Towards Configuration Support for Collaborative Simulator Development

– A Product Line Approach in Model Based Systems Engineering

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Henric Andersson, Magnus Carlsson, Johan Ölvander

Dept. of Management and Engineering
Linköping University, Sweden
&
Saab Aeronautics, Linköping, Sweden

Presentation of the presenter

- MsC in Control Engineering (1994)
- Modeling and simulation of power plants at ABB
- Saab Aeronautics
  - Flight Control
  - Project Management / Systems Engineering
  - Product Line Engineering
  - Research / PhD (2005 -> 2012)

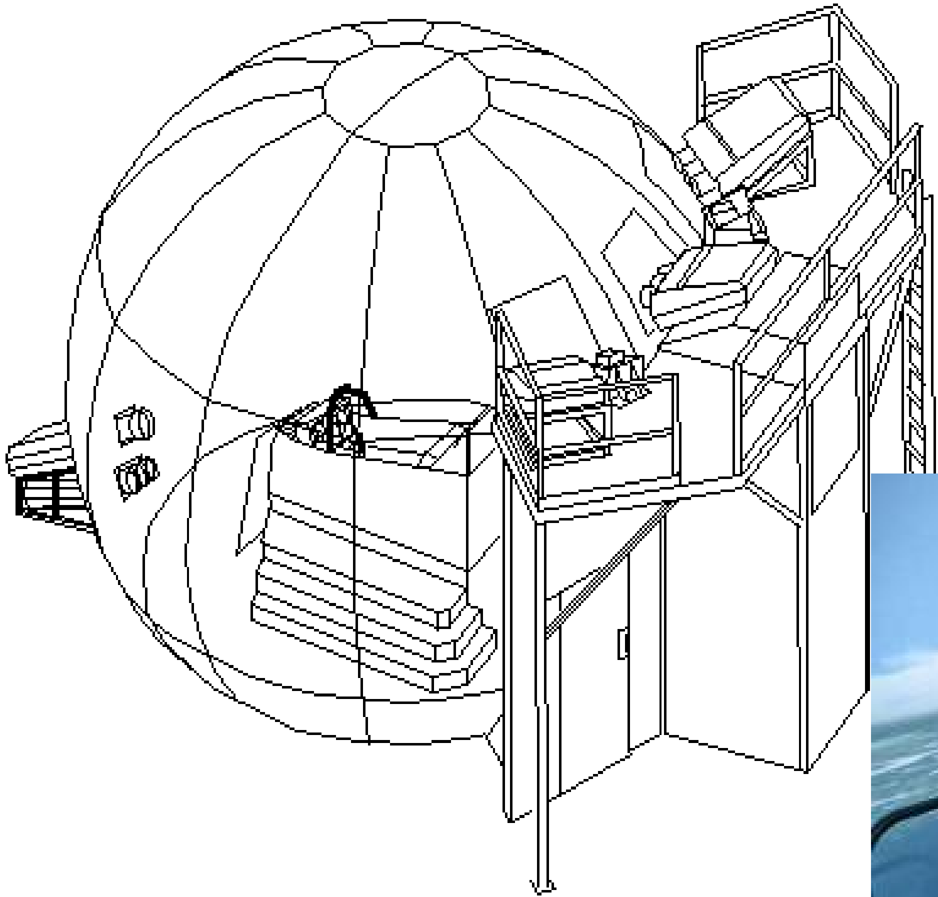
Content

- Context - Simulator Usage
- Model Based Systems Engineering
- Product Line Engineering
- Example application
- Configurator implementation
- Conclusions & Further work

Simulator example 1(3)

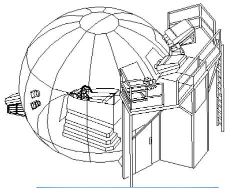
Engineer in the loop; Development, Training

Simulator example 2(3)



Pilot in the loop; Training, verification

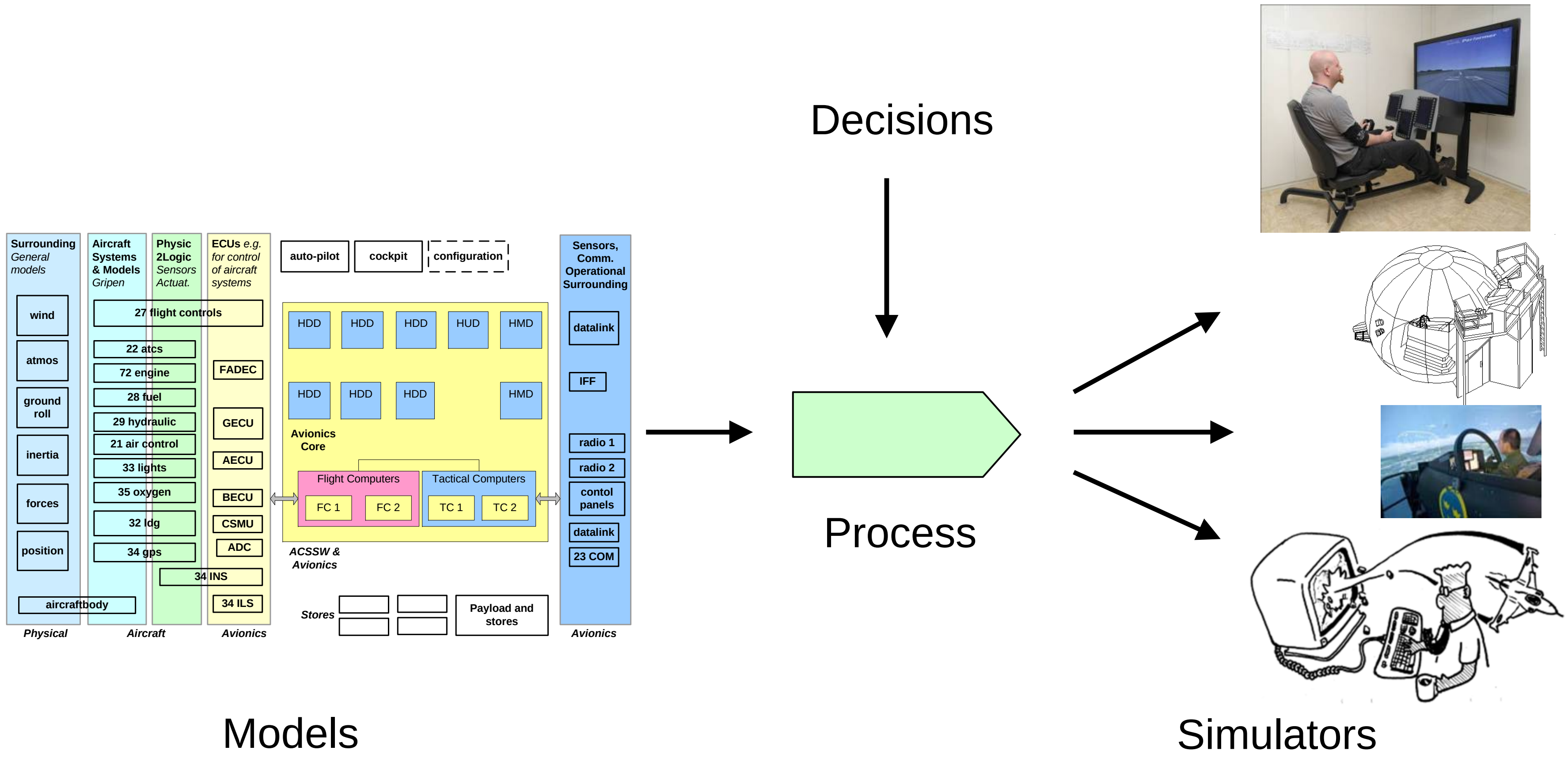
Simulator example 3(3)



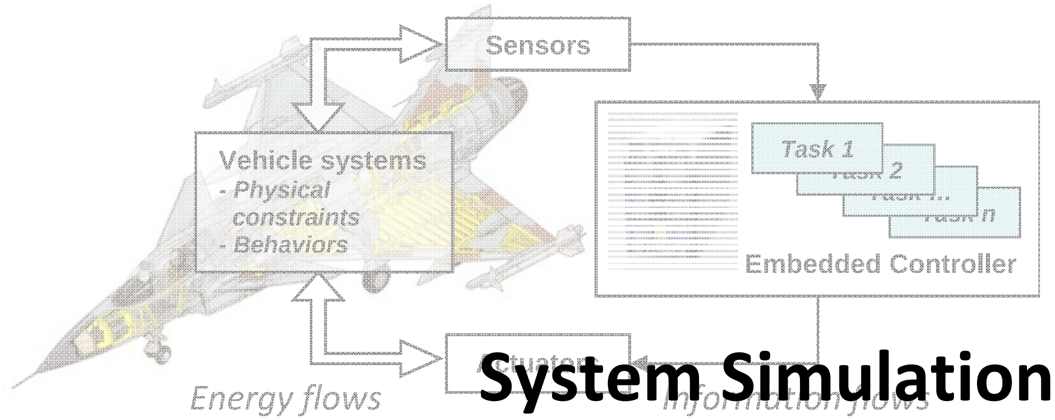
Desktop; batch simulation

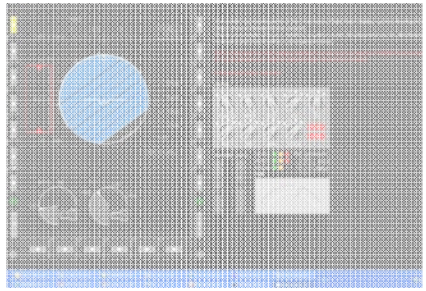
Simulator creation from models

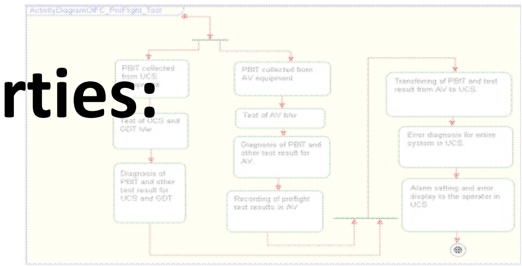
The Product Line Approach – a concept for reuse



MODEL BASED DEVELOPMENT

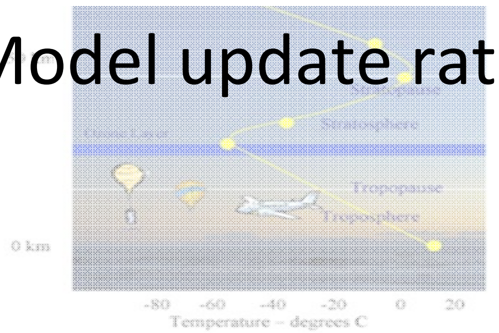


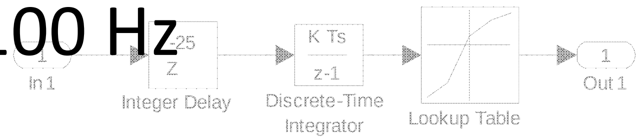


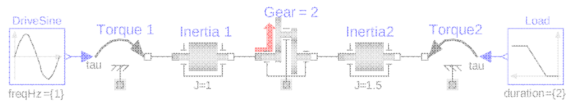


System Simulation Properties:

- Global Scheduler
- Local solvers
- Model update rate 1-100 Hz







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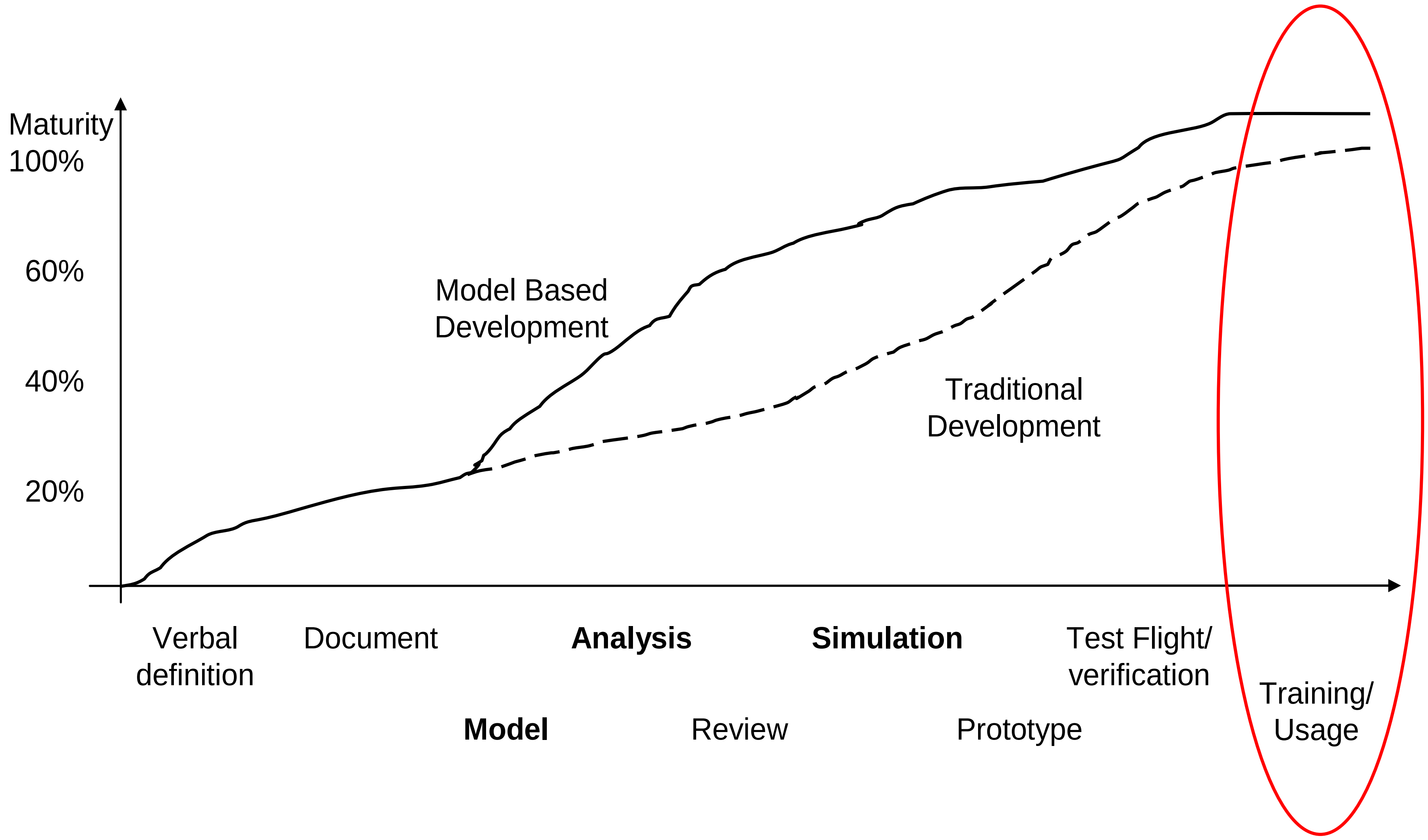
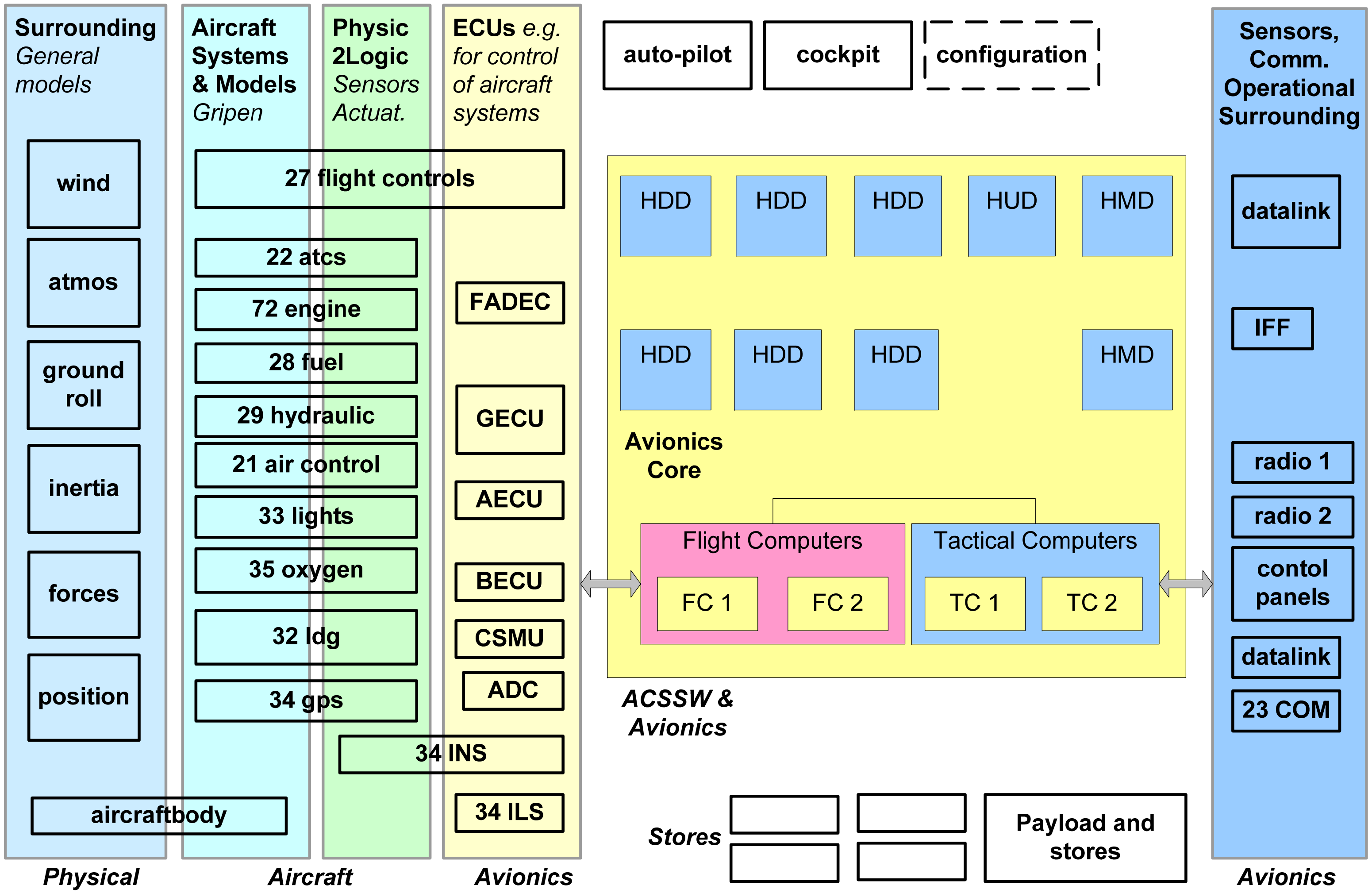
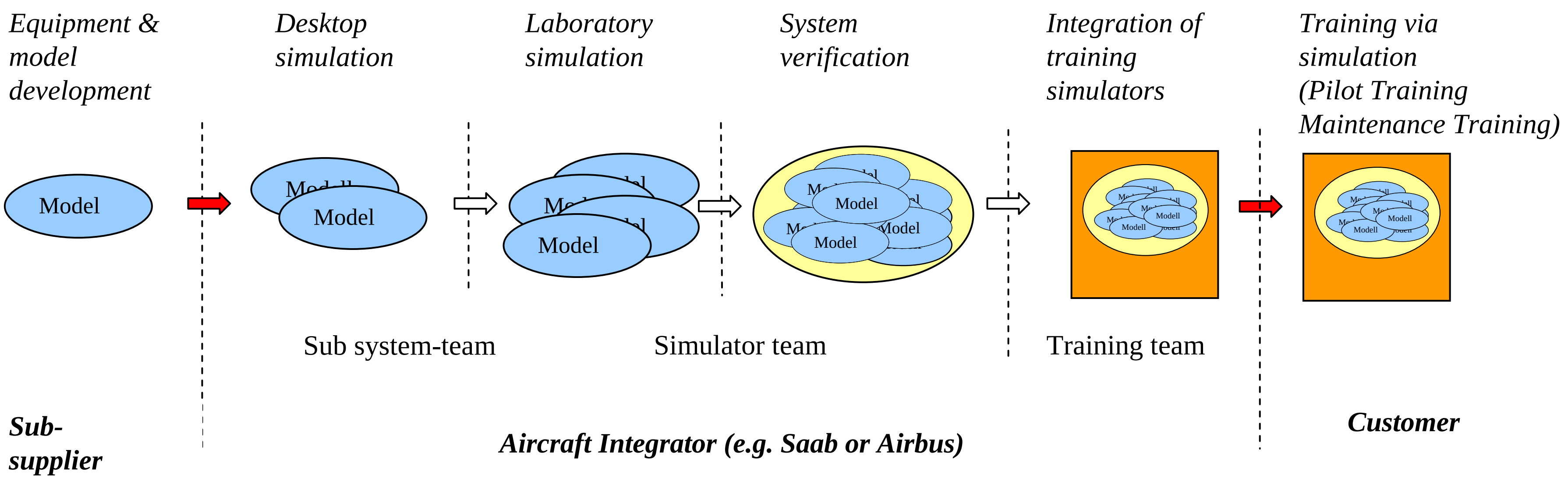


Model overview and classification



FLOW OF SIMULATION MODELS

- Origin of models :
  - Deliverables from sub suppliers (e.g. Engine)
  - In-house development of aircraft specific models (e.g. Mass & Inertia)
  - In-house development of simulator specific models (e.g. Cockpit)

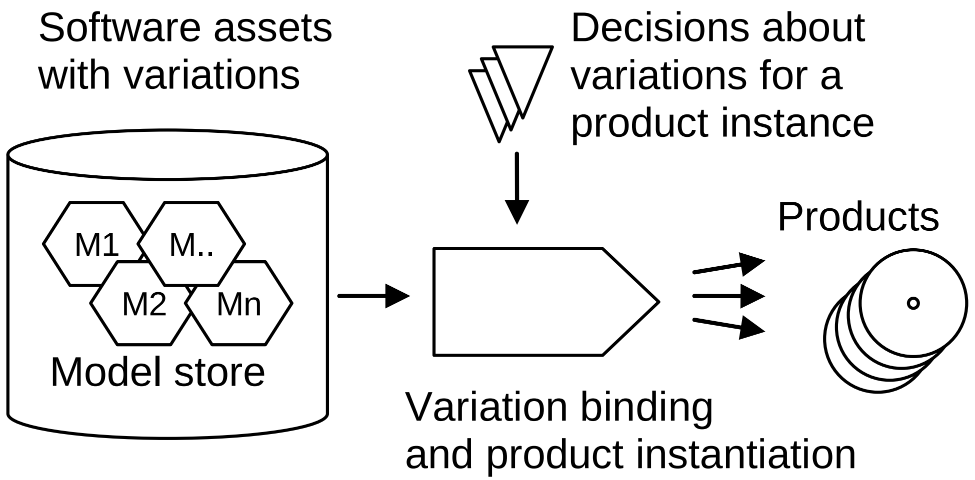


Challenges in Aircraft Simulation

Some challenges in set-up and support of large-scale simulations:

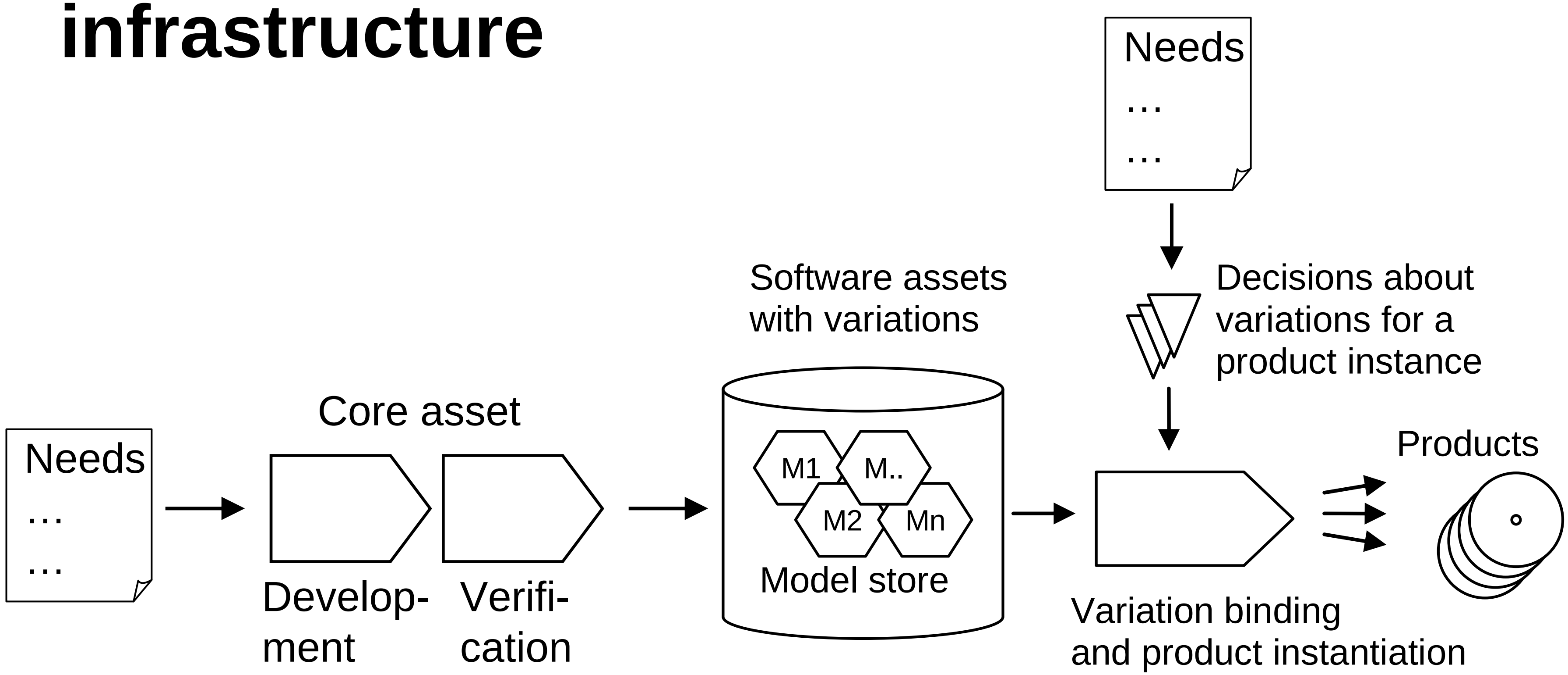
- Different operating systems & simulation platforms
- Many models ~100 including “legacy codes”
- Variants of the systems that the models represent
- Variants of “the same” model, e.g. different levels of fidelity
- Versions of models, e.g. due to error correction
- Parametric models with different sets of System Parameters
- Lack of standards & tools for collaboration

Basic components of M&S Software Product Line (SPL)



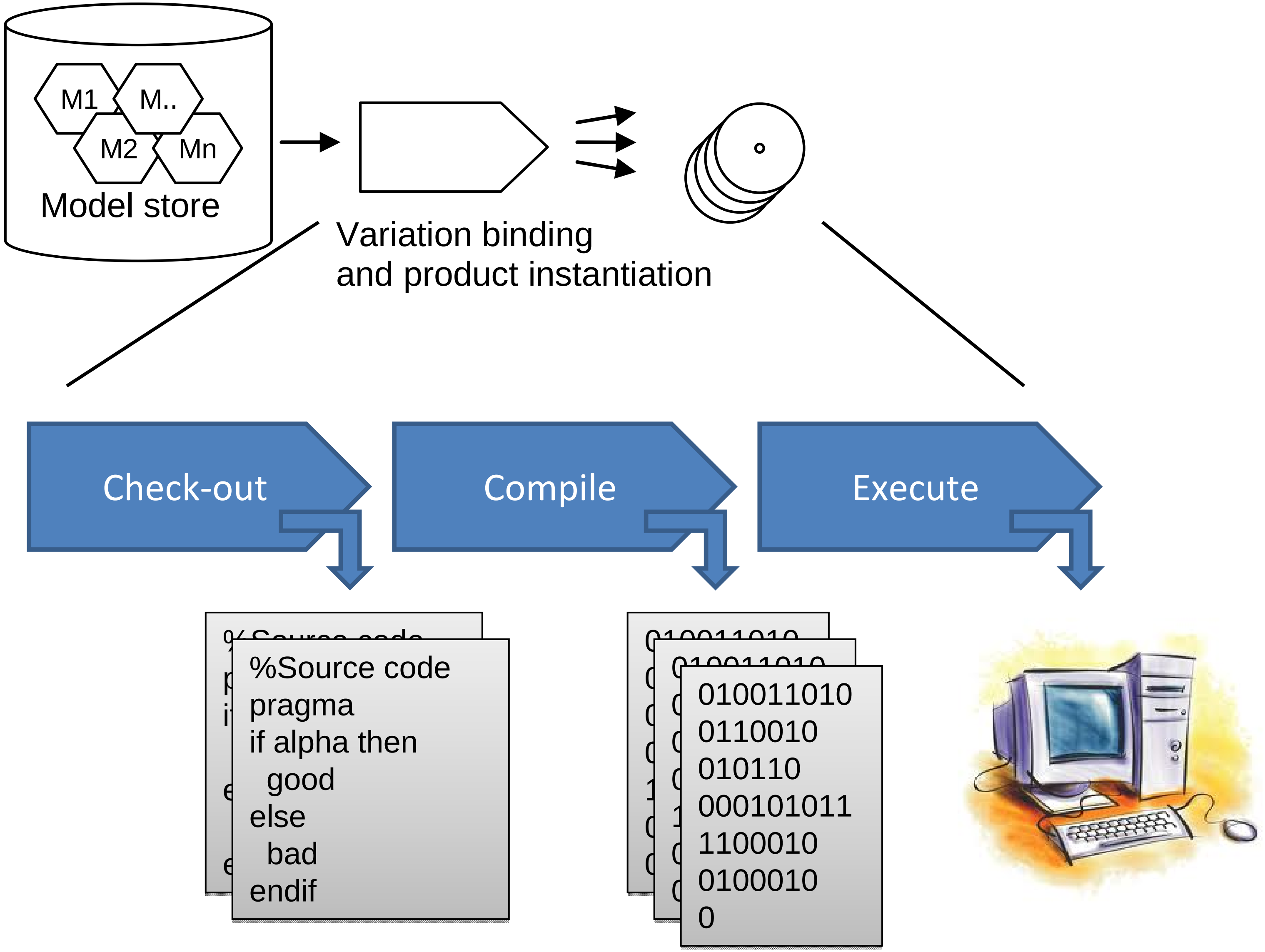
- Basic Mean: Assets with variations.
- Variation methods:
  - Model variants. A “variant master” describe their properties
  - Configurable models. Switches to instantiate desired behavior

Collaboration aspects of the SPL infrastructure



- Collaboration at model supplier interaction
  - Architectural requirements and standards collaboration/agreement
  - Transparency of development status
- Collaboration at customer interaction
  - Early validation of product functions and properties

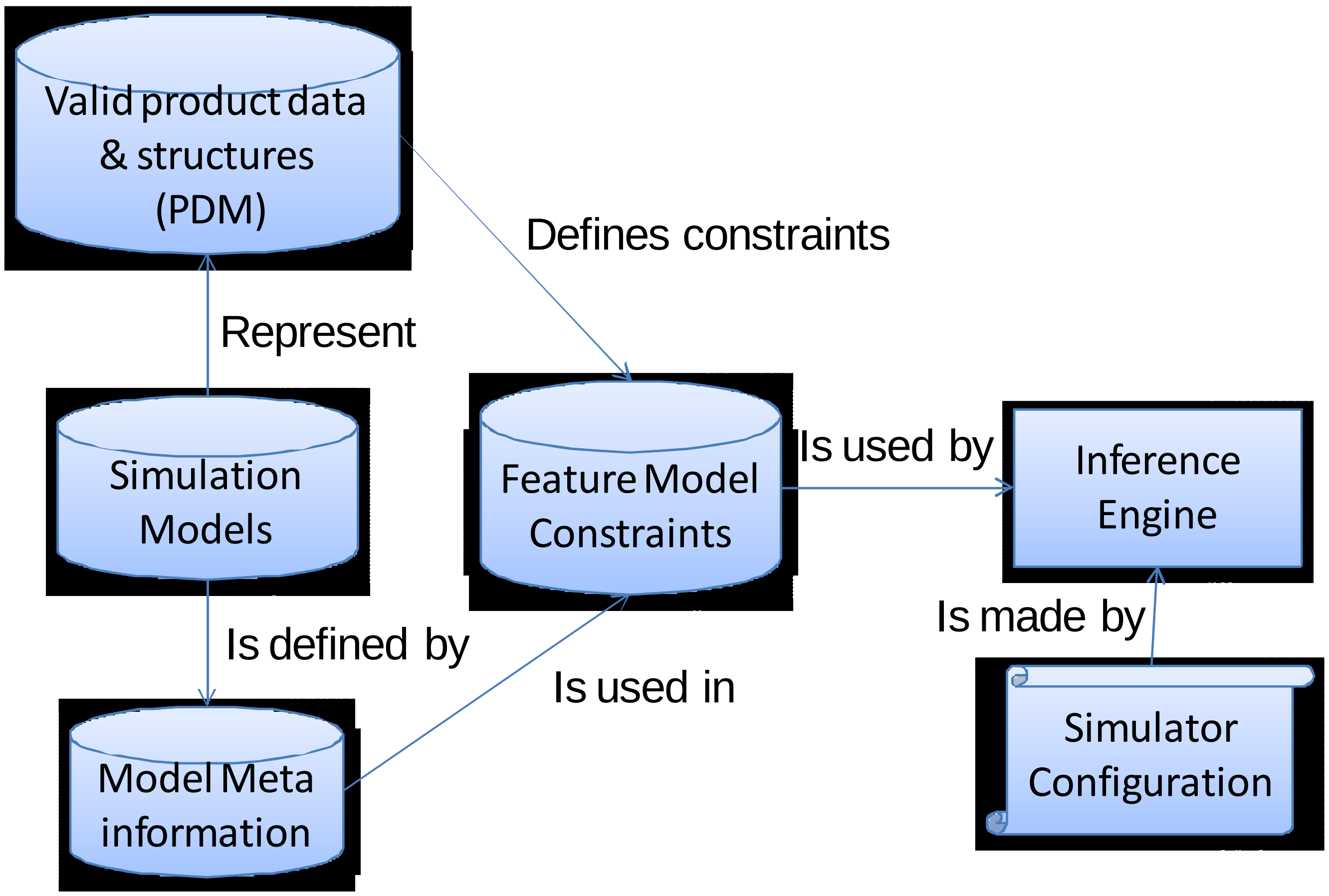
Binding time alternatives



Binding Time overview

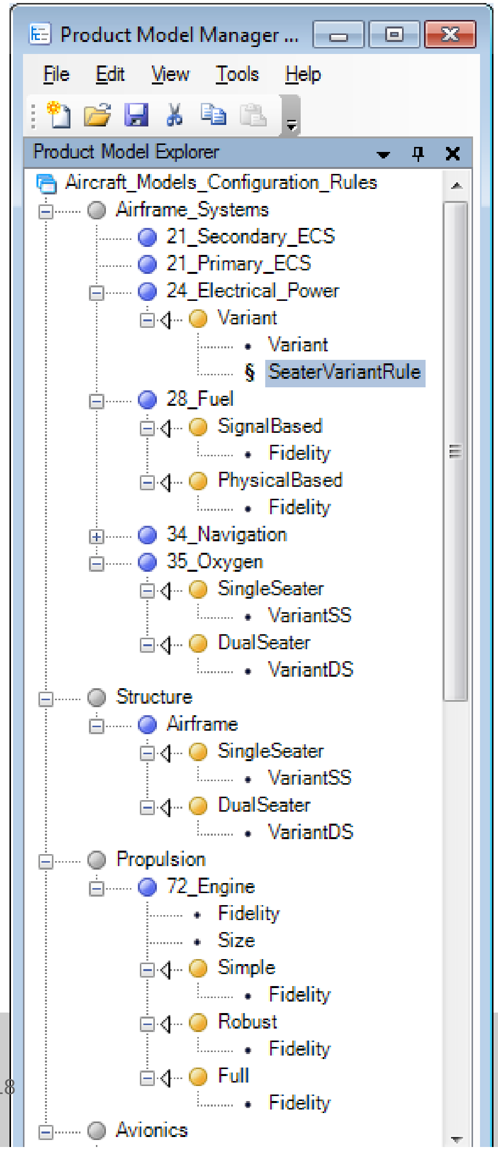
Binding at / Aspect	Check-out-time	Compile-time	Run-time
Creates	Different source code variants	Different object code variants	Different instances
Used for	Reliable configuration	Implementation oriented configuration	Fast reconfiguration
Example	When security / IRP aspects is important	Target / platform variation	Reconfiguration at end-user site

Configuration & Customization System Architecture



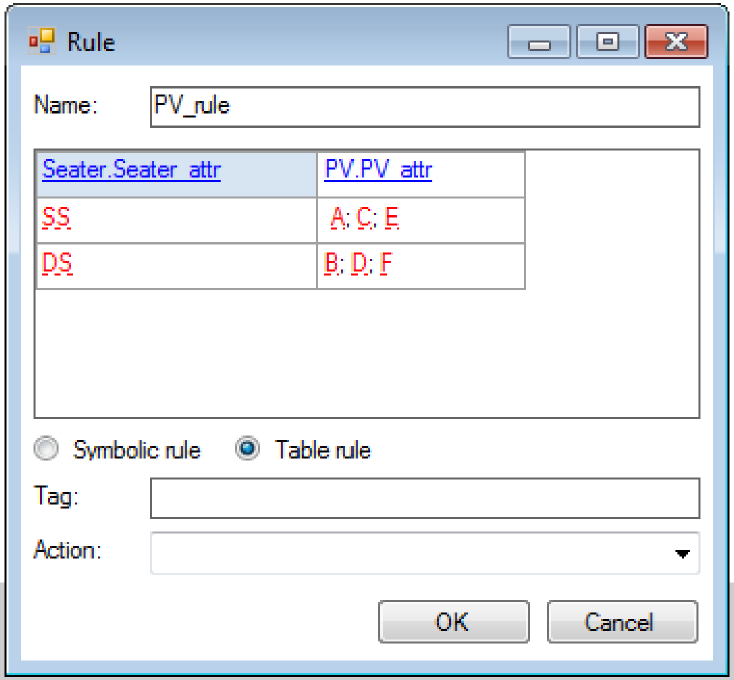
Product Variant Master – an analyze

- the first step towards a configurator prototype

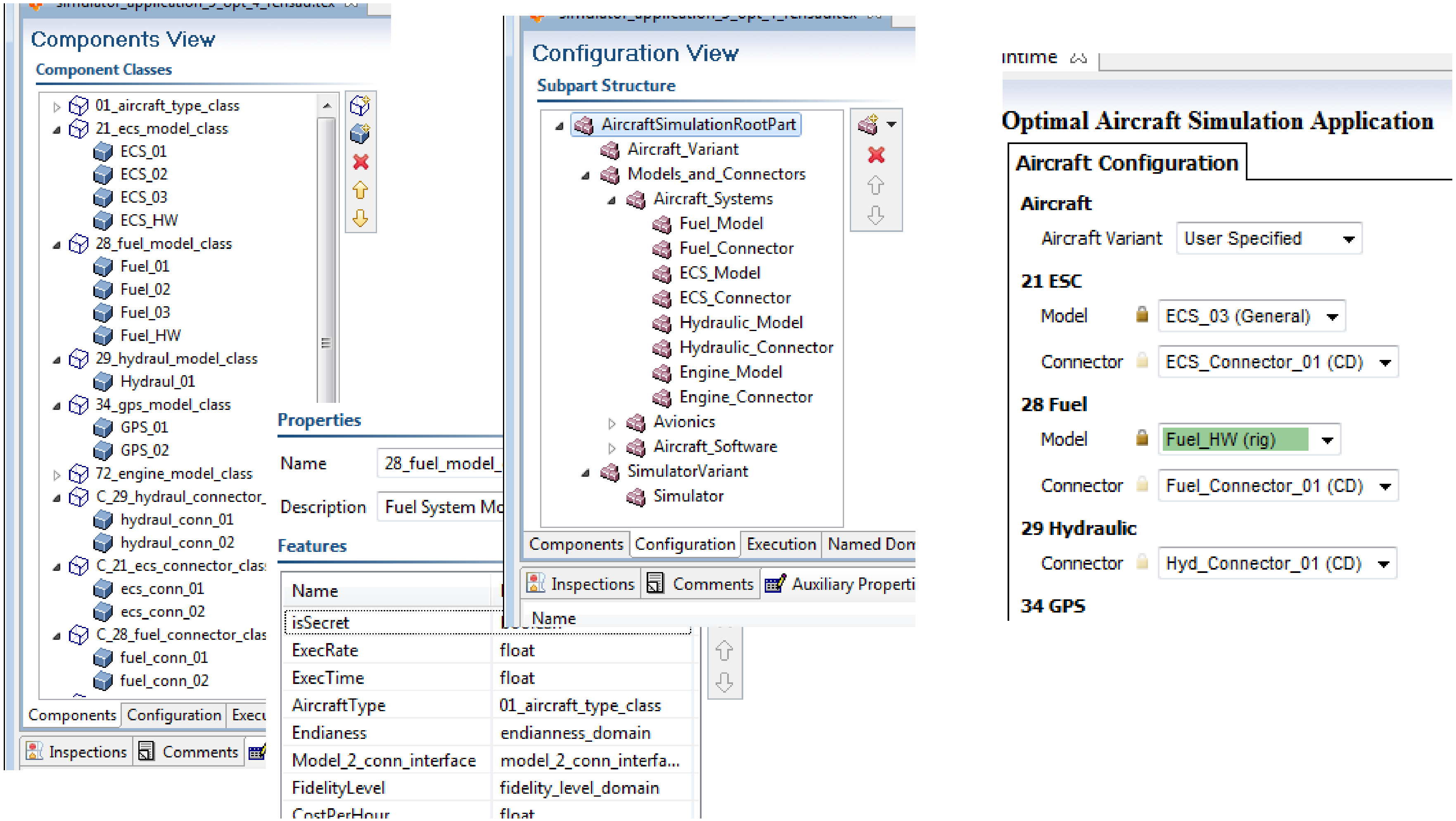


Object oriented model of model variants

- Objects to represent model variants
- Attributes to repr. variation points
- Rules for valid / not valid combinations



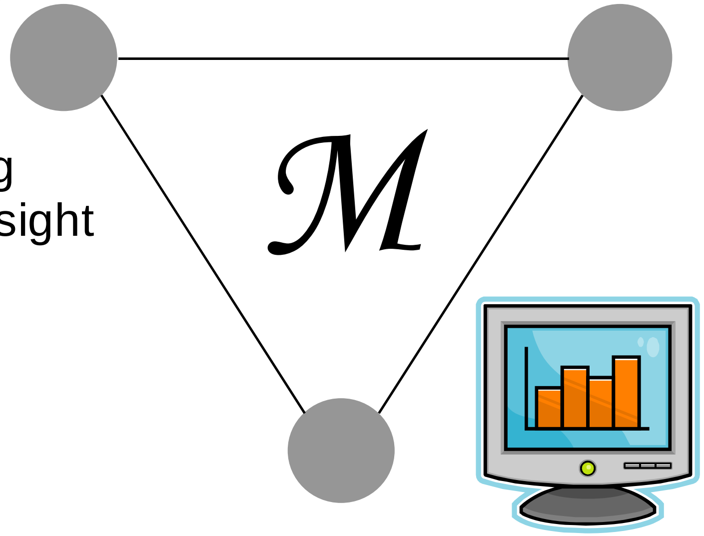
Prototype implementation
– Tacton Configurator Studio (COTS tool)



THE UTILIZATION POINTS OF MODELS

Insight
Create
Understanding
and deeper Insight

Collaboration
Communication
Visualization
Decision support
Documentation



Automation
Data storage
Analyze
Simulation
Transformation

Conclusions and further work

Conclusions

- Constraints input from PDM for integration of configuration data between PDM and the simulation environment
- Model Interface Compatibility is crucial. The emerging FMI (Functional Mock-up Interface) standard is promising for improved collaboration

Further Work

- Develop a robust meta-model for model variability, configuration/customization
- Connection to emerging standards; PLMXML, FMI & SysML
  - Use XML, XSD & XSLT for data storage, exchange, presentation and mapping
- Validate prototype configurator implementation in the application project

Thank You!