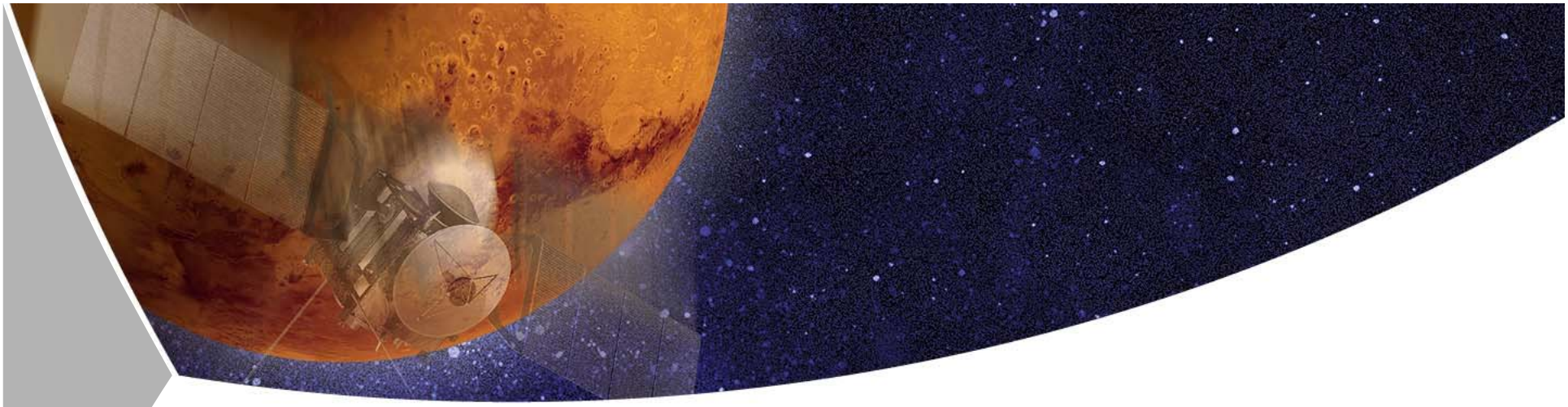


Collaborative Development of a Space System Simulation Model

Volker Schaus

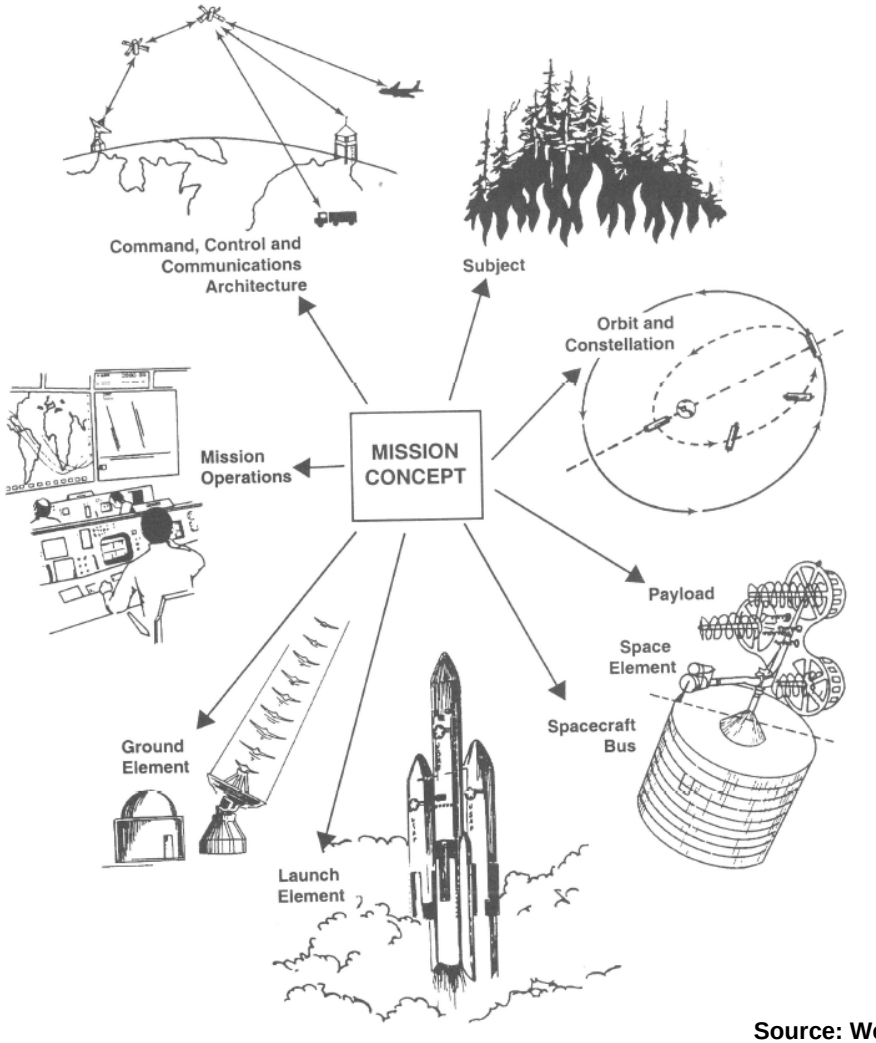
20th IEEE International Conference on Collaboration Technologies and Infrastructures

2nd International Track on Collaborative Modeling & Simulation - ***CoMetS'11***

Outline

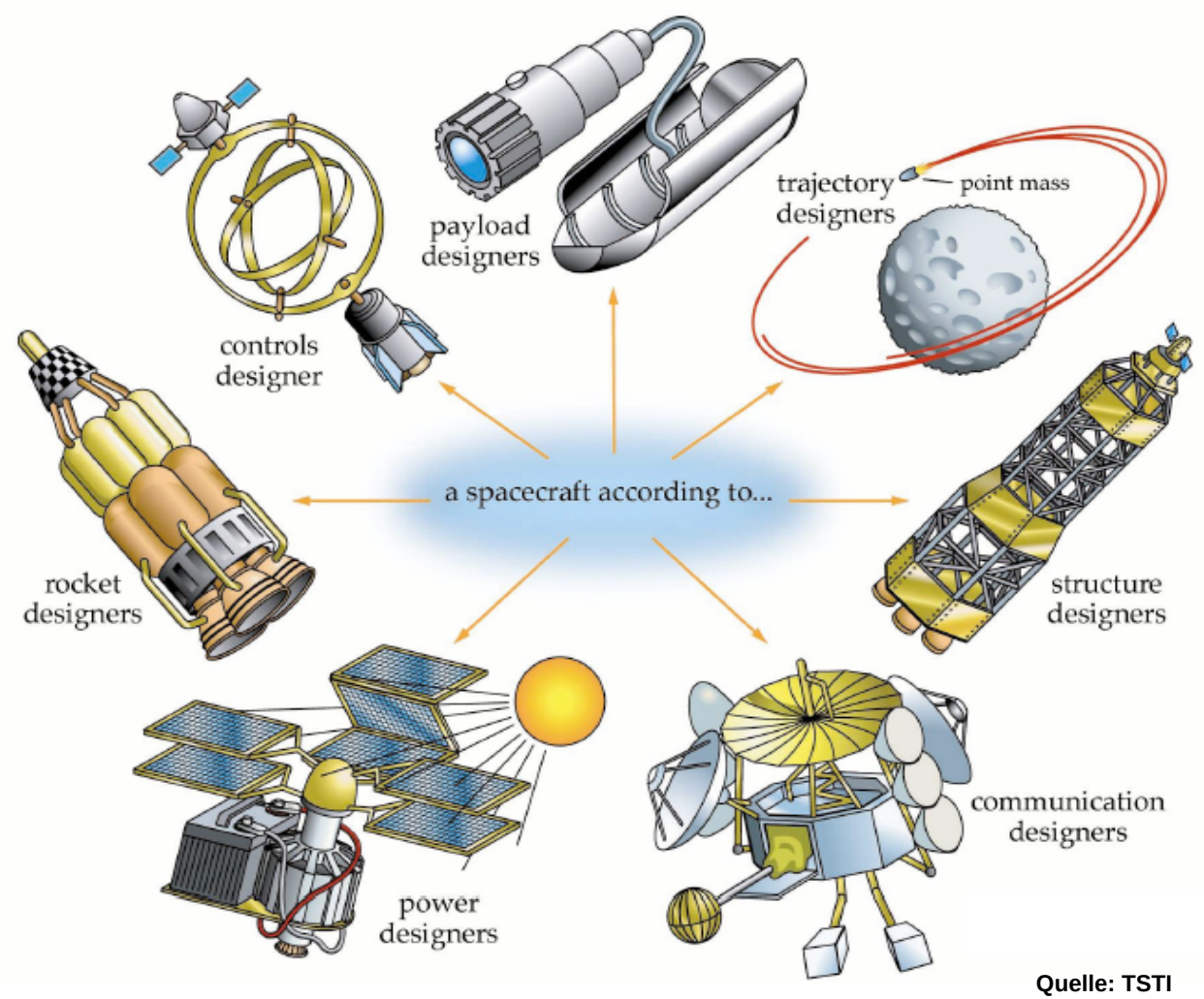
- Introduction
- Model development process and reuse activity
- Space System Simulation Model
- Model database
- Conclusion

Introduction – Space System Design



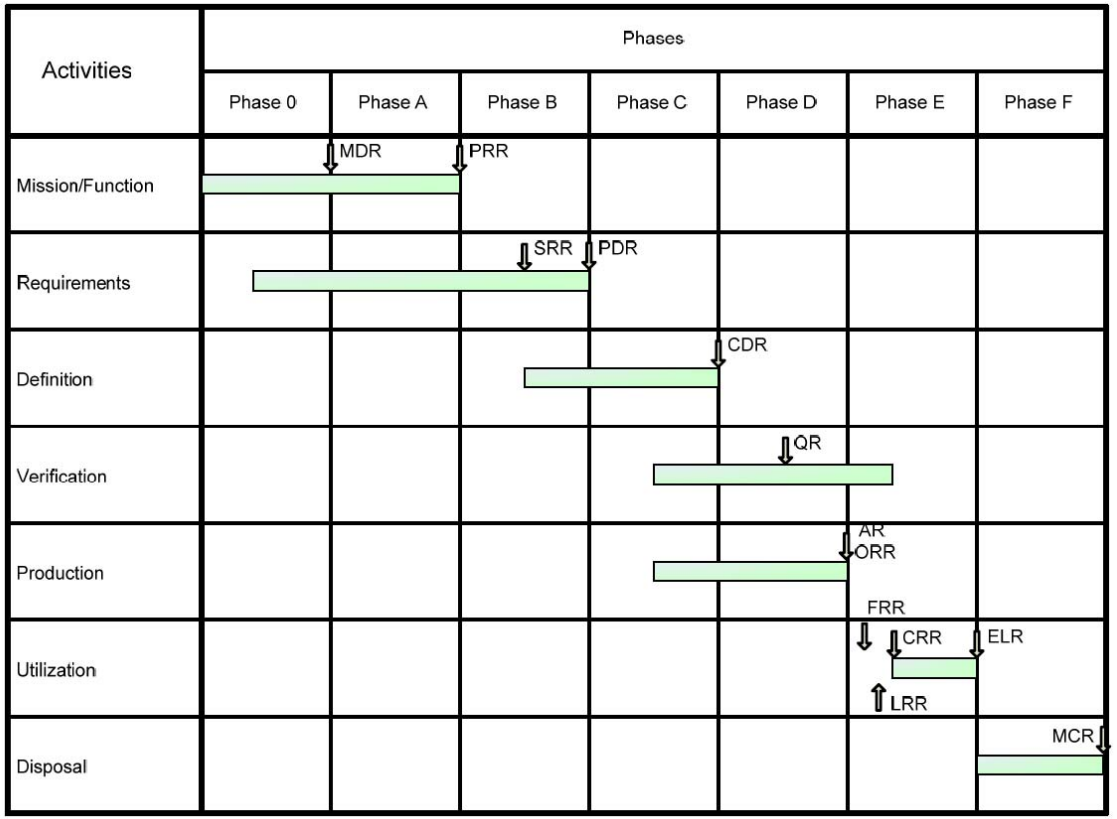
Source: Wertz, Larson - Space Mission Analysis and Design

Introduction – Space System Design



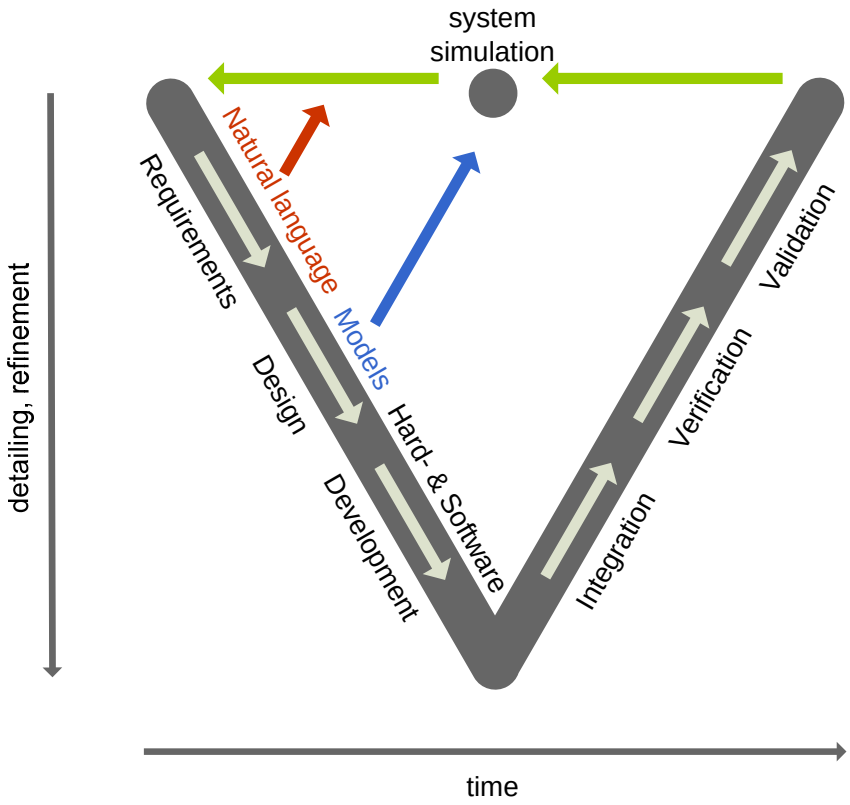
Quelle: TSTI

Introduction – Product Lifecycle



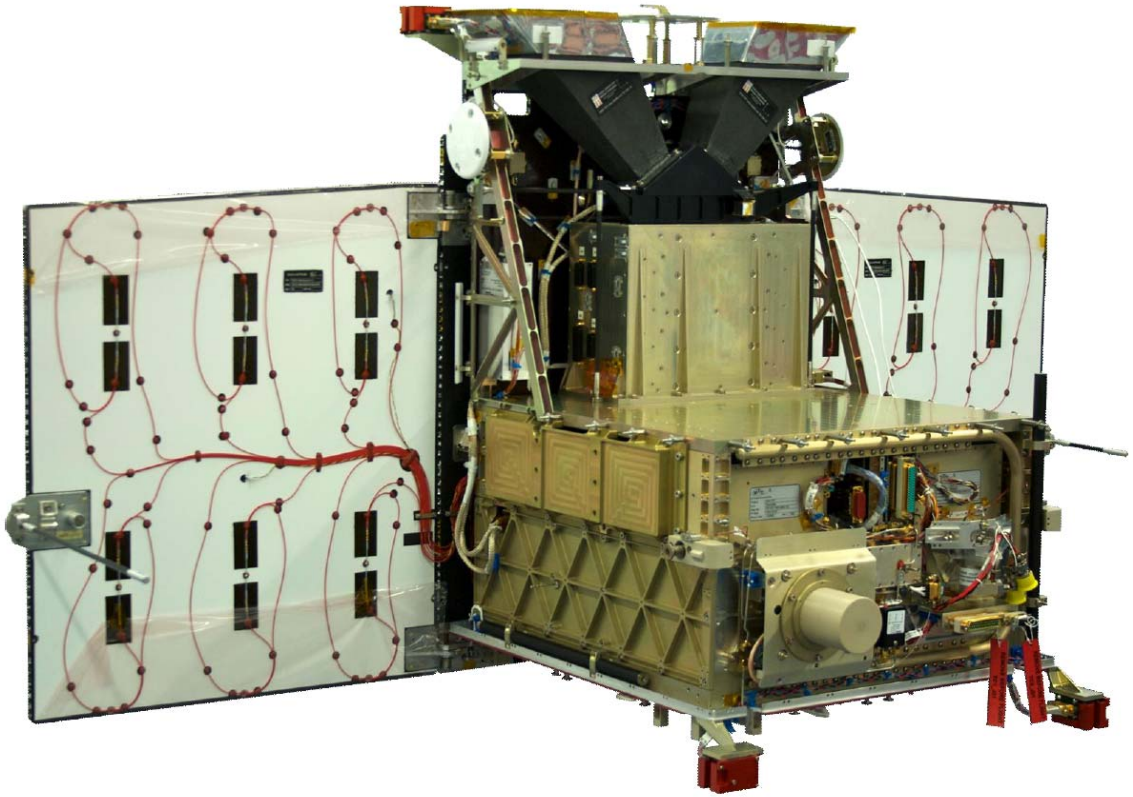
Source: European Cooperation for Space Standardization ECSS-M-ST-10C

Introduction - Simulation



- System simulation
- Requires time and effort
- Contains knowledge
- Large research organization and SME
- Models exist, but…
  - Undocumented
  - Different implementations
  - Different tools
- Model sharing, reuse
- Collaboration across partners

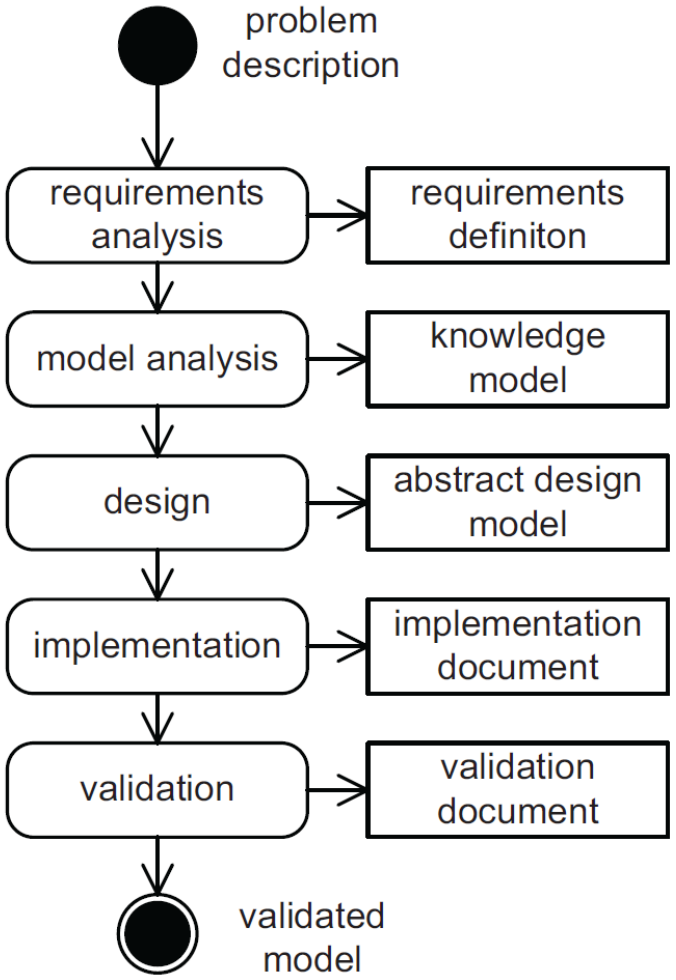
Satellite OOV-TET



- On-orbit verification
- Reusable platform design
- Customizable payload
- Product family concept

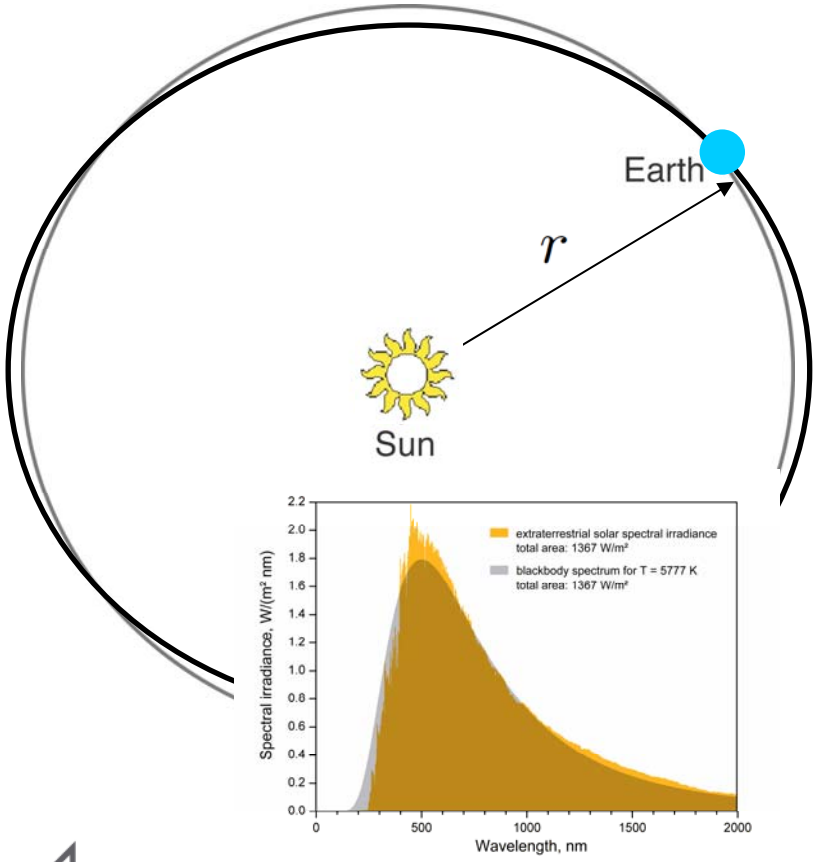
Source: Astrofein

Model Development Process



- Sequential
- Documentation at every step
- Tools, integration
- Collaboration
- Review process

Example – Sun's flux model



- Space environment
- **Requirement:**
  Radiation of the Sun
- **Knowledge model:**
  Stefan-Boltzmann-Law

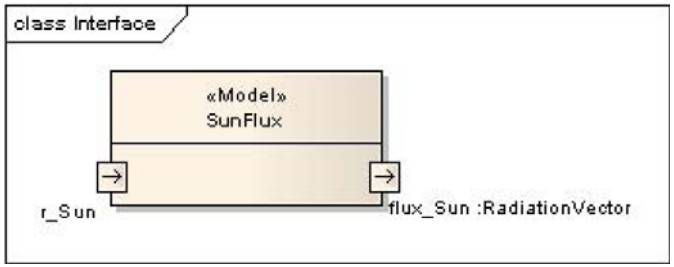
$$\Phi(r) = \sigma T^4 \left(\frac{R}{r}\right)^2 r$$

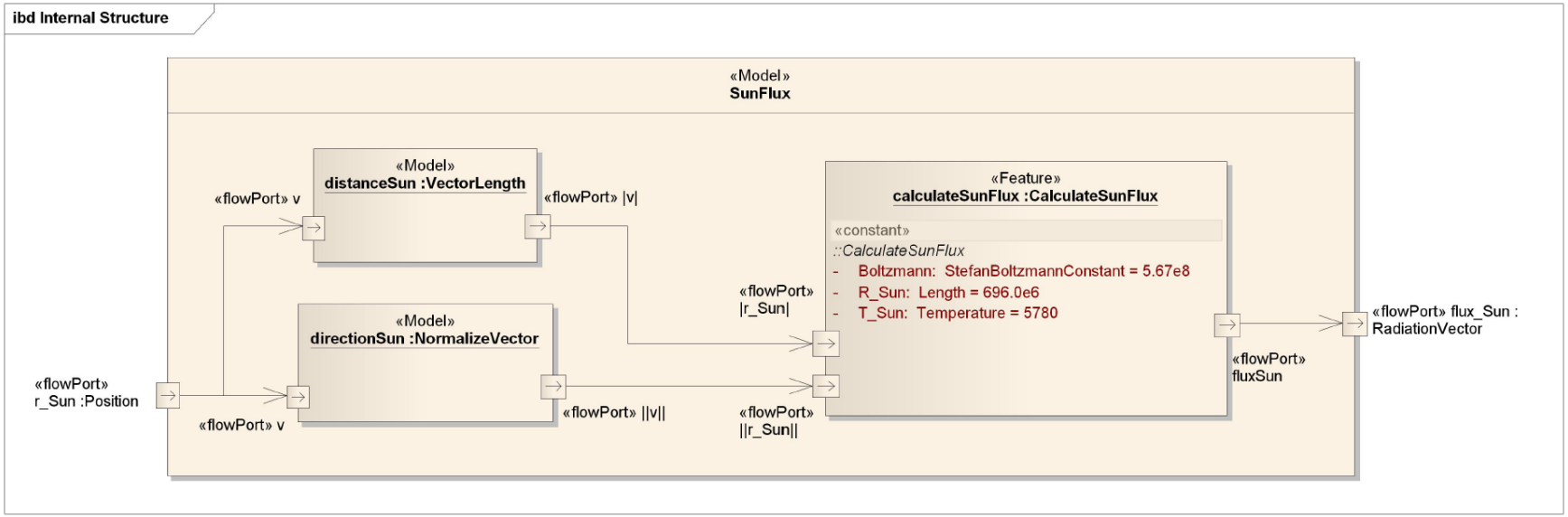
Assumptions

- Variations and the Sun's cycle are neglected
- Earth's orbit around the Sun is assumed to be circular
- Sun's radius is assumed to be constant
- Sun is considered as a black body

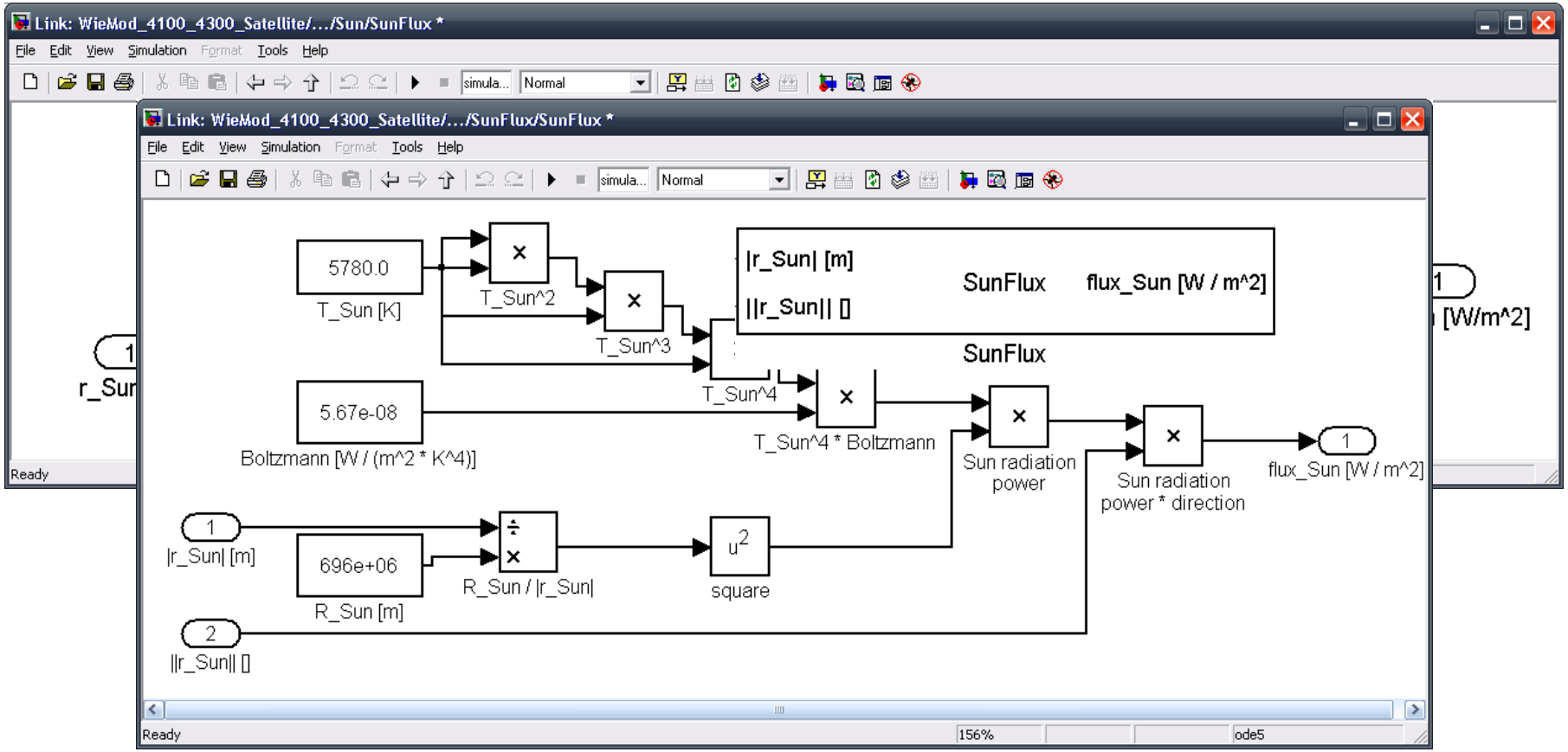
Abstract Design - SysML

- Class interface: input / output ports
- Internal structure: data flow, architecture

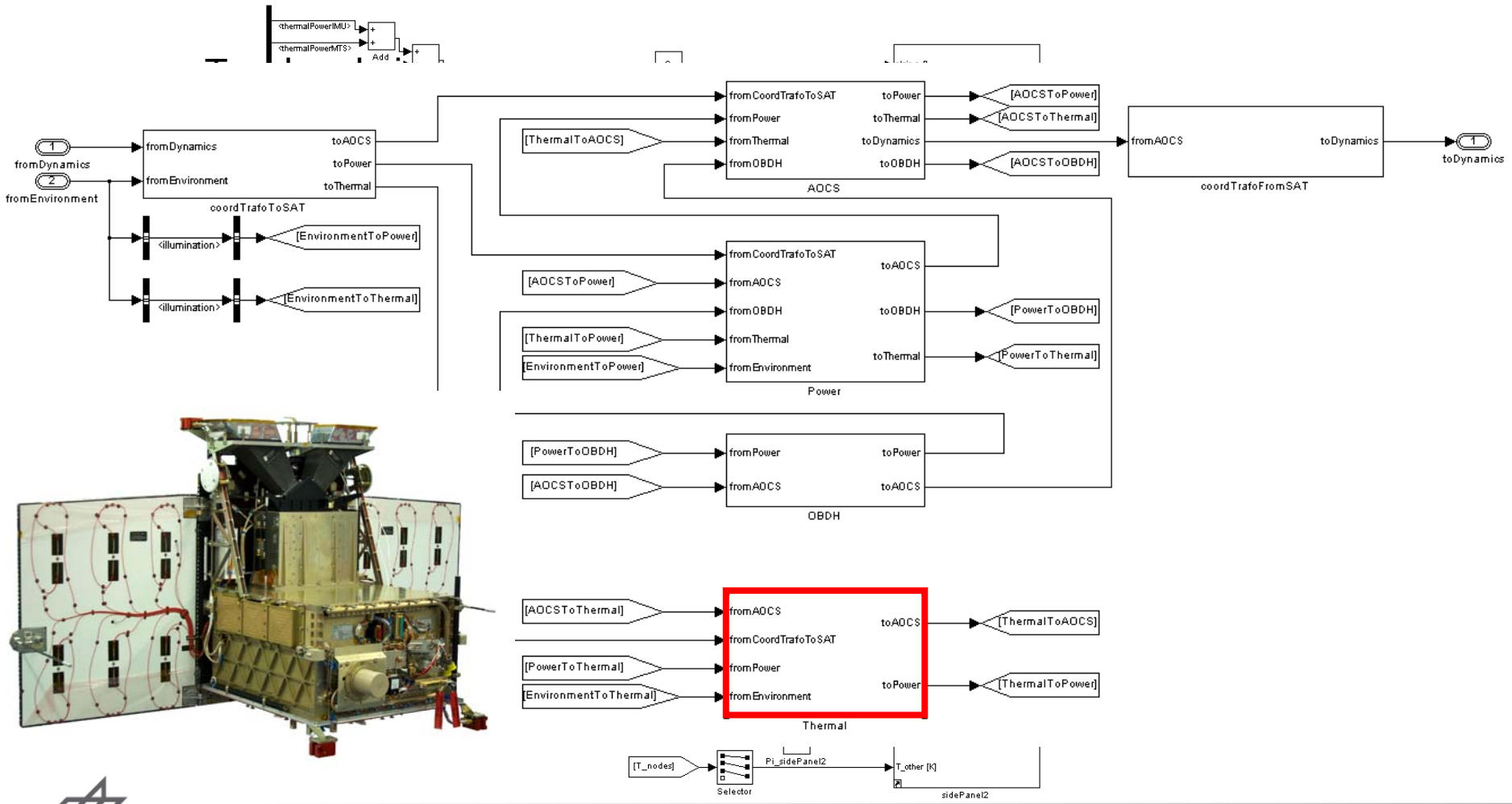




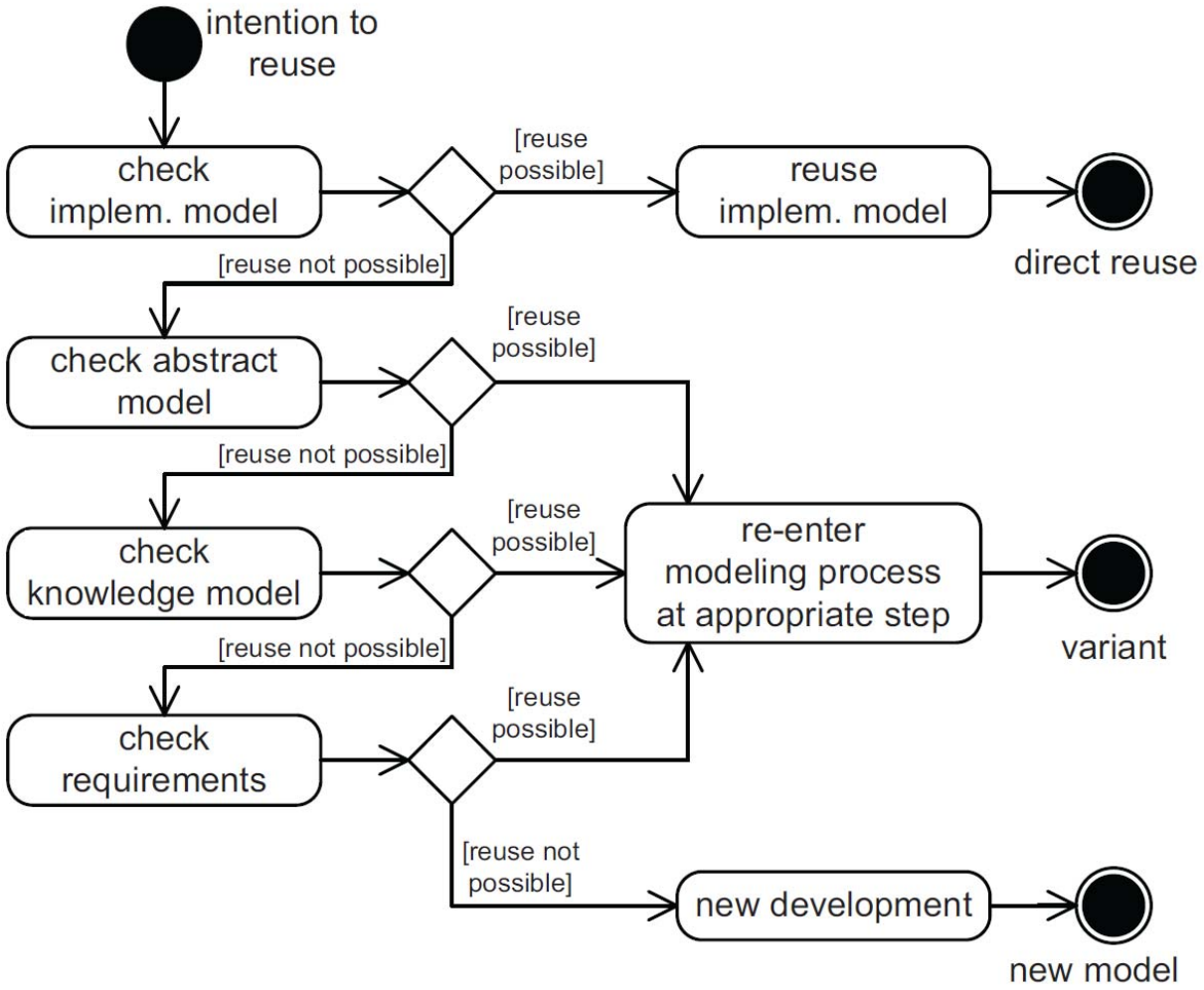
Implementation – Simulink



Satellite Model



Model Reuse Activity



Model Database – SimMoLib

SimMoLib

- Development of a model library
- Reuse of models
- Knowledge base
- Collection of simulation models across projects and institutes / partners
- Web-based search client
- Allows variants
- Basis for model-driven development in engineering
- Modern database and version control concepts

Search Simulation Models

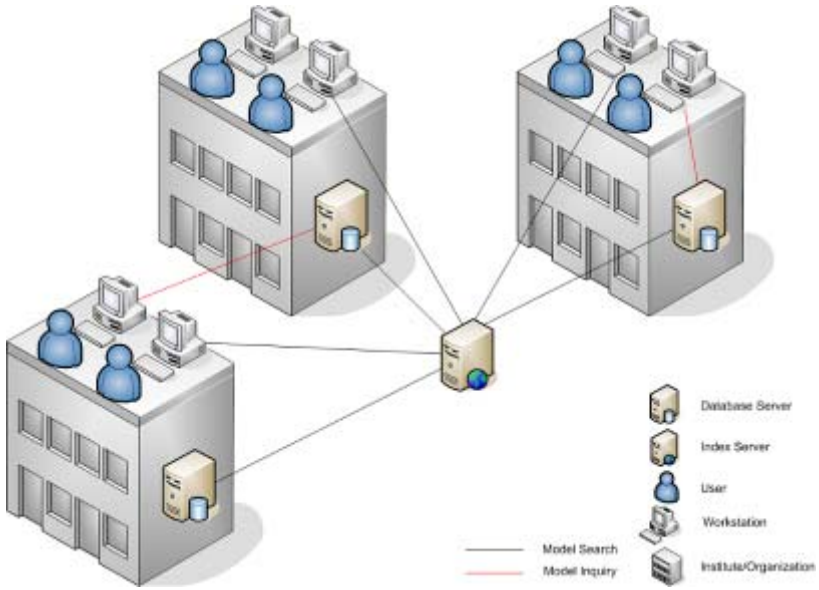
enter some keywords

Search

e.g. solar panel, aocs, ...

3 model(s) found

Name	Description	Keywords	Release	Status
ModelicaBattery	This is a battery model developed in Modelica.	modelica, battery, power	0.1	validated
EME2000toTOD		matlab, stk	1.0	validated
SMP2Model	A SMP2 model	smp2, battery, power	1.0	validated



CouchDB relax

mercurial

SUBVERSION

git

Conclusion & future work

- Model development process
  - Documentation, review, reuse
  - tool integration
- System simulation of OOV-TET
- Model database

- Extend the satellite simulation with more subsystems
- Use it for qualification, training
- Make model database operational

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- Co-Authors
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Astro- und Feinwerktechnik Adlershof GmbH

DLR

itemis

ISG

ISW Institut für Steuerungstechnik der Werkzeugmaschinen und Fertigungseinrichtungen Universität Stuttgart

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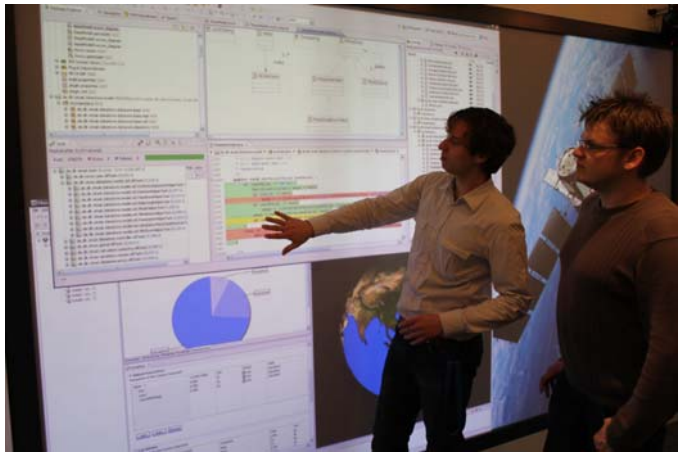
Contact



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Thank you for the attention…