributions to the 21th ISPE Inc. International Conference on Concurrent Engineering held in Beijing, China, on 8–11 September 2014 [4].

Marcus Zeuschner and John P.T. Mo address the concept of Product Service System representing a novel way to transform it to the high reliability support service system. This paper proposes a new methodology to support ideation and preliminary design of the Product Service System (PSS), a new business concept that aims to integrate all phases of the life cycle of complex engineering products from acquisition through sustainment to disposal. However, the PSS design has imposed significant risks to the manufacturer not only in the manufacture of the product itself, but also in the provision of support services over long periods of time at a pre-determined price. It is imperative that servitization transformations are linked to people's expectations and the acknowledgement that no two service experiences or pathways to service are the same. Research of High Reliability Organizations (HROs) has shown that HROs have the required characteristics that can be applied to PSS design to overcome these issues. This paper explores correlations between HRO causal factors and PSS requisite capabilities along with a service business model to define a new high reliability service dominant product service system.

Nicolas Figay et al. present an approach for Federative Interoperability Framework in an aerospace enterprise. In order to confront the growing complexity of products and organizations, Aeronautic, Space and Defence (ASD) manufacturing enterprises are using more and more System Engineering, Product Lifecycle Management and Computer Aided Solutions for various engineering and management activities. Combined with a more and more important outsourcing, such trends led to the emergence of what is called Dynamic Manufacturing Networks (DMN). These DMNs are facing important difficulties for the establishment of PLM interoperability based on legacy PLM standards for Manufactured Product and Process data exchange, sharing and long term archiving. To address such issues, Airbus Group Innovations (AGI) has been developing a Federative Interoperability Framework (FIF) through iterations between research, operational and standardization projects. FIF defines interoperability principles, brakes and enablers. Based on an analysis of DMN interoperability brakes and enablers, this paper proposes a new way based on FIF interoperability principles for dealing with pragmatic interoperability of PLM processes within the ASD digital business ecosystem. We propose a DMN interoperability conceptual framework, coupled with an experimental collaborative open platform (cPlatform), to achieve pragmatic PLM process interoperability. For this, we rely on DMN blueprint of PLM Business Processes developed within the frame of the IMAGINE project. The proposed approach is then assessed according to scientific, business and standardization viewpoints.

Stolt et al. reconsider the management of risk in the introduction of new technology in products. In this paper interviews with staff involved in product development from four different companies are presented. The objective is to find out how the companies manage the technical risk of introducing new technology in products and how they prepare for meeting changing requirements from customers. The companies originate from aerospace, automotive and production engineering. Based on the results of the first study, a case study was carried out at an aerospace company. The study shows that the introduction of new technology varies with the risk of failure in the validation of products. Companies that easily can revert back to the former technology are more risk taking. The types of products and the companies' place in the supply chain have an impact on technology introduction and requirements handling. The companies have strategies for developing requirement specifications prior to the start of the project. This is most elaborate at the aerospace company where a thorough concept evaluation clarifies possible variations in requirements.

Emmer et al. present the advances in ECAD-MCAD integration and interoperability achieved in a collaborative project. Adopting mechatronics as the contemporary most emerging engineering discipline, the integration of mechanical and electrical CAD (MCAD/ECAD) systems remains a big challenge in concurrent engineering because their data models and functionality have been continuously developed in different directions. Market research confirms that an integrated tool chain for ECAD and MCAD design is prerequisite for a better mechatronic development process. This paper presents an overview of various integration approaches with different degrees of maturity and describes the concept of deep integration for mechatronic products conducted by ProSTEP iViP Association which combines existing standards in engineering collaboration context. Version 3 of the current ProSTEP iViP Recommendation PSI 5 entitled "ECAD/MCAD-Collaboration" provides a comprehensive specification for collaboration between the ECAD and MCAD worlds. A considerable number of vendors have now implemented the underlying data schema and integrated it in the corresponding products. As a result, users can now choose the solutions that best meet their particular needs from an increasingly wide range of efficient systems for collaborative product development within the ECAD and MCAD fields.

Raudberget et al. investigate the modularization potential for the early phase of product development. The establishment of a platform architecture is a critical task, but there is no methodological support for this in the first phases of development. There are several approaches for evaluating designs and architectures when an initial design is present, however, not for the phases foregoing the embodiment of ideas into concepts. This paper fills this void by introducing a new design methodology for modelling, assessing and narrowing down the architectural design space. It allows exploration of more alternatives in the earliest phases of development, which ultimately may produce better designs. The result is a design space of a manageable and desirable size for subsequent embodiment and detailed design with traditional engineering tools. The advantage is that feasibility of the candidate platforms have been established to a high degree of certainty. The approach is illustrated with a case of redesign showing how a manufacturer of parts for a jet engine can use the methodology to model and assess platform concepts in the earliest phase of development.

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References

[1] N. Wognum and J. Trienekens, 'The System of Concurrent Engineering', in: Stjepandić J. et al. (eds.): *Concurrent Engineering in the 21st Century: Foundations, Developments and Challenges*, pp. 21–50, Springer International Publishing Cham, 2015.

[2] R. Curran, X. Xiao and W.J.C. Verhagen, 'Concurrent Engineering and Integrated Aircraft Design', in: Stjepandić J. et al. (eds.): *Concurrent Engineering in the 21st Century: Foundations, Developments and Challenges*, pp. 571–606, Springer International Publishing Cham, 2015.

[3] J. Stjepandić, N. Wognum and W.J.C. Verhagen, *Concurrent Engineering in the 21st Century: Foundations, Developments and Challenges*, Springer International Publishing Switzerland, 2015.

[4] J. Cha, S.Y. Chou, R. Curran, J. Stjepandić and W. Xu, *Moving Integated Product Development to Service Clods in Global Economy*, IOS Press, Amsterdam, 2014.