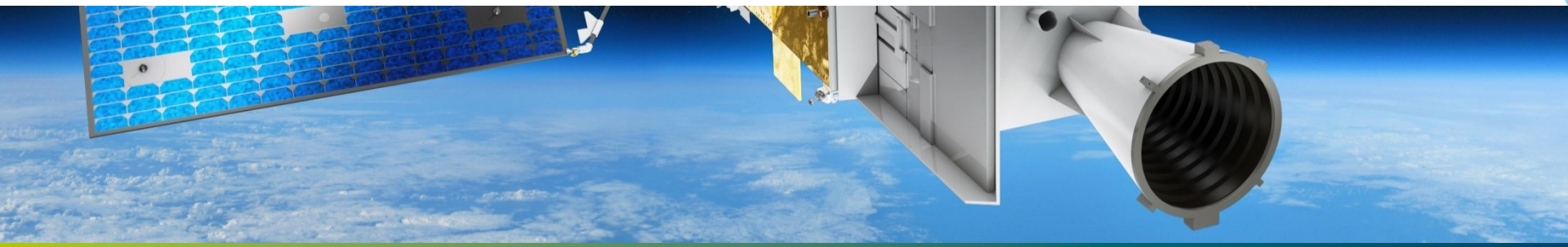
OHB System AG
Andreas Wortmann
28. September 2020, ESTEC, Virtual Setting

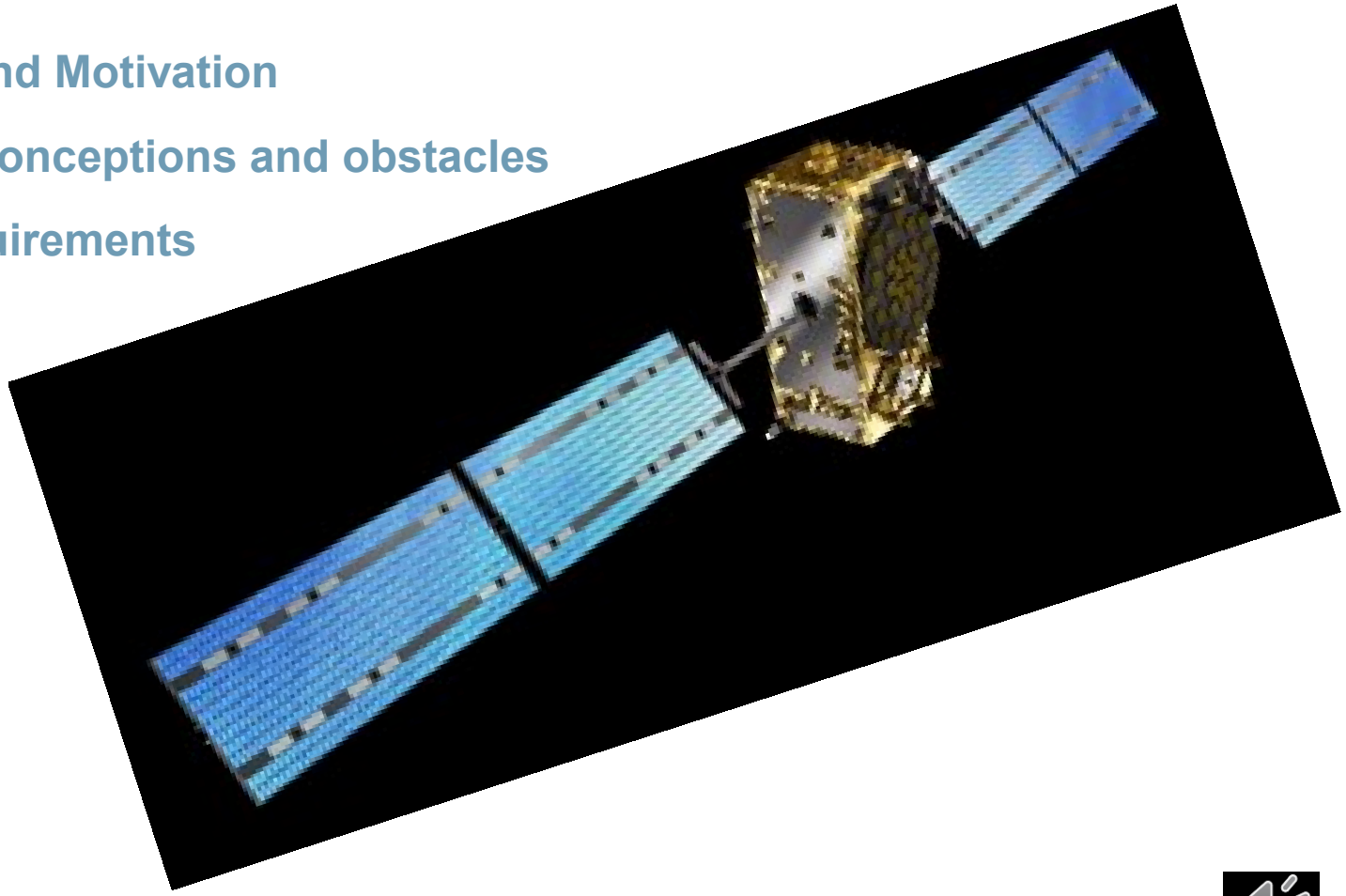


SPACE SYSTEMS

EXPERIENCES AND EXPECTATIONS WITH MODEL BASED SYSTEMS AND SOFTWARE ENGINEERING

Agenda

- Introduction and Motivation
- Common misconceptions and obstacles
- Essential Requirements
- Outlook



Introduction and Motivation

- Projects for a long time have engaged ideas of [illegible]ed engineering
  - in various flavors
  - in order to optimize quality and efficiency of development.

- ADCSS 2016 some examples have been presented
  - Software Development (UML, Rhapsody, EA)
  - Hardware/Software Codesign (focus in Interface Definitic
  - Timing Analysis (Mathematical Model)
  - Mission Analysis and Breakdown (Capella)
- Since than more projects engaged / related with MBSE
  - Requirements, Simulator Development
  - PDM

- Most activities have been carried out in isolated applications
  - not sharing data, structure and processes

→ Lessons Learned boil down to the presented Comments and Requirements

Common Misconceptions a

Language and Wording

The term 'model' is overloaded

- Simulator (modelling some behav
- Spacecraft model like the EM, PFM

MBSE commonly is mistakenly understood to be …

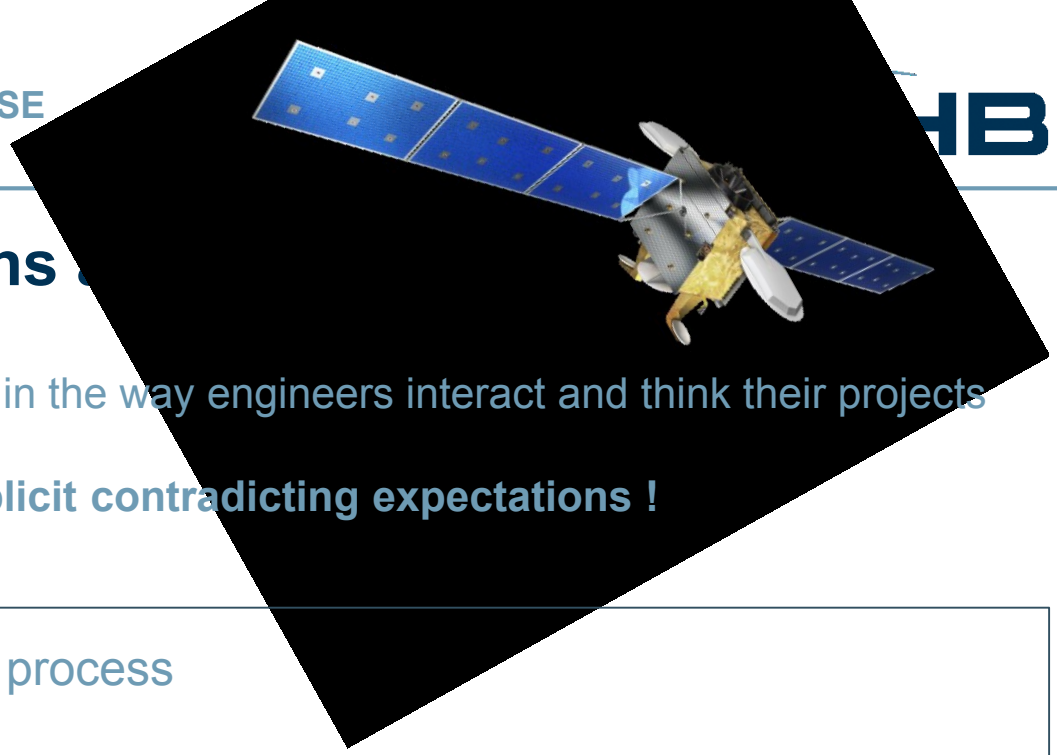
- Synonymously with “using UML or SysML”
- Something graphical

New terms with unclear or overlapping semantics introduced

- digital clone, digital twin
- digitalization, digital continuity
- …

Their use sometimes seems rather arbitrary

Common Misconceptions



MBSE calls for a significant change in the way engineers interact and think their projects

But there are implicit contradicting expectations !

Introducing MBSE is a long-term process

↯ Implicit expectation that the Return of Invest is quickly achievable in short term

Expectation that everything will be better, more efficient and cheaper

↯ Assumption that we don't have to change our way of thinking and

↯ Assumption that we don’t need to invest in related development processes

Common Misconceptions

Elements (source code, docs, configuration) with heritage can be fully reused

- Different tools and infrastructure call for different artifacts

Replacing artifacts with heritage by models inadvertently leads to loss of heritage

- Prior knowledge (good design pattern) are rigorously applied to all artifacts
- Heritage is in reuse of concepts and pattern rather than in source code
  → Possible by raising the level of abstraction when actually implementing

Essential Requirements

Some Basic Requirements against an envisioned MBSE Environment

- Scale to Size and Complexity of Future Systems
- Collaboration of many different Engineering Disciplines

Two (apparently) contradicting needs: an engineer …

- ... requires a stable baseline to base his work on
  (continuous changes will stifle progress)
- … requires the latest information in order to not design the wrong system

Both is required:

→ Transaction-based collaboration (e.g. git in s/w Eng. with branch/diff/merge)

→ Collectively edit a model in a “google docs style” (e.g. concurrent engineering)

Essential Requirements

User interface (UI) is important for acceptance and efficient operation

- 1000-button menus for doing simple jobs are not suitable
- Customized to the engineering task (only see the buttons and options needed)
- Tooling must remain live even with very large models being handled
  - Interactive failure and consistency checks and simple analyses
  - No fading out while editing
  - No “make”-button to trigger long lasting activities

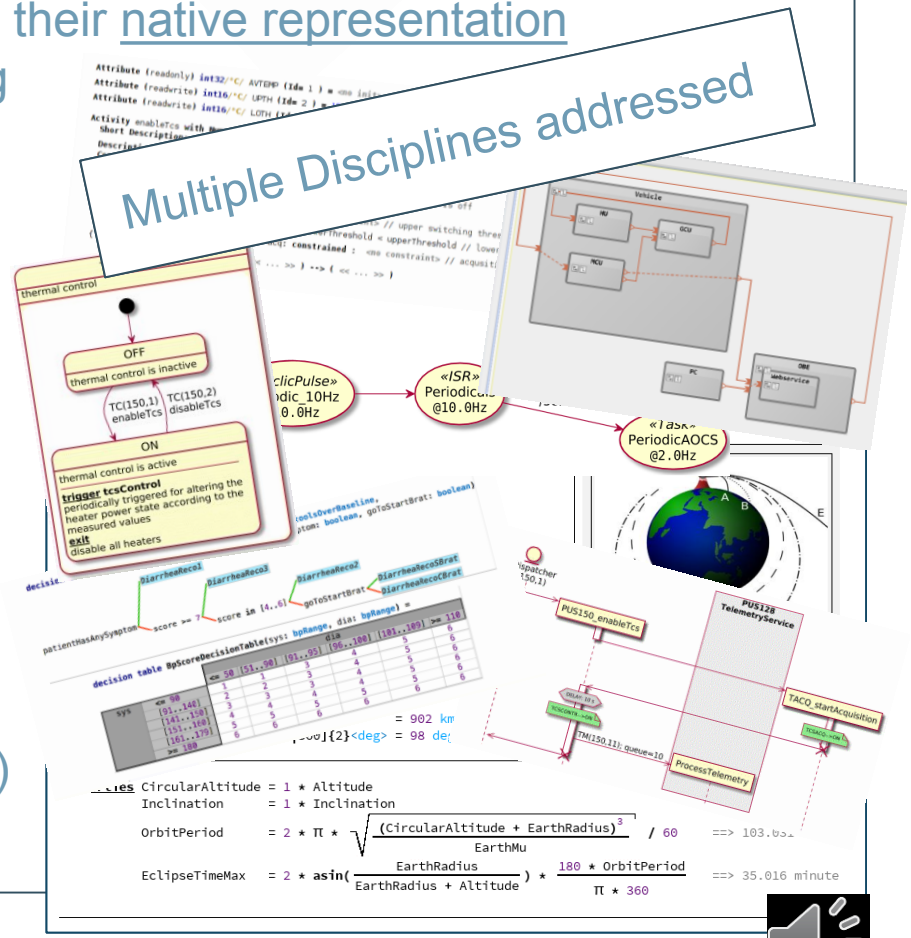
Essential Requirements

Edit domain specific aspects of a system in their native representation

- More than what's achievable when using UML/SysML or item trees

- Multiple paradigms including
  - prose-style (high level requirements)
  - declarative (type system)
  - behavioral (test, math expression)
  - structural (deployment) languages

- Multiple notations including
  - guided text (requirements)
  - tabular (lookup)
  - graphical (state machine, deployment)
  - symbolic (math, chemistry) notations

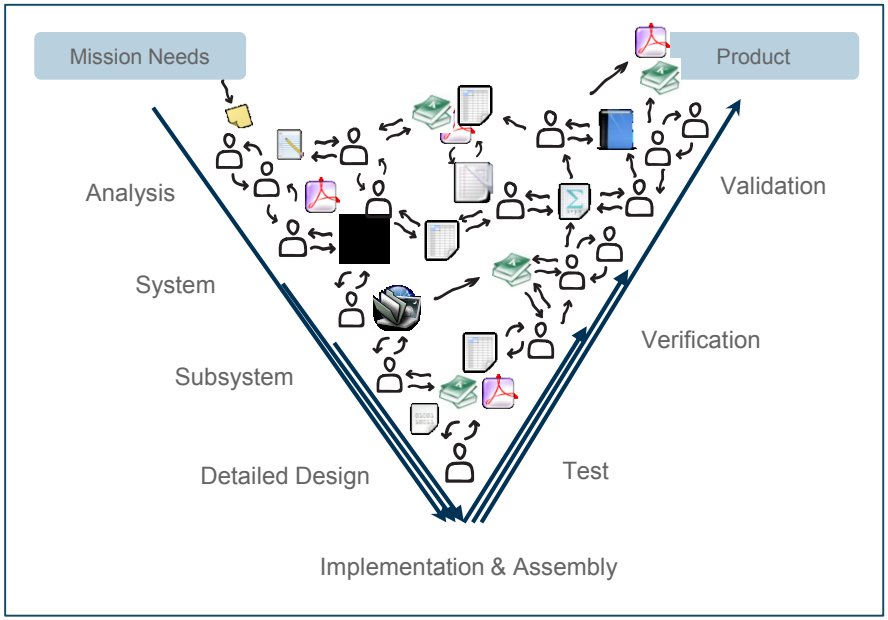


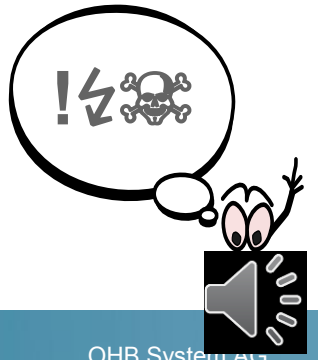
Outlook

How could such a future engineering framework look like ?

Now/Past:

- Discipline Specific Tools (CAD, Thermal, FMECA, Software, Radiation …) export into and import from General Purpose Formats (Excel, Word, CSV …)
- Data Exchange between Engineering Disciplines commonly is exchanged via such General Purpose Formats

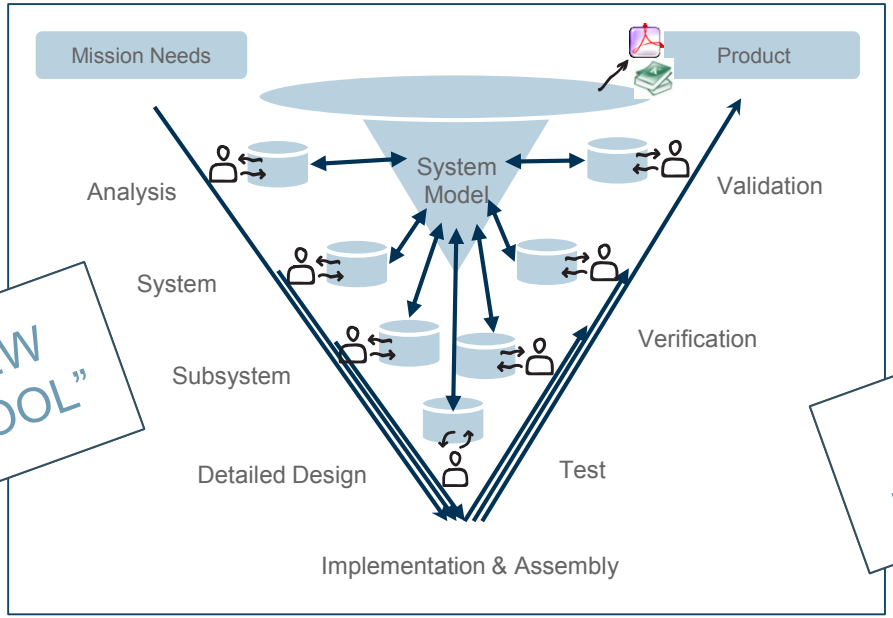




Outlook

1st Improvement:

- Substitute General Purpose Formats with a set of shared models
- Discipline Specific Tools operate on their own local models (MB Engineering) and may be transformed and exchanged among Tools
- In an MBSE environment data common to multiple disciplines is shared in a common model (need to synchronize with local models)



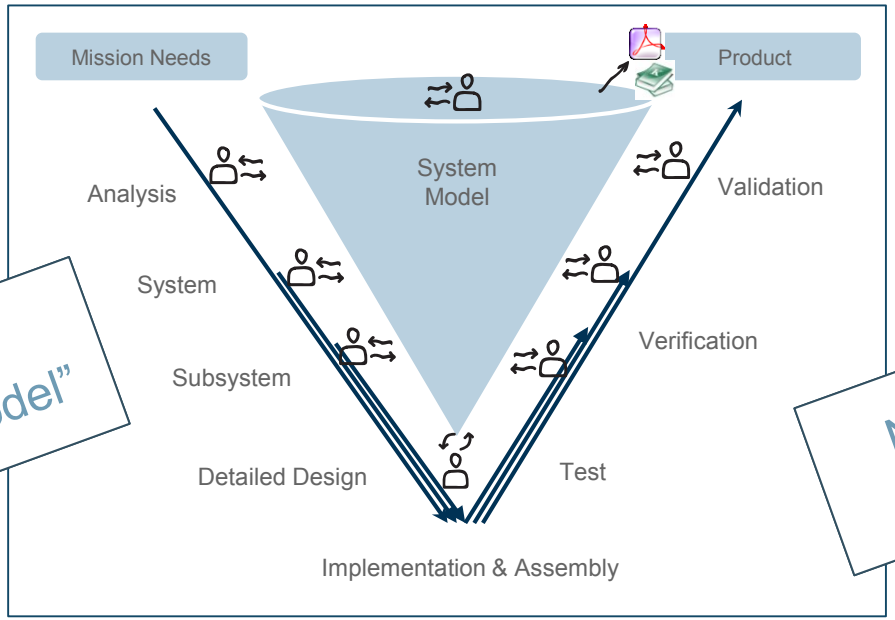
No "ONE BIG NEW ENGINEERING TOOL"

PDM implements many of these needs

Outlook

2nd Improvement:

- Substitute the set of models with a single common model
- Discipline Specific Tools directly interact with the common model (requires API to support transaction-based or continuous exchange of data)
- Repo/Hub to provide collaboration features
- Workbench for direct model maintenance



Focus on a "Single Shared Model"

No common Tool, but common Framework

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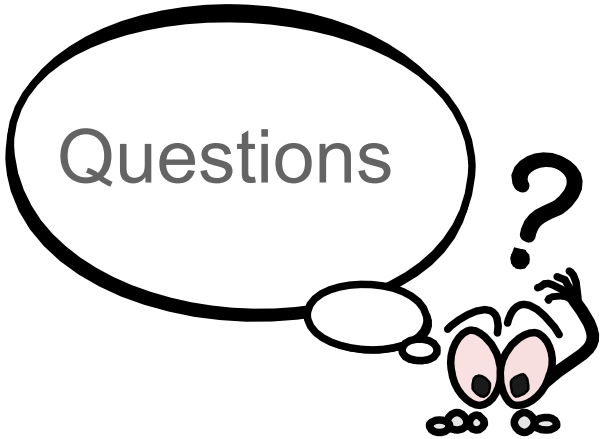

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