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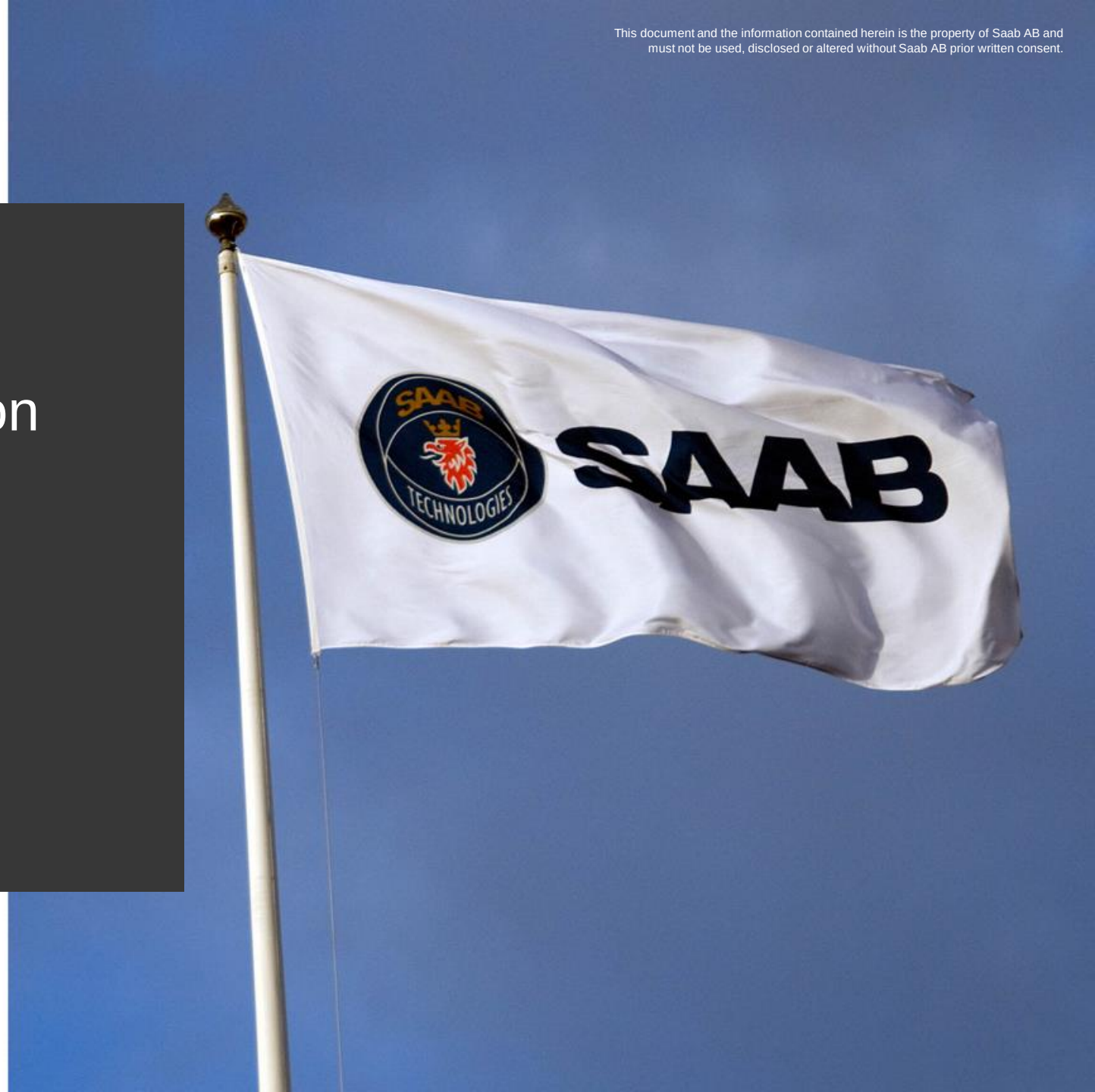
Enhancing the Model Integration Workflow in Aircraft System Simulation using FMI & SSP

Industrial User Presentations

Modelica Conference 2019, Regensburg

Magnus Eek
Saab Aeronautics



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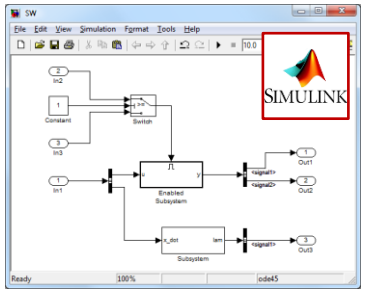
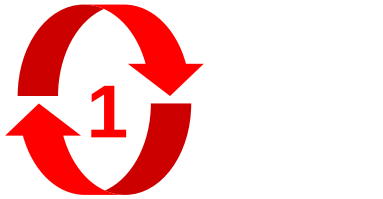
Background: Current way of working at Saab
Model-Based Development of Aircraft Vehicle Systems

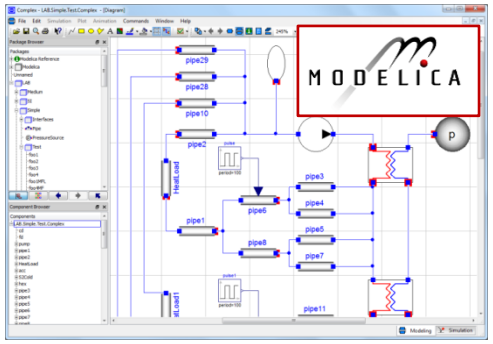


Design & Implementation of S/W

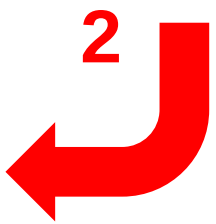
Test rigs & simulators

Test A/C

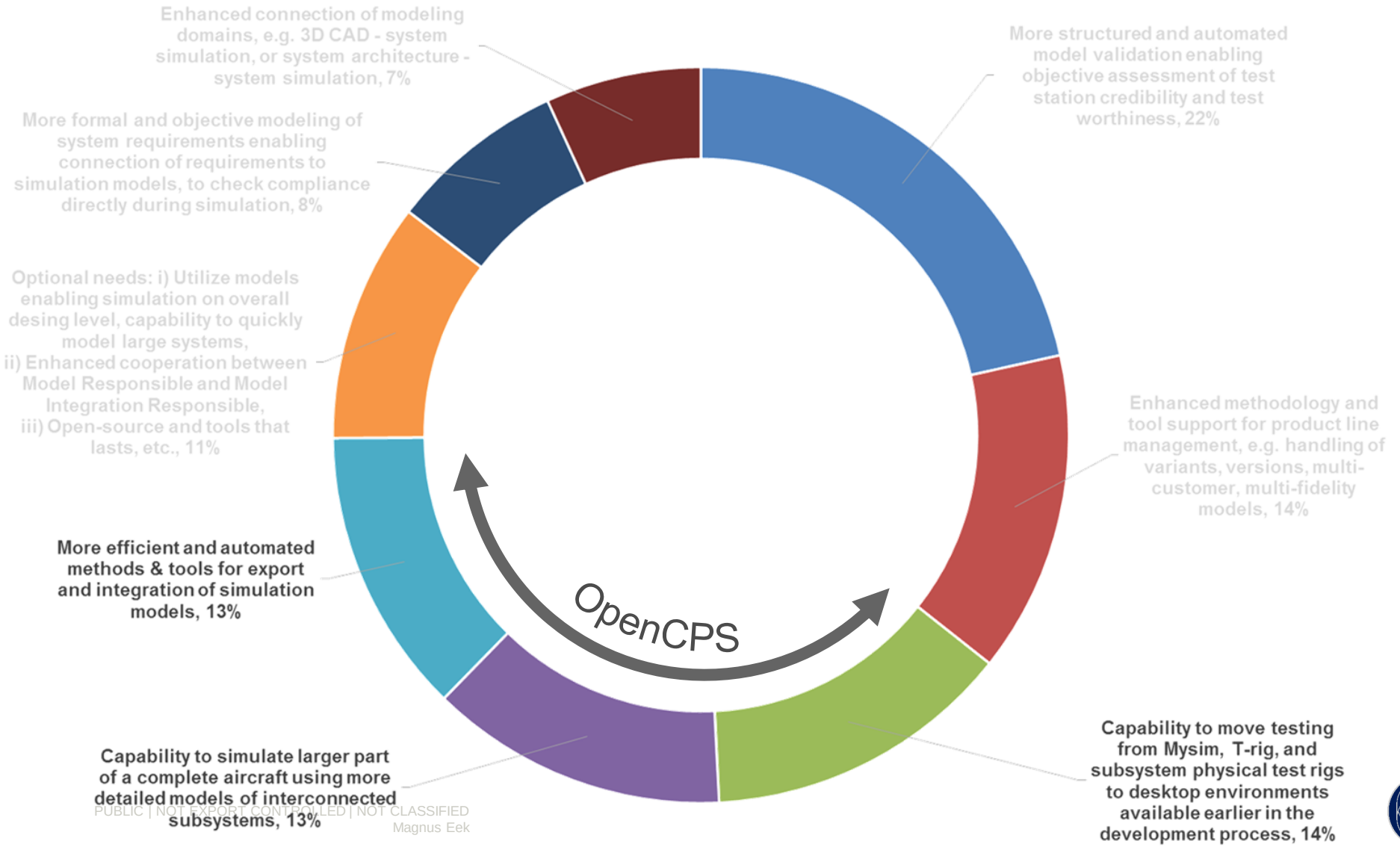




M&S of physical systems



Future Needs in System Development



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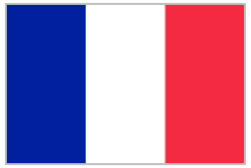
openCPS



COLLABORATIVE R&D ON METHODS, STANDARDS & OPEN SOURCE TOOLS FOR EFFICIENT DEVELOPMENT OF CYBER-PHYSICAL SYSTEMS

Duration: December 2015 to December 2018

4 countries: Sweden, France, Finland, Hungary

Current status: 46.5 person-years, 6.5 M€, 18 partners

Project coordinator: Saab

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Magnus Eek

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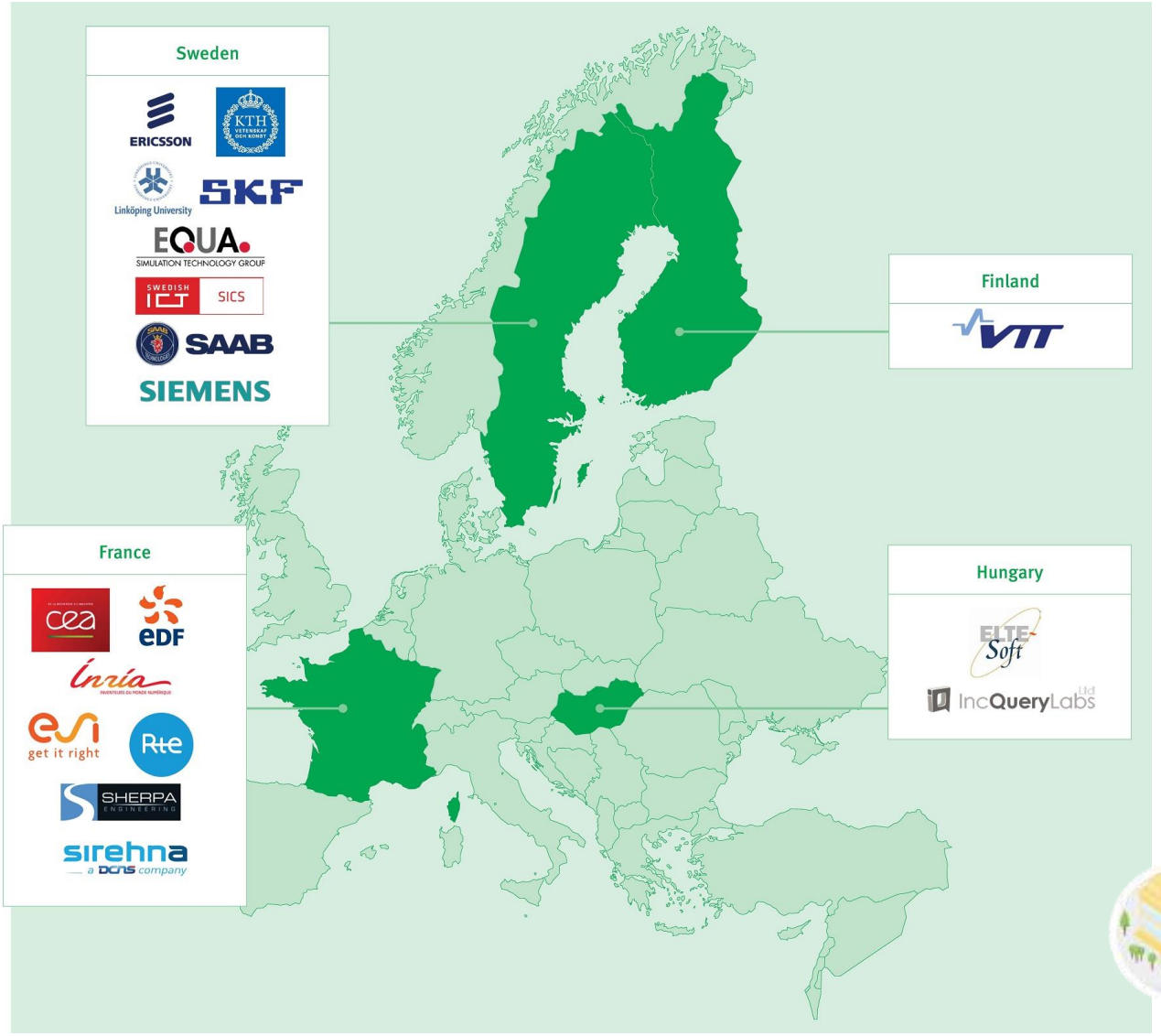
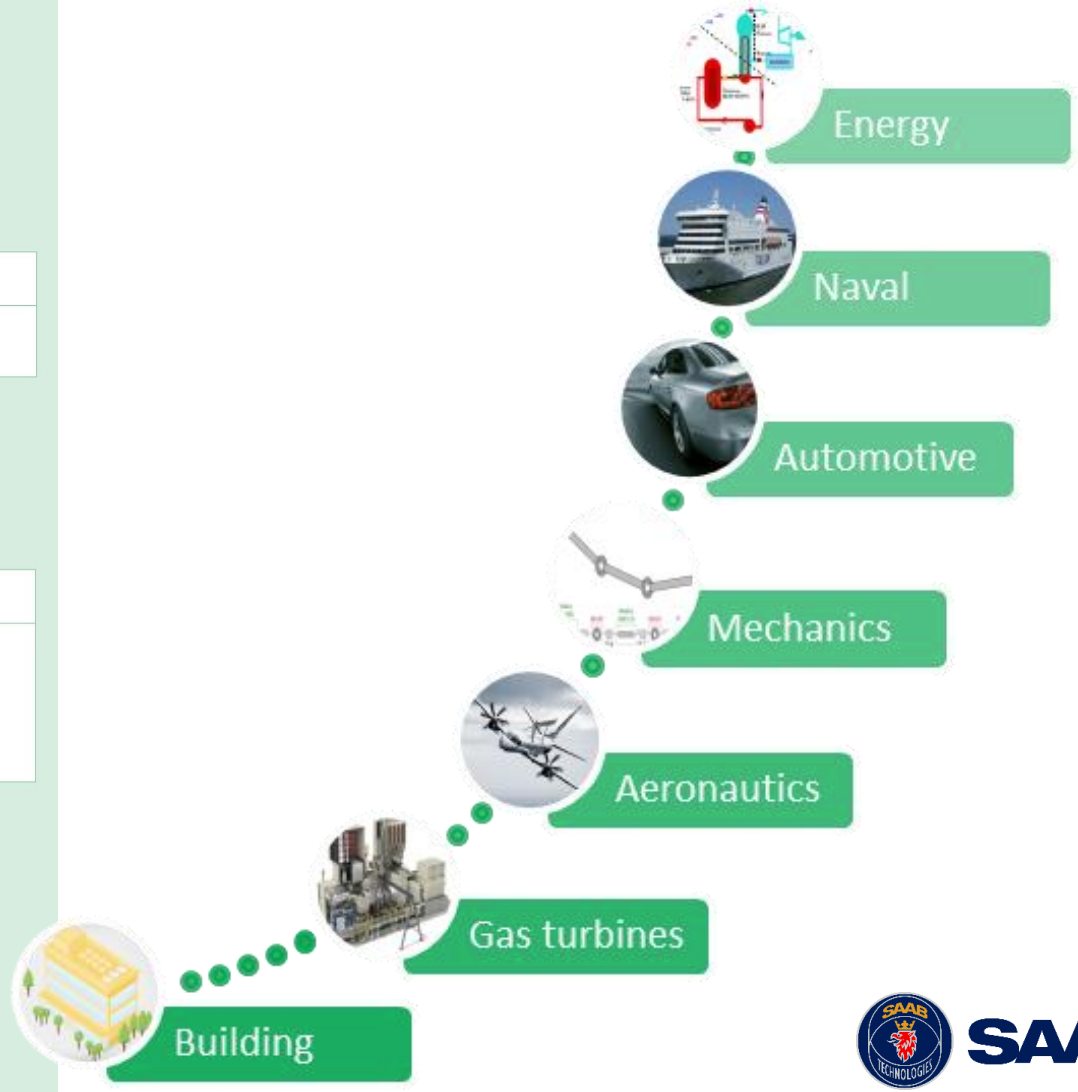
EUREKA
innovation across borders

Project Consortium & Industry Domains





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Innovation Areas & Industrial Demonstrators

Overall aim: Increase **front loading** capability in development of cyber-physical systems by enabling **large-scale simulation**

- FMI Master Simulation Tool including UML/Modelica Interoperability
- State Machine and Real-Time Debugging & Validation
- Efficient Multi-Core Simulation

Vehicle energy management
Sherpa, CEA

Aircraft Vehicle Systems
Saab AB, LIU

Joint Energy Demonstrator
Siemens, EDF, KTH, EQUA

Ship Decision Support System
Sirehna

Tunnel ventilation HIL and SIL
EQUA

Mechanical Bearing-related demonstrator using FMI TLM
SKF, LIU

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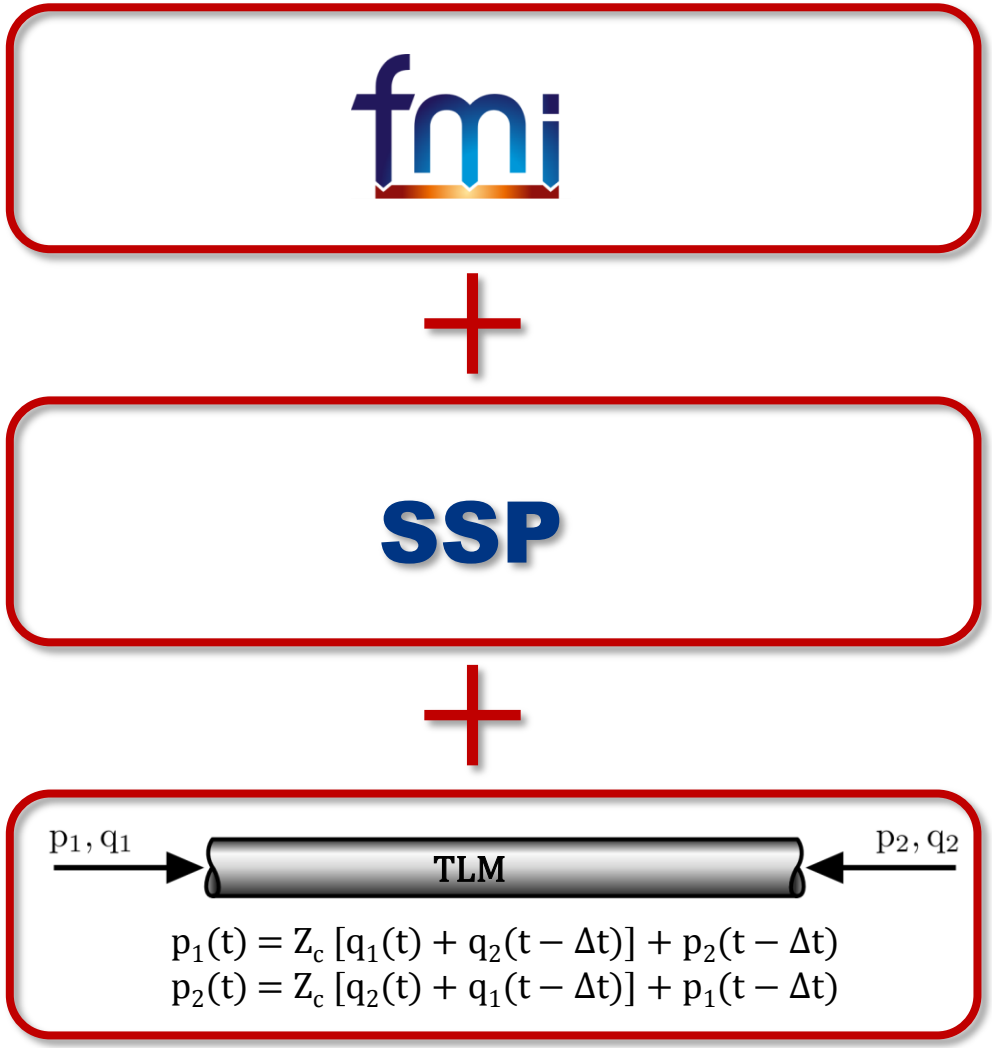
FMI Master Simulation Tool: OMSimulator

- Open source tool for **standardized**, **numerically robust**, and **efficient distributed (co-)simulation**
  - Functional Mock-up Interface (FMI) 2.0 CS & ME
  - System, Structure & Parameterization (SSP)
  - Transmission Line Method (TLM)
- Scripting support in Lua & Python, GUI support for composite model editing and simulation in OpenModelica & Papyrus
- FMUs and external tool integration, e.g. Simulink, Adams, Hopsan, Dymola
- Standalone: Open for integration into scripting frameworks, third-party tools, and specialized applications, e.g. flight simulators, optimization tasks



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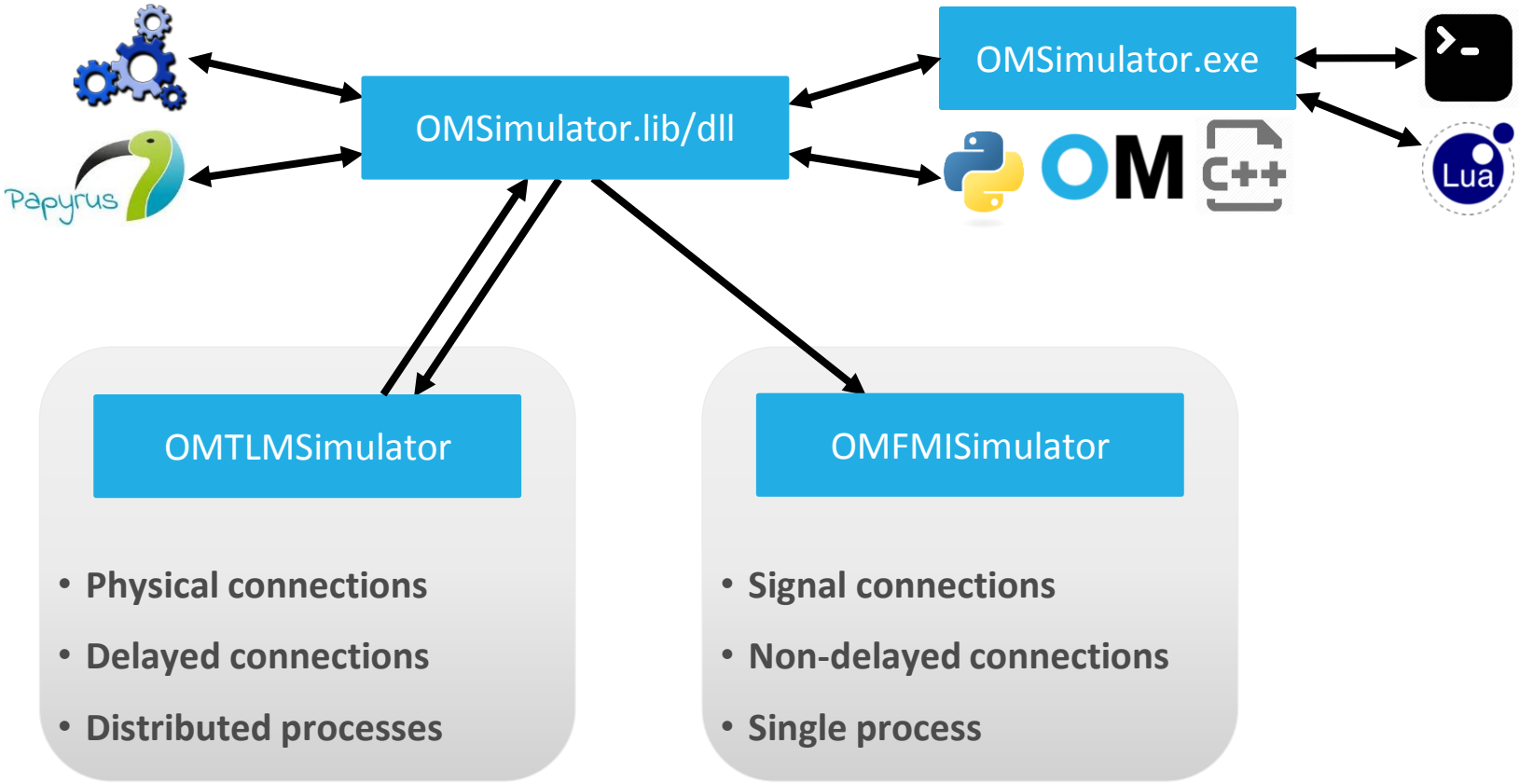
FMI Master Simulation Tool: OMSimulator



Standalone: **https://github.com/OpenModelica/OMSimulator**
Integrated in OpenModelica tool suite: **https://openmodelica.org**

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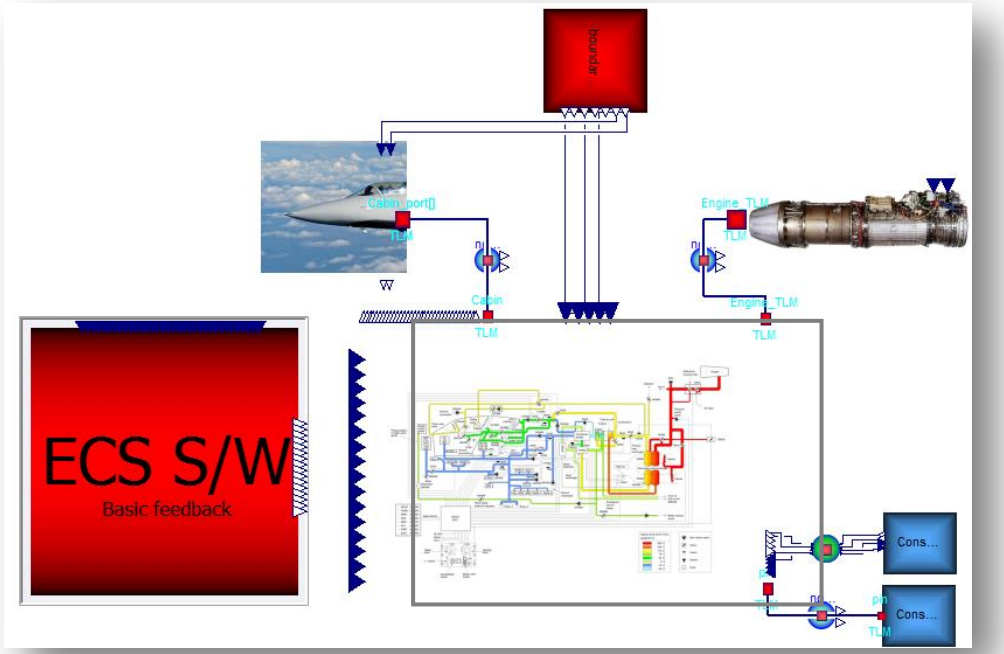
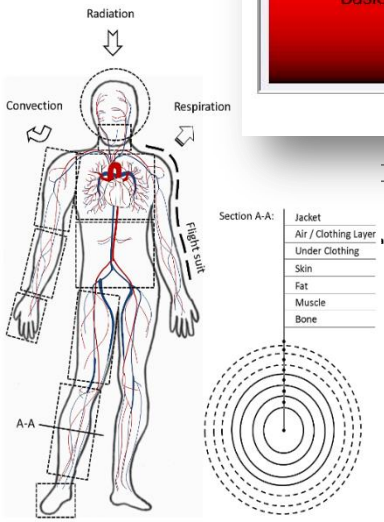
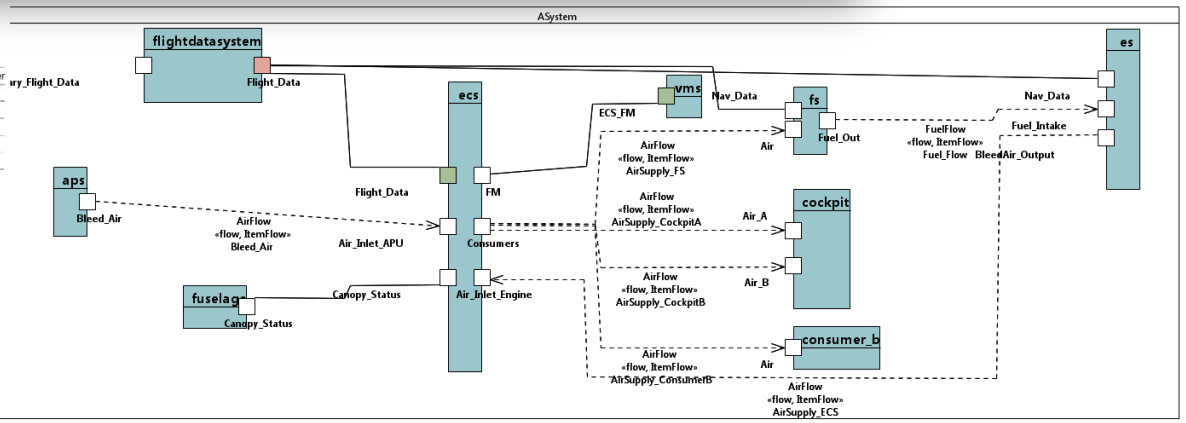
Saab Aeronautics Demonstrator
FMI-based co-simulation of Aircraft Vehicle Systems

- Demonstrate
  - Standardized model export and integration into desktop simulators
  - Interoperability between different modeling tools/domains
  - Expansion in M&S of aircraft vehicle systems at Saab, increased scope, availability, and utilization of “high fidelity” simulations
- OMSimulator development
  - Input to requirement specification
  - Aid in development prioritization
  - Verification in an industrial setting
- Multiple languages/tools involved
  - Modelica (OpenModelica, Dymola)
  - xtUML (Bridgepoint)
  - SysML (Papyrus)
  - Simulink







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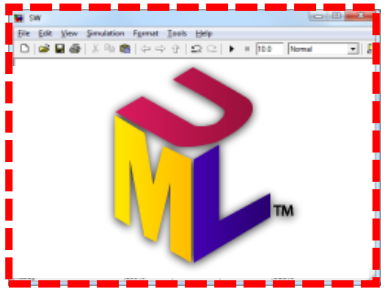
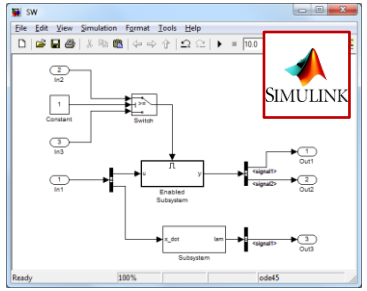
Updated way of working
Model-Based Development of Aircraft Vehicle Systems





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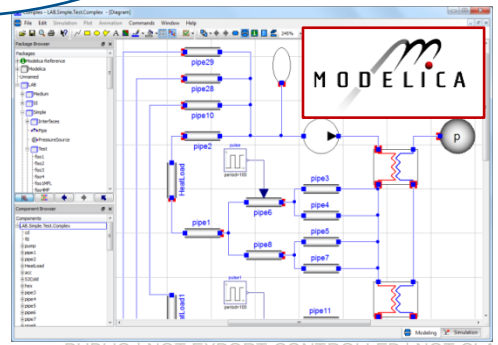
fmi OMSimulator SSP



M&S of physical systems

fmi

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FMI-based digital twin

fmi OMSimulator SSP

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Summary & Conclusions

- **Open and transparent integration tools make sense**
- Enabling easy setup of FMI & SSP-based simulator applications at Saab
- FMI for increased efficiency in Saab's model integration workflow
- Workflow and tool support for FMI & SSP-based interoperability between system architecture (e.g. SysML) & system simulation (e.g. Modelica, Simulink)
- Industrial needs on standardization:
  - FMI: Provide means to improve **numerical robustness** and **simulation speed**: FMI Change Proposals (FCPs) #015, #010, #012, #013
  - SSP: Manage **simulation settings** and **external models**
- More info on OMSimulator: **Tuesday 11:00, Session 1C: FMI 1**

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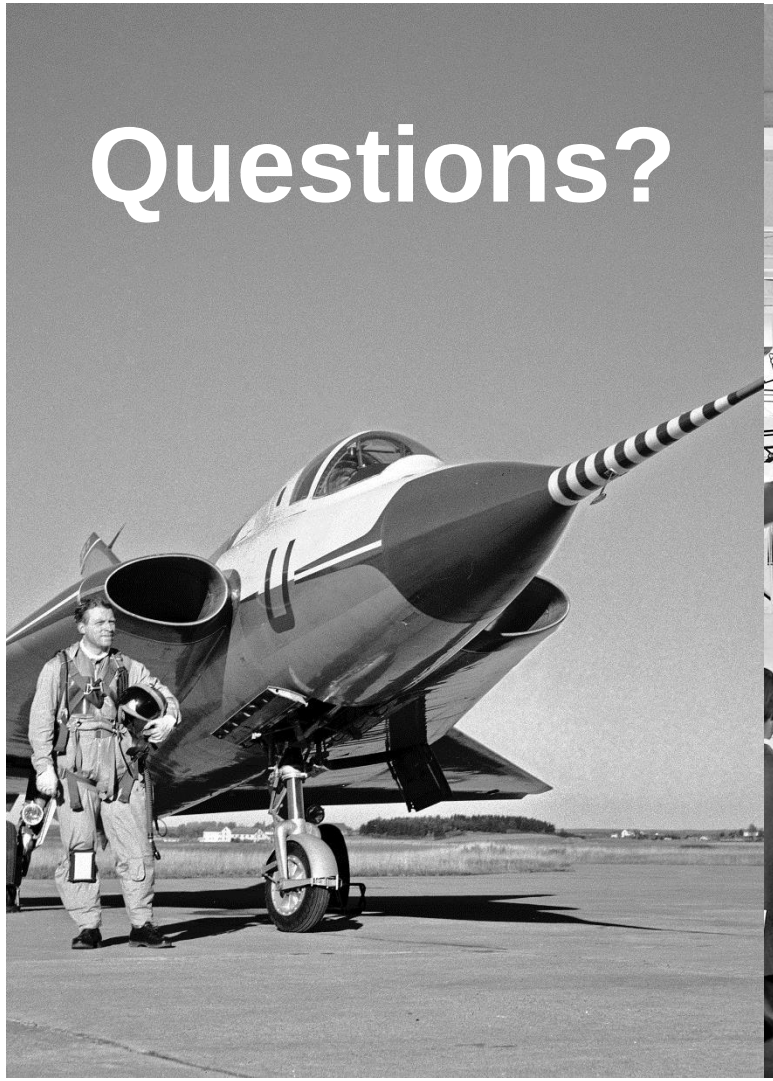
Questions?



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