

Title: Training in Model Based Systems Engineering

Presenters

Prof. Dr. Hervé Panetto, University of Lorraine, CRAN CNRS UMR 7039, France.

Mr. Fabien Bouffaron, MsC, PhD candidate, University of Lorraine, CRAN CNRS UMR 7039, France.

With the support of:

Prof. Dr. Gérard Morel, University of Lorraine, CRAN CNRS UMR 7039, France.

Dr. Frédérique Mayer, University of Lorraine, ERPI

Presenters Biography

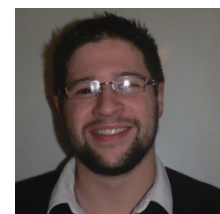
Dr. **Hervé PANETTO** is Professor of Enterprise Information Systems at University of Lorraine. He teaches Information Systems modelling and development, and conducts research at CRAN (Research Centre for Automatic Control), Joint Research Unit with CNRS. He received his PhD in production engineering in 1991. He has strong experience in information systems modelling, systems engineering, semantics modelling and discovery, and database development. He is expert at AFNOR, CEN TC310 and ISO TC184/SC4 and SC5. He is author or co-author of more than 100 papers in the field of Automation Engineering, Enterprise Modelling and Enterprise systems integration and interoperability. He is currently Chair of the IFAC Technical Committee 5.3 "Enterprise Integration and Networking". He is member of the Editorial Board of the Journal of Applied Mathematics, Hindawi, the International Journal on Universal Computer Science, the scientific journal Facta Universitatis, series Mechanical Engineering, and an Associate Editor of the international Journal of Intelligent Manufacturing (JIM), Springer.

E-mail: herve.panetto@univ-lorraine.fr - Homepage: www.panetto.fr



Mr. **Fabien BOUFFARON** is a Phd Student at the University of Lorraine, CRAN (Research Centre for Automatic Control) joint Research Unit with CNRS and a lecturer at Lorraine University. He completes his thesis under the direction of Pr. Gérard MOREL on model based systems engineering and control of critical systems. He works in collaboration with two specialist engineers (Automation domain and Physiological domain) to specify a control system around a co-simulation bus. Its work about the system co-specification contributes to the cluster CONNEXION (NUclear Digital Control Systems for International Market and Revamping). He holds a master in complex systems engineering and is member of AFIS (French chapter of INCOSE).

E-mail: fabien.bouffaron@univ-lorraine.fr



Abstract

Model Based Systems Engineering is generating a considerable amount of interest - occasionally verging on controversy – within both the discipline of Systems Engineering and the traditional engineering disciplines when addressing the increasing complexity of large-scale systems as well as the collaborative development of parts of them for a broad range of applications.

Professional bodies are promoting standards such as the *IEC/ISO/IEEE 15288* on «*Systems and software engineering - System life cycle* » and guides such as the living authoritative to the « *Systems Engineering Body of Knowledge* » in order to support the systems engineering and management framework in a documentation-based way.

The tutorial will address some of the basic features of this generic systems engineering paradigm related to the iterative, recursive and concurrent application of a process-driven approach aligned with the system breakdown structure.

Scope

The tutorial will address some of the required systemic basic concepts and precepts in order to provide key principles and patterns to bridge the gap between fundamentals of systems sciences and engineering best practices.

Intended Audience

Practicing engineers, researchers, graduate students, and academics who have some knowledge in modelling, mainly complex systems with an interest on Systems Engineering domain and System-based thinking when approaching the specification of complex tangible and intangible systems.

Motivation

Systems engineering guidelines are not enough to explore the holistic dimension of the required problem-solving systems approach. What is a system remains a questionable notion according to the role of the modeller in the loop of engineering man-made socio-technical systems. What are the interactions that the system under requirements specification has to measure from and to control on its environment as well as from and on its structure throughout its life-cycle? How to perceive, to understand and to represent with models and process-driven guidelines the multi scale aspects of systems?

Objectives

After the tutorial the audience will have a good overview of Model Based System Engineering means with a modeller point of view and practitioner requirements. **Modelling** means to represent systems with models? What is the nature of the modelling activity? Is it only a formal process to define a symbolic representation of a reality? Is it simply a graphical process to draw another symbolic representation with a de-facto standardized Systems Modelling Language supported by software-based tools? Is it a less formal but more complex and informal process to design the essence of interactions in reality to model? It has been demonstrated within the « problem frames » approach in software engineering (Jackson, 1997) that requirements are located in the reality. That means that it

is the effects that the implemented system can manifest into reality which validates its model. In another way, this external manifestation is also closely related to the system structure. We suggest, on the basis of these important works, that the basic nature of the overall collaborative process of engineering and architecting a system as a whole in reality is basically related to the dynamic construction of the overall domain knowledge between all the engineering disciplines involved in a system-project.

Furthermore, the audience will have the insight of what challenges there are today by **Enabling Model-Based Systems Engineering** within a platform-based engineering as models become the pivotal artefacts of the overall engineering process and replace as main deliverables the conventional approaches based on generating documentation. Knowledge interdependencies is making the proliferation of isolated tools no longer adequate for efficiently addressing the RFLP-IVVQ approaches. Does the model exist only in a description, or is it an executable model that permits simulation?

Outline

Session 1. Fundamentals in Systems Engineering (2 hours)

- Concepts of systems, models
- Basics of Systems engineering and System thinking paradigms
- Requirements for Model Based Systems Engineering

Session 2. Whole-System modeling paradigm (1 hour)

- Critical sub-system to control case study
- Co-specification, Co-simulation environment
- Whole-system model definition
- Whole-system models analysis