CPS Simulation models categories in Extended Enterprises (Short paper)

Renan Leroux\textsuperscript{1,2}, Marc Pantel\textsuperscript{1},
Ileana Ober\textsuperscript{1}, Jean-Michel Bruel\textsuperscript{1}

\textsuperscript{1} IRIT / University of Toulouse

\textsuperscript{2} French Institute of Technology (IRT) Saint Exupéry, seconded from Altran
8 IRTs were launched since 2012 in the frame of the French ‘Investissement d’Avenir’ (PIA), to supplement to other instruments (Competitivity Clusters, SATT for IP valorization, IDEX for higher education and fundamental research, etc.)

The aim of those thematic multi-disciplinary institutes is to reinforce competitiveness of French industry on the global market through world class technology research projects, teams and platforms.

Based on a 50-50 private-public partnership between French government and Public Research and Higher Educations establishments on the one hand, and key industrial partners on the other hand.

In 2015, the 8 IRTs came together to create the Association of Technological Research Institutes (FIT)
MOISE Project: Economics Challenge

- **Productivity**
  - Cost containment
  - Control of process deadline in Extended Enterprise (Customers, Suppliers, Subcontractors…)
  - Change anticipation

- **Competitiveness**
  - Innovative products, quality of products and services,
  - Reduction of time to market,
  - Reduction of the customer training cost
In the MBSE and Extended Enterprise (collaborative work, IP protection) context:
How to handle the variety of engineering domains and heterogeneous data?

Modeling and Early Validation and Verification are key assets
MOISE AIDA Use Case

AIDA : Airplane Inspection Drone Assistant

Support the pilot in the mandatory pre-flight aircraft inspection

Allow to scrutinize all areas (top of the wings, ...)

Detect irregularities (forgotten caps on sensors, ...)

Can follow automatically flight plan

Can be manually controlled

Radar

GPS Locator

Vision system

Inertial central

Data is saved locally, and transferred in real-time to the ground
MOISE methodology and MBSE for CPS co-simulation activities
How do we handle the development of simulation models?
Co-Simulation activities

FMI standard allows to preserve the know-how of the stakeholders in an Extended Enterprise

How do we ensure the consistency of simulation models?
• Environment Models are descriptive \textit{Science (Lee)} models used to assess the product models.

• \textbf{Key point:} should be deterministic and the level of details should be consistent in order to ensure an efficient and meaningful simulation.

• Product Models are prescriptive \textit{Engineering (Lee)} models and must be deterministic.
Model categories

- **Internal Model**
  - Designed by Stakeholder System Architects
  - Prescriptive Engineering
  - Exact by Design

- **Frontier Model**
  - Designed by Stakeholder Simulation Architects
  - Partly Prescriptive
  - Partly Descriptive
  - Engineering
  - Must be assessed w.r.t. other Stakeholders models

- **Environment Model**
  - Designed by external Simulation Architects
  - Descriptive Science
  - Required fidelity & representativeness

**Simulation**

- **Simulation Model Developer**
  - Simulation Model

**Product**

**Simulation Architect**

**System Architect**

**GEMOC 2018, 15/10/2018**

© IRT AESE “Saint Exupéry” - All rights reserved Confidential and proprietary document
Conclusions - Expectations
Conclusions - Expectations

- Need for intermediate simulation models when developing a system using agile Concurrent Engineering in an Extended Enterprise
- These models are used only to conduct early model based V&V activities
- Models are neither fully prescriptive nor fully descriptive with respect to the product => additional verification activities
- Can explore more easily a large spectrum of situations & environment behaviour
- This work will be extended to the full AIDA model and other use cases
- Create an ontology of models categories for developing Cyber-Physical Systems and associated V&V activities
The authors would like to thank the MOISE project members for its support as well as the French Commissariat Général à l'Investissements (CGI) and the Agence Nationale de la Recherche (ANR) for their financial support in the frame of the Programme d'Investissement d'Avenir (PIA).
Any question?