SOUTENANCE DE THESE

THESIS DEFENSE

Freddy KAMDEM SIMO

Unité de Recherche **: Laboratoire Heudiasyc, Labex MS2T**

soutiendra sa thèse de **Doctorat** sur le sujet **:**

Model-based federation of systems of modelling

A l'Université de Technologie de Compiègne

Le mardi 26 septembre 2017 à 14h00

Amphi du Centre d'Innovation

Devant le jury composé de :

- M. Eric Bonjour, professeur des universités, université de Lorraine, ERPI, Nancy
- M^me^ Isabelle Borne, professeur des universités, université de Bretagne Sud, IRISA, Vannes
- M. Dominique Ernadote, MBSE, Airbus Defence & Space, Élancourt
- M. Dominique Lenne, professeur des universités, université de technologie de Compiègne, laboratoire Heudiasyc
- M. Dominique Luzeaux, ingénieur général de l'armement, DGA, Bagneux
- M. Mohamed Sallak, maître de conférences, université de technologie de Compiègne, laboratoire Heudiasyc

Abstract :

The engineering of complex systems and systems of systems often leads to complex modelling activities (MA). Some challenges exhibited by MA are: understanding the context where they are carried out and their impacts on the lifecycles of models they produce, and ultimately providing a support for mastering them. Few (if any) approaches have formally addressed these challenges at the level of modelling activities architecture. Nonetheless, to a large extent, this problem may fall in the framework of the co-engineering of product (system to make) and the project (system for make) systems.

Convention ANR-11-IDEX-0004-02

www.labexms2t.fr

In this thesis, we propose a methodology named MODEF that aims to master the operation of MA by addressing these challenges. MODEF is compared and positioned against works that address the coupling of the product and the project systems engineering. MODEF consists in: *primo*, characterizing MA as a system (and more globally as a federation of systems) in its own right. *Secundo*, iteratively architecting this system through: the modelling of the conceptual content and the lifecycles of the models produced by MA, the tasks carried out within MA and their effects on these life cycles. *Tertio*, specifying the expectations over these life cycles and *quarto* analysing models (of MA) against expectations (and possibly tasks constraints such as cost) to check how far expectations are achievable via the synthesis of the acceptable behaviours.

On a practical perspective, the exploitation of the results of the analysis allows figuring out what could happen with the modelling tasks and their impacts on the whole state of models they handle. We show on two case studies how this exploitation provides insightful data on how the system is end-to-end operated and how it can behave. Based on this information, it is possible to take some preventive or corrective actions on how the MA are carried out.

On the foundational perspective, the formal semantics of three kinds of involved models and the expectations formalism are first discussed. Then the analysis and exploitation algorithms grounded on the state-of-the-art search and graph algorithms are discussed and roughly compared with model checking and systems synthesis approaches.

Last but not least, two enablers whose first objectives are to ease the implementation of MODEF are presented. The first one is a modular implementation of MODEF's buildings blocks. The second one is a federated architecture (FA) of models which aims to ease working with formal models in practice. Despite the fact that FA is formalised within the framework of category theory, an attempt to bridge the gap between theory and practice (in model engineering) is sketched via some basic data structures and base algorithms.