

In partnership with



*AFNeT Standards Days*

Systems Engineering in a Prime Management Office : Integration of  
Multi-Systems Analysis by Eric Thomas (Dassault Aviation)

<http://standardsdays.afnet.fr> - AFNeT Standards Days 2020 : 6 & 7 October 2020

# TOPICS

**Context**

Challenges

Enablers

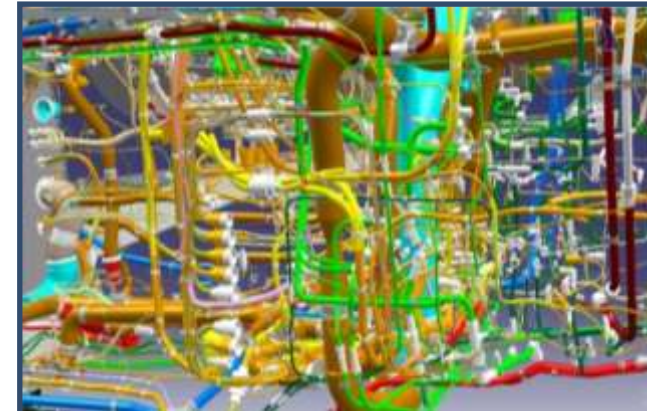
Status

Conclusions and Outlooks

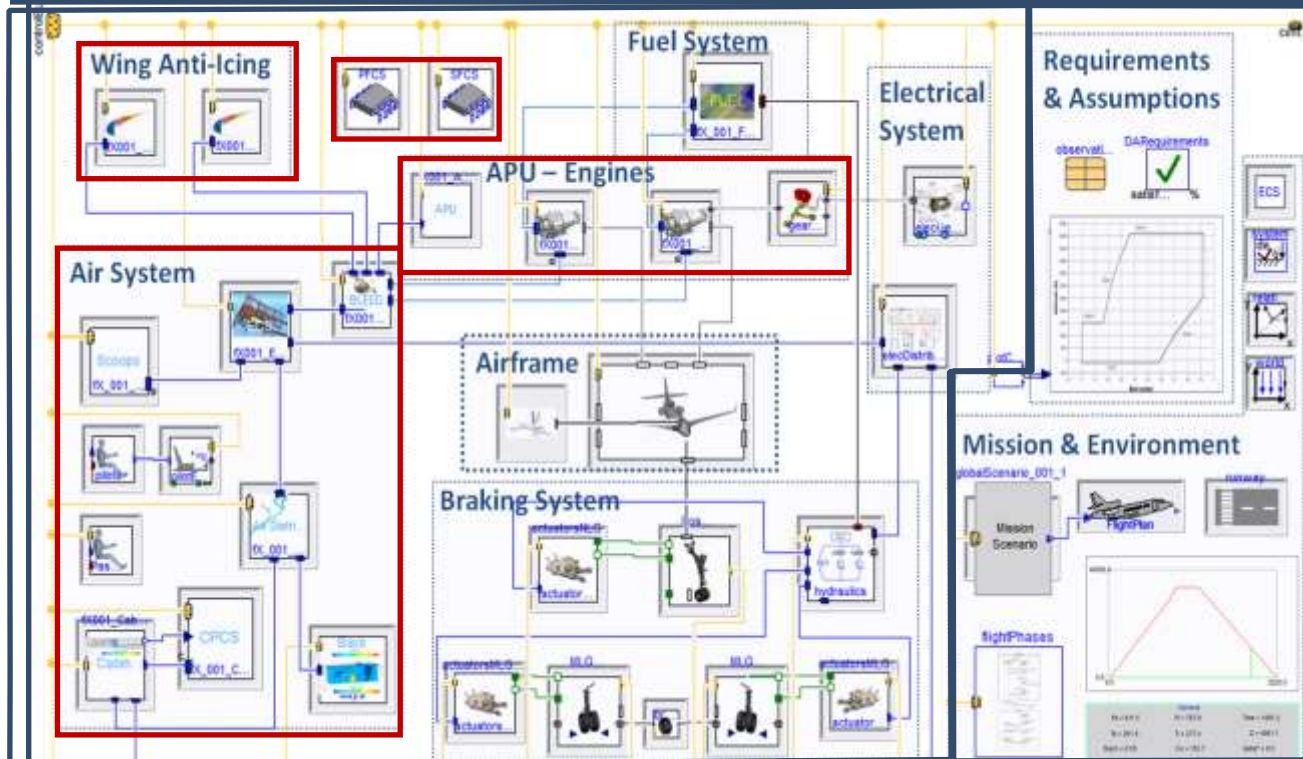
# CONTEXT : ANALYSIS OF AIRCRAFT VEHICLE SYSTEMS

Vehicle Systems of an Aircraft:

- Engines, Air, Fuel, Braking, Electrical... systems
- **Network of more than 1000 parts** (power and information)
- **Collaborative work** with partners (PLM...)
- **Analyzed in contexts** (Mission, environments...)

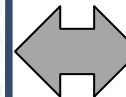
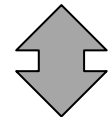
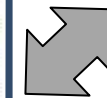


PLM/ DMU (Reference) / Digital Twin



Main systems of a «conventional» architecture

Architecture Layout in context



Target : Real Product in operation

# TOPICS

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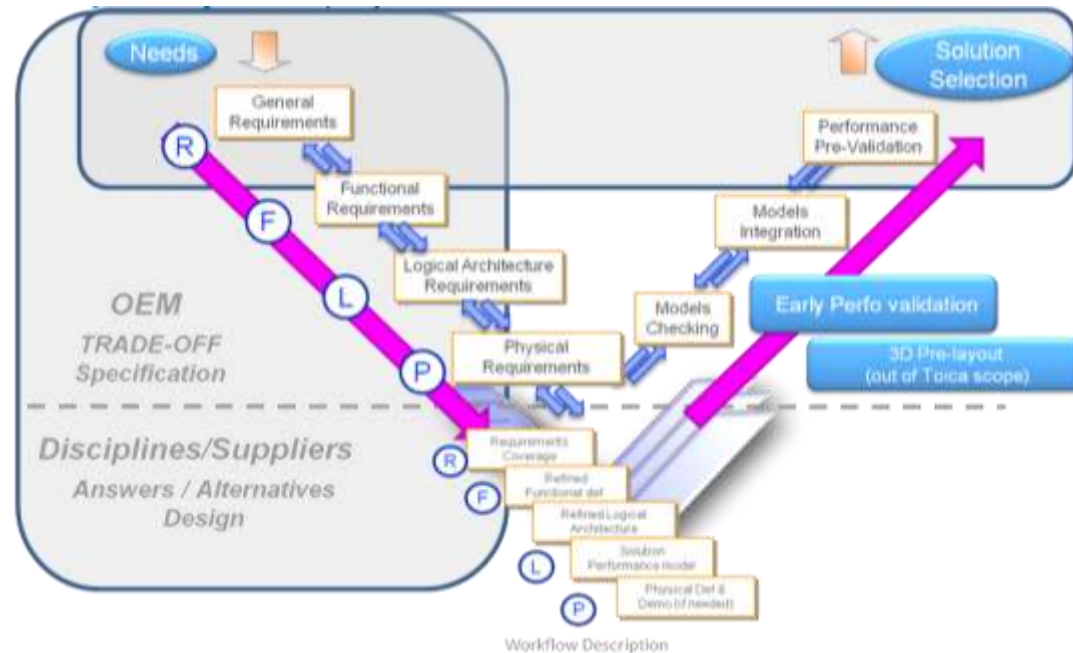
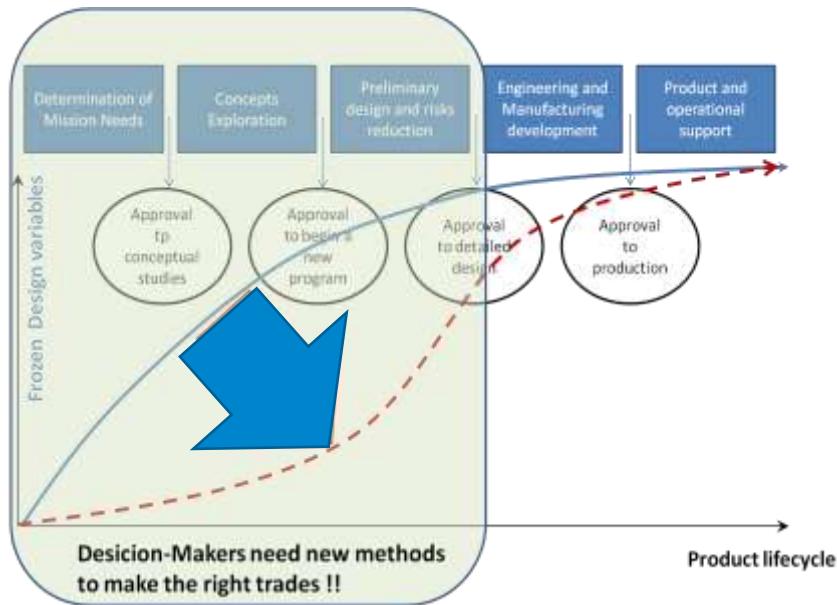
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Conclusions and Outlooks

# TECHNICAL CHALLENGES

- Develop enhanced capabilities for **System Analysis, collaborative design and trade-off**
  - on parts of **Systems** up to alternates **Architectures of Systems**
  - applicable **from early design stages to detailed design, and during operation**
  - Including interactive tools to **support decision making**

Challenges





# PLM OBJECTIVES

Challenges

Objectives	Figures
<p>Platform with consistent description of Systems for Collaborative Design with all Stakeholders</p>	
<p>... with capabilities for Collaborative Reviews and Decisions Making</p>	

# TOPICS

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Context

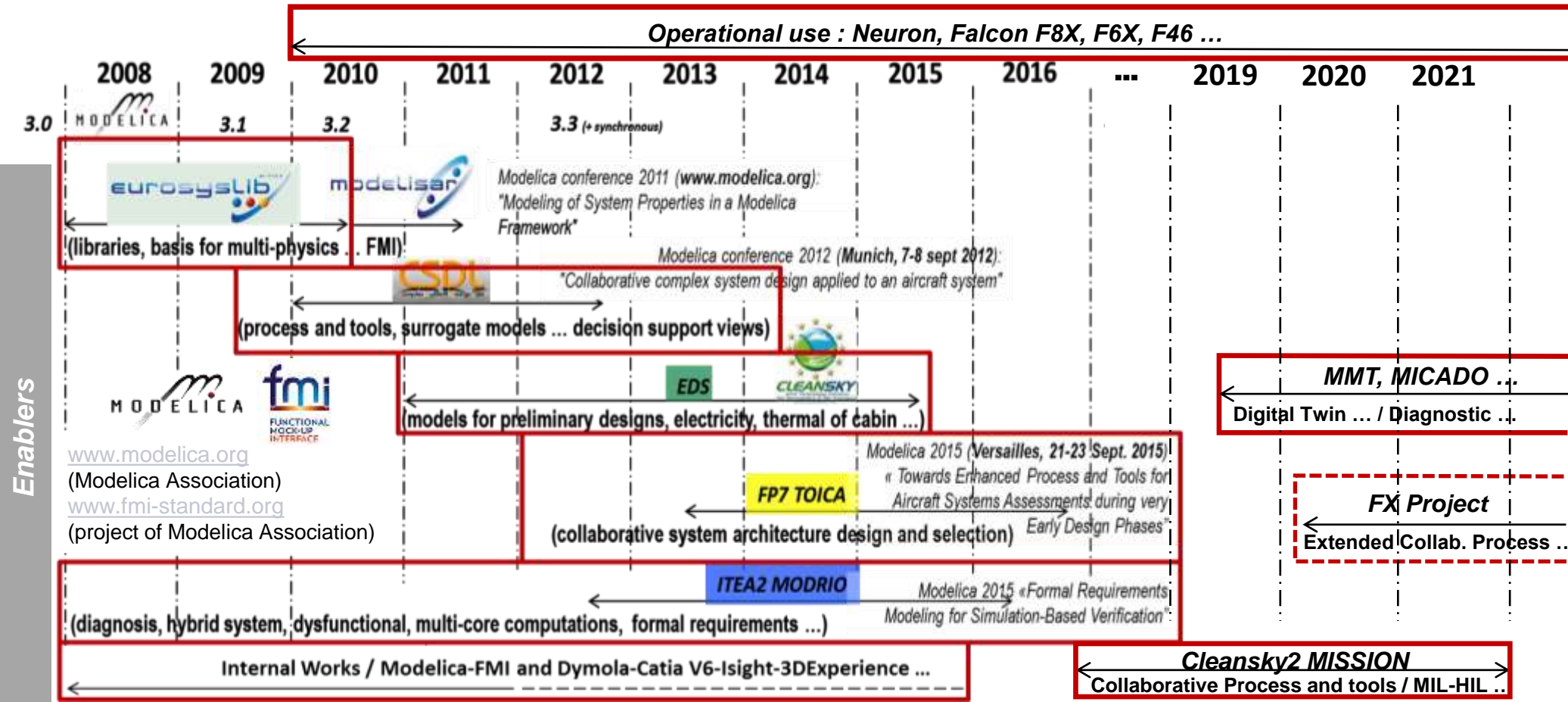
Challenges

**Enablers**

Status

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# STANDARDS FOR SYSTEM SIMULATIONS ... PROCESS AND TOOLS

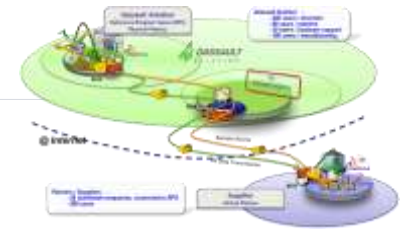


- ITEA2 Eurosyslib :** "European Leadership in System Modeling and Simulation through advanced Modelica Libraries"
- Systematic CSDL :** "Complex System Design Lab "
- ITEA2 MODRIO :** "Model Driven Physical Systems Operation"
- FP7 TOICA :** "Thermal Overall Integrated Concept of Aircraft"
- CS2 MISSION :** "Eco-Design for Systems" / "Modeling and Simulation Tools for Systems Integration on Aircraft"
- FX project :** "Extended Laboratory with Collaborative Process"

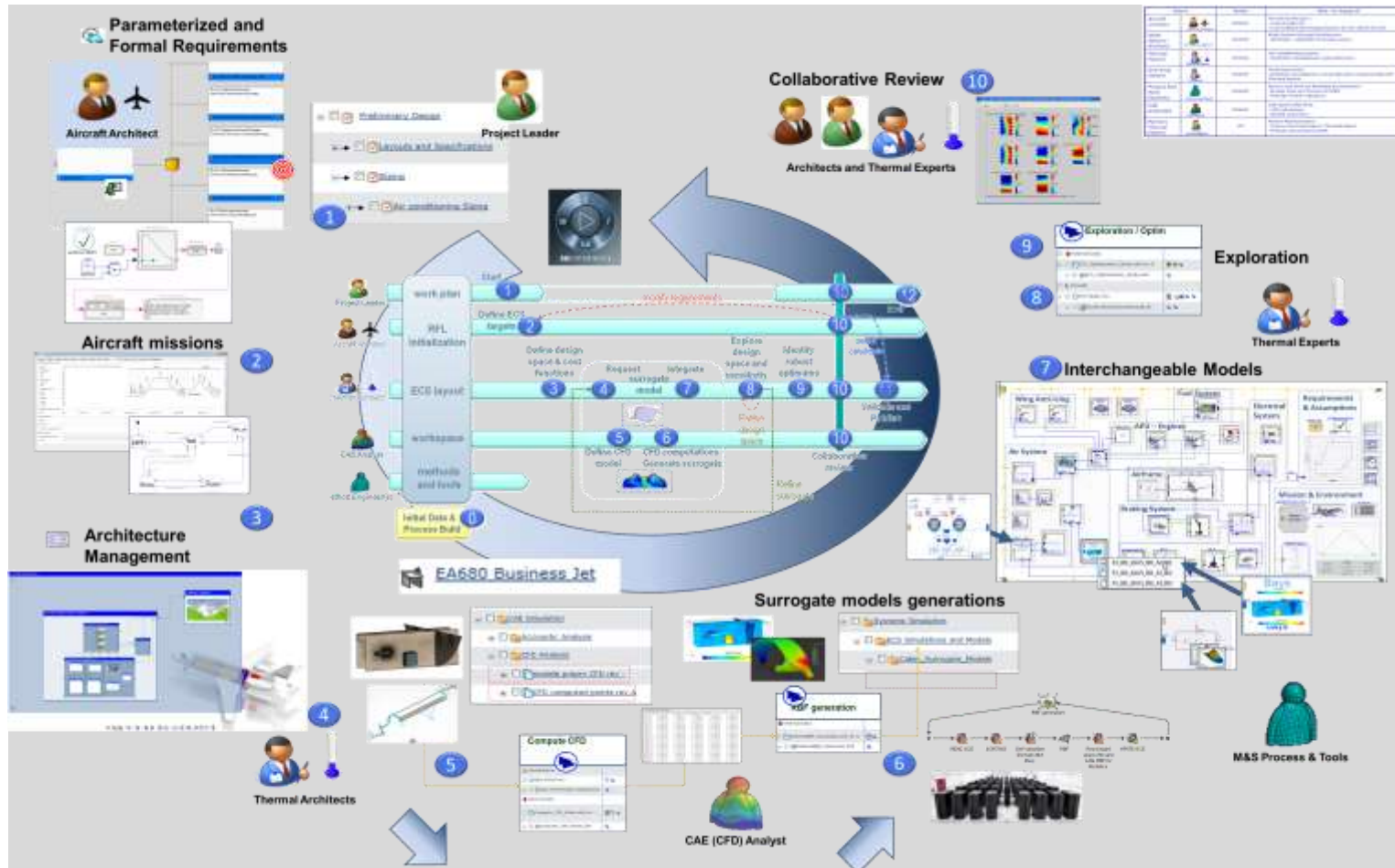
- Enablers to simulate complex CPS models:**
- **Standards** (Modelica-FMI-SysML...)
  - **Tools** (Dymola, 3DExperience ...)
  - **People** (Designers-Architects...)



# COLLABORATIVE ENGINEERING WITH SYSTEM ANALYSIS



Physical and Virtual Plateaus



- Enablers :**
- Definition of Process and associated tools** for management of
- Roles and IP
  - Requirements
  - Architectures
  - Models
  - Analysis
  - Results
  - Decisions
  - ...
  - And links between them

Enablers

# COLLABORATIVE ENGINEERING WITH PARTNERS

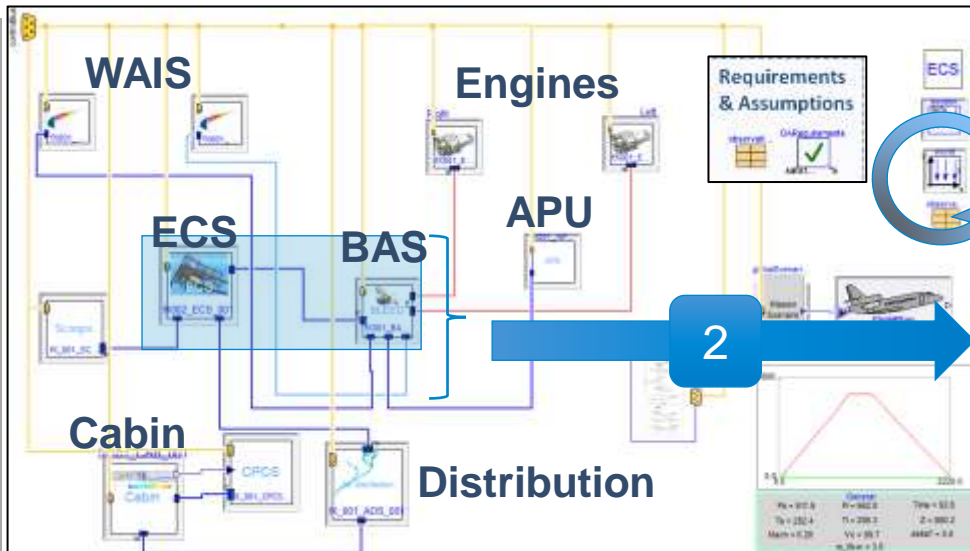
- 1: Provides Models: Interfaces, Boundaries, Mission, Requirements within Test-Cases

Partners (LTS ...)

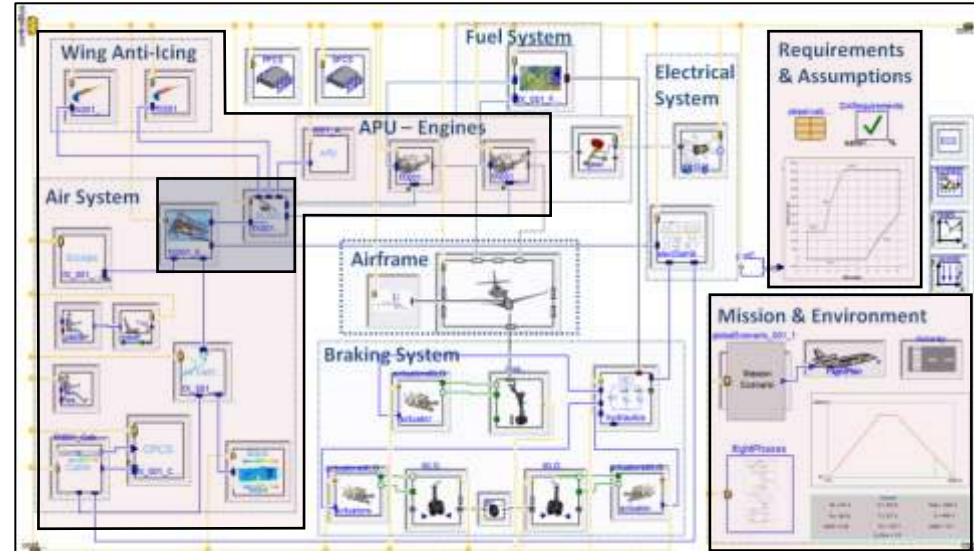


Dassault Aviation

TOICA/MODRIO



(Format : set of Dymola encrypted models)



(Format : FMUs generated from Dymola -IP-, Embedded in Modelica interfaces)

- 2: Provides sub-systems models (with the right level of details) compatible with interfaces, tested within predefined environments and conditions, and execution assumptions, using standards (Modelica, FMI, SysML ...)

**Enablers :**  
 New Process for management of Collaborative Design  
 ...

# TOPICS

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Context

Challenges addressed

Enablers : integration within 3DExperience

**Current status**

Conclusions and Outlooks

# CURRENT 3DEXPERIENCE ENABLERS

## Base Tools

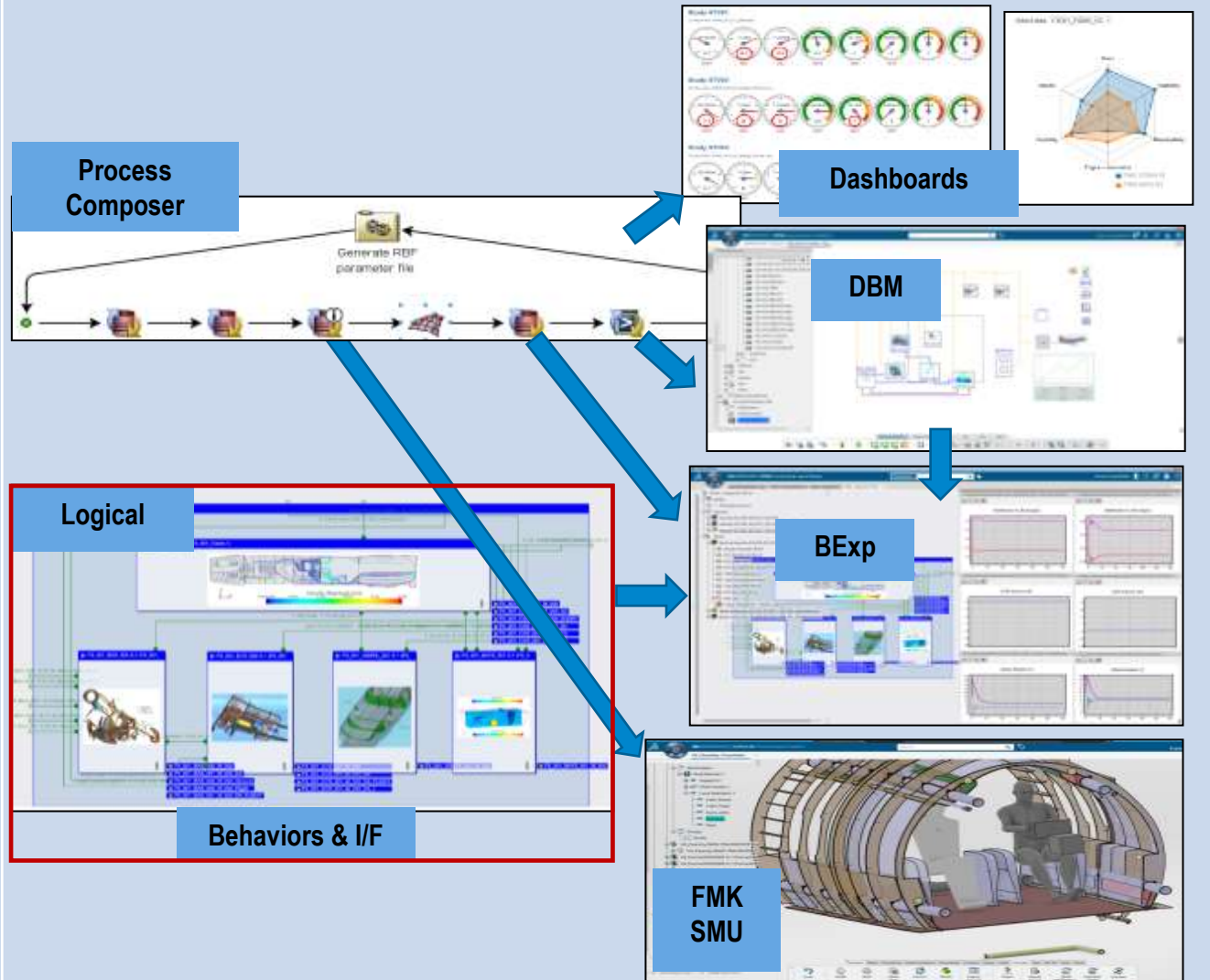
## Figures

For System Analysis

### 3DEXperience

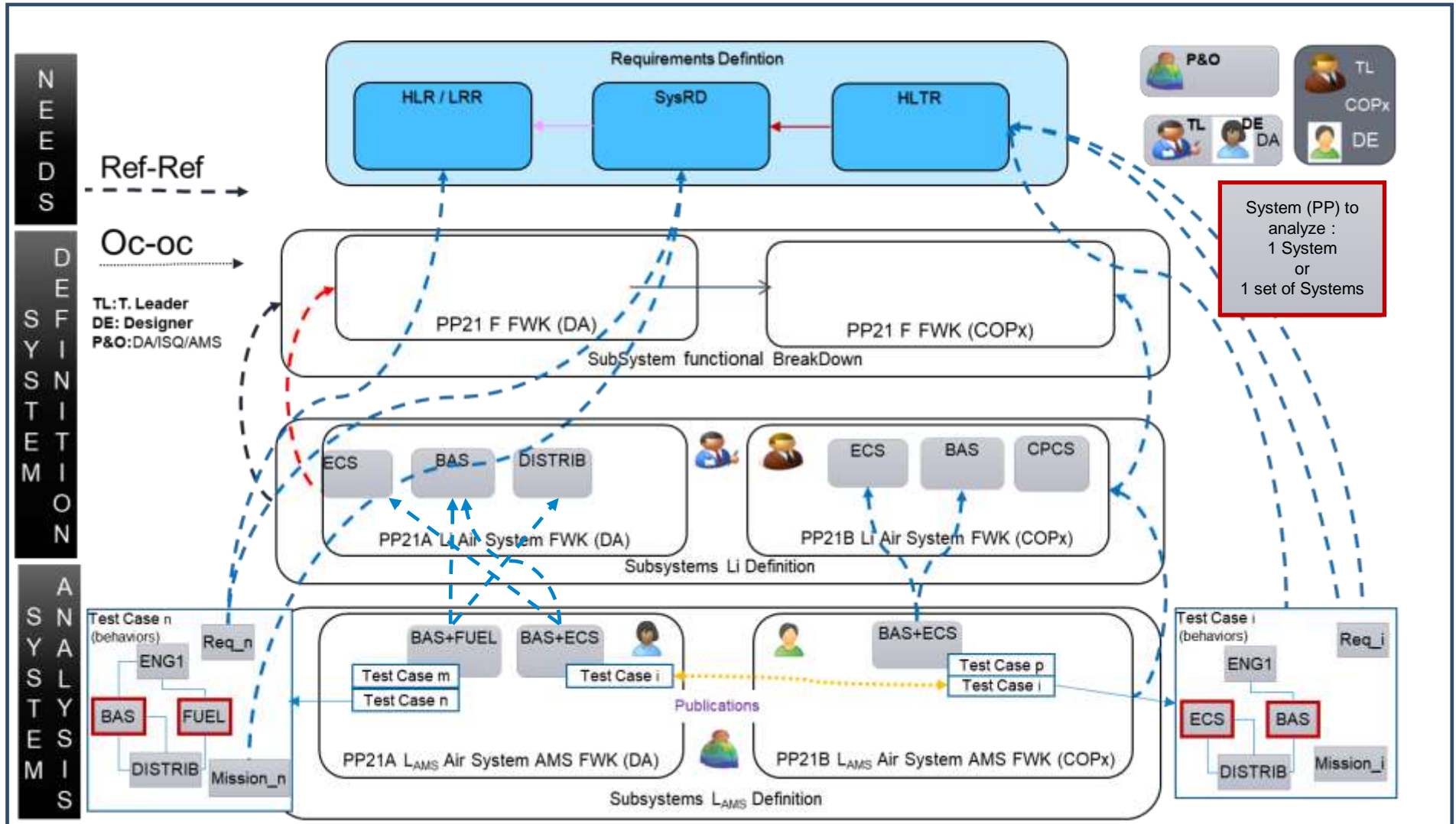
- Dashboards
- Process Composer / Result Analytics
- DBM (Dymola)
- Requirements, Logical
- Behavior Experiment
- FMK/SMU (Fluid & Mechanical -Abaqus-Analysts)

...

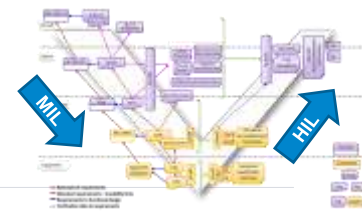


Enablers

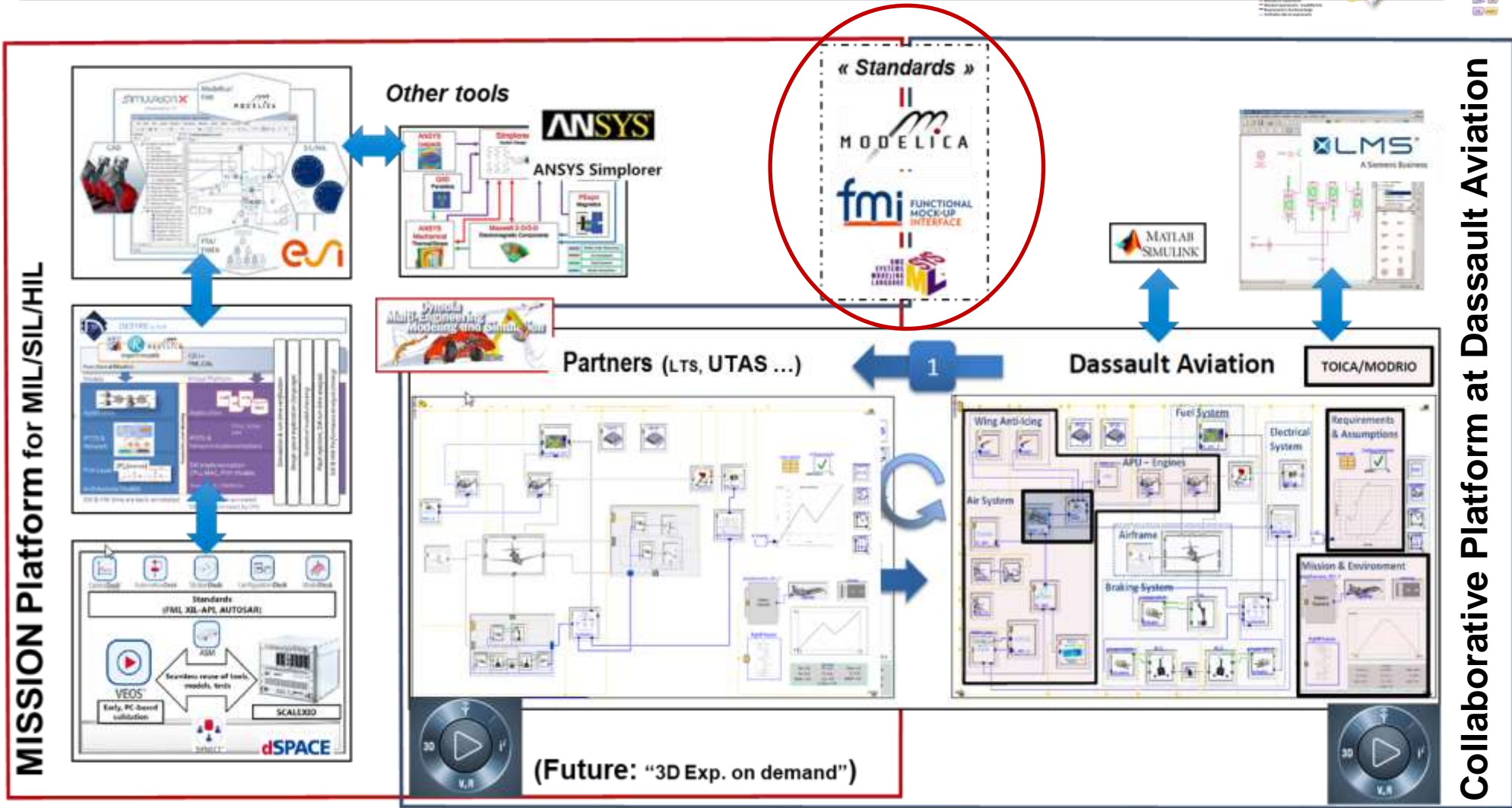
# DATA MODEL FOR INTEGRATION OF SYSTEMS ANALYSIS



# CURRENT STUDY : CLEANSKY2 MISSION => USE OF STANDARDS FOR SE



Status



# CURRENT STUDY : BRIDGING THE GAP BETWEEN SYSTEM DESCRIPTION AND ANALYSIS

## Compare

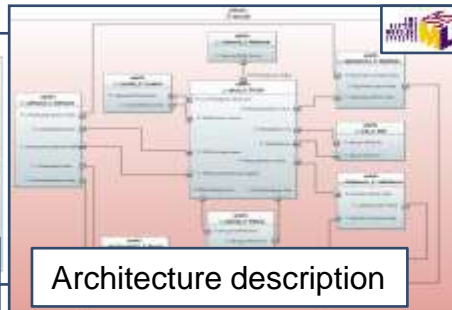
- Current **3DExp capabilities** : RFLP, System Traceability, Tools and Models
- Explore link **SysML** ⇔ **Modelica**, brings by Cameo integration



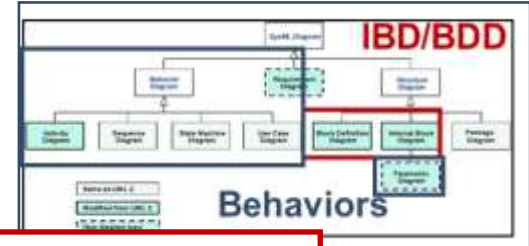
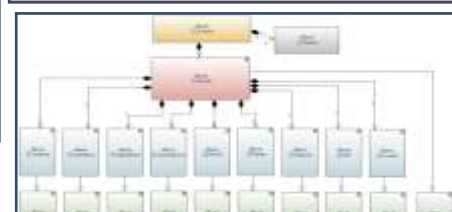
Simulation Architecture description



Allocation of architectural ports to model interfaces

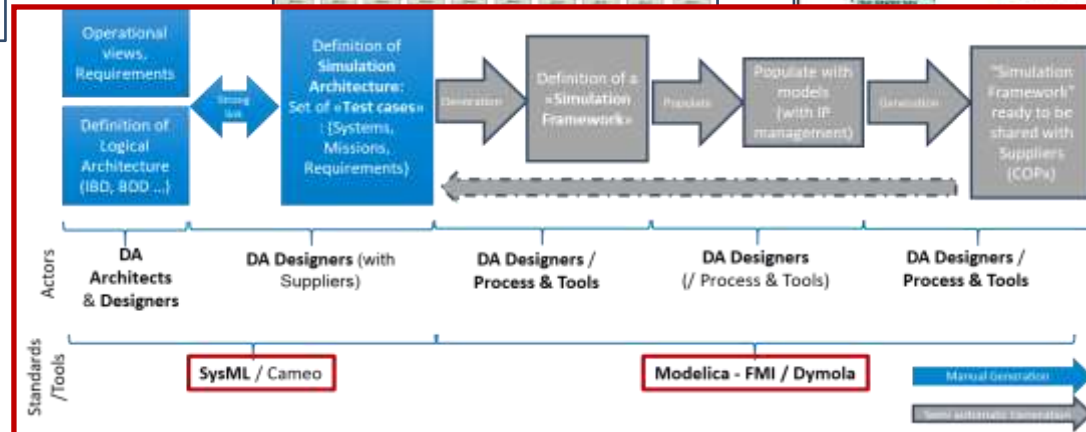


Architecture description



## Target

Compare capabilities and opportunities by prototyping generation and management of the transformation between SysML and Modelica ...



Status

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# CONCLUSIONS AND OUTLOOKS

- **Current integration of Multi-Systems Analysis in System Engineering**
  - **Drastic evolution of Simulation models and tools**
    - Increased capabilities of simulation language Modelica, and tools allows analysis required for versatile small to large scale CPS models of Systems
    - FMI standard, now widely integrated in Modelica and other legacy tools; allows easier integrations or co-simulation of simulation models (to be used with caution)
  - **New collaborative process with design partners**
    - Capabilities to build Agile and flexible collaborative process for Architectures. Evaluation have been demonstrated on realistic use-cases.
    - On going integration in program developments, based on 3DEXperience
- **Outlooks**

Future opportunities bring by some major evolutions of

  - **Standards** : Modelica (3.x, 4.0 ...), FMI (3.0, ...), SysML (v2 ...) ...
  - **Process** : more flexible and Agile ... increasingly supported by tools and users
  - **Tools** : 3DEXperience, future integration of Cameo ...

Questions  
&  
Answers



6th and 7th October

<http://standardsdays.afnet.fr>