

Model-Based SE and Design: Goals, Tools, Process, and People

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- Introduction
- Why do MBSE? What's the value?
- Goals and Questions
- Tools, Process, People
- MB at JPL
 - IMCE (Integrated Model Centric Engineering)
 - OPALS
 - Europa Clipper Mission Concept

The Value Statement

For the development of complex systems, using model based methods should decrease the apparent complexity of a system by increasing the understanding of the system.

Value = $f(\text{Benefit, Complexity, Cost})$

Complexity = $1/\text{Understanding}$

Understanding :=

Knowing the $\rho(\text{Everything})/\rho(\text{Everything Else})$

Four Columns

- Goals and Questions
 - Tools
 - People
 - Processes
-

Goals and Questions

“Wherever you go, there you are.”

Great advice for life or projects with infinite budgets...

...but the relevance is debatable when you want to get somewhere specific.

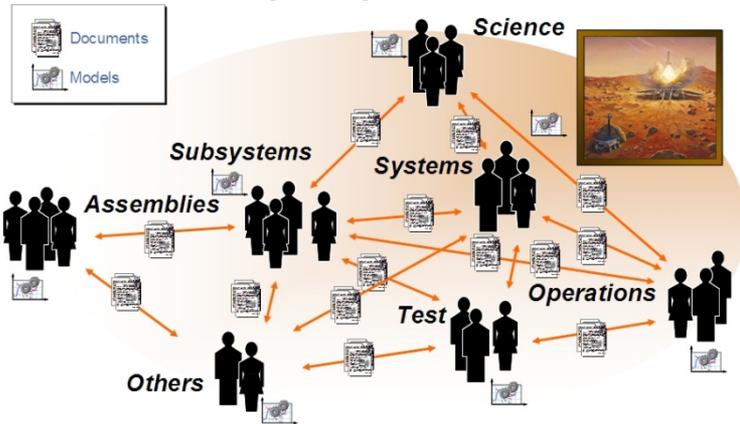
The best way to get any model effort off the ground is to have clearly defined and *flexible* (but not necessarily *detailed*) goals

...otherwise you risk ‘modeling to death’ and driving down value by increasing costs but not increasing understanding.

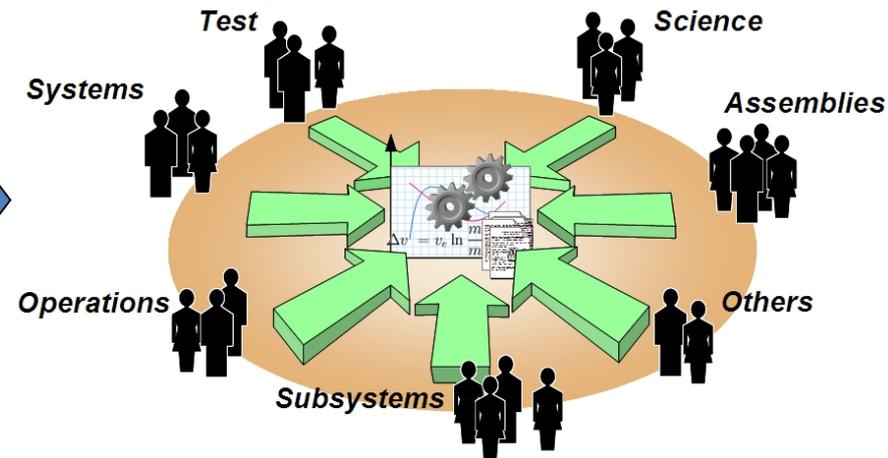
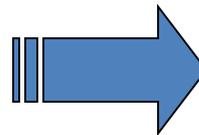
Tools, People, Processes

- These three items have to spiral outwards together.
- They don't have to proceed necessarily in lock step, but if one drags behind, it will impede the others.
- 'People' is probably the most challenging.
 - Having effective tools (ones that work toward goals), processes ('how-to's), and training will help immensely

- **Integrated Model Centric Engineering (IMCE)** is a JPL initiative established to accelerate the application of model-centric engineering (centered around MBSE) **at various levels of detail** across the **full system life cycle**, with a focus on:
 - developing **an institutional re-usable capability** for model-centric engineering practices
 - nurturing model-centric engineering practices by partnering with doing organizations and projects

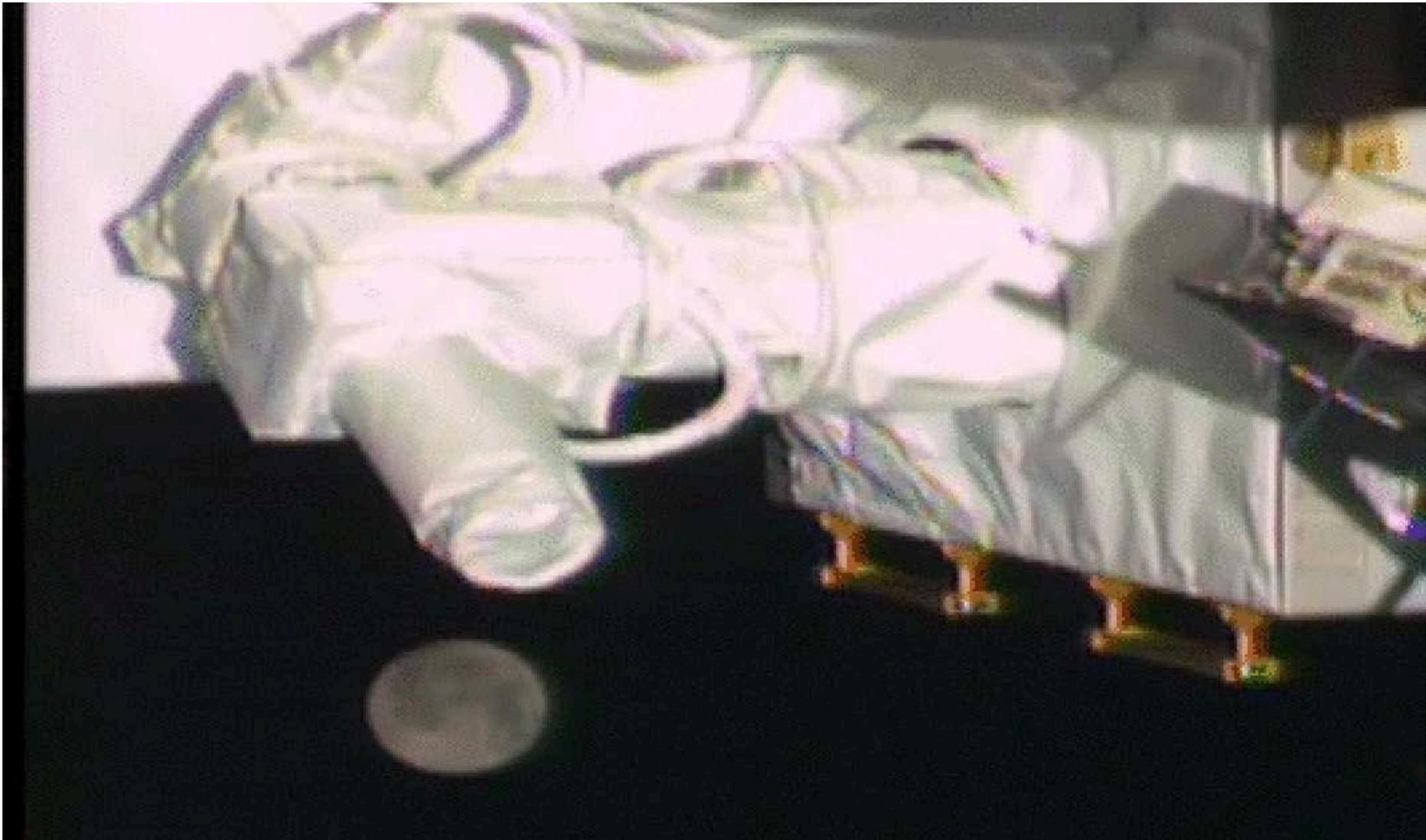


Today: Standalone models are related through documents

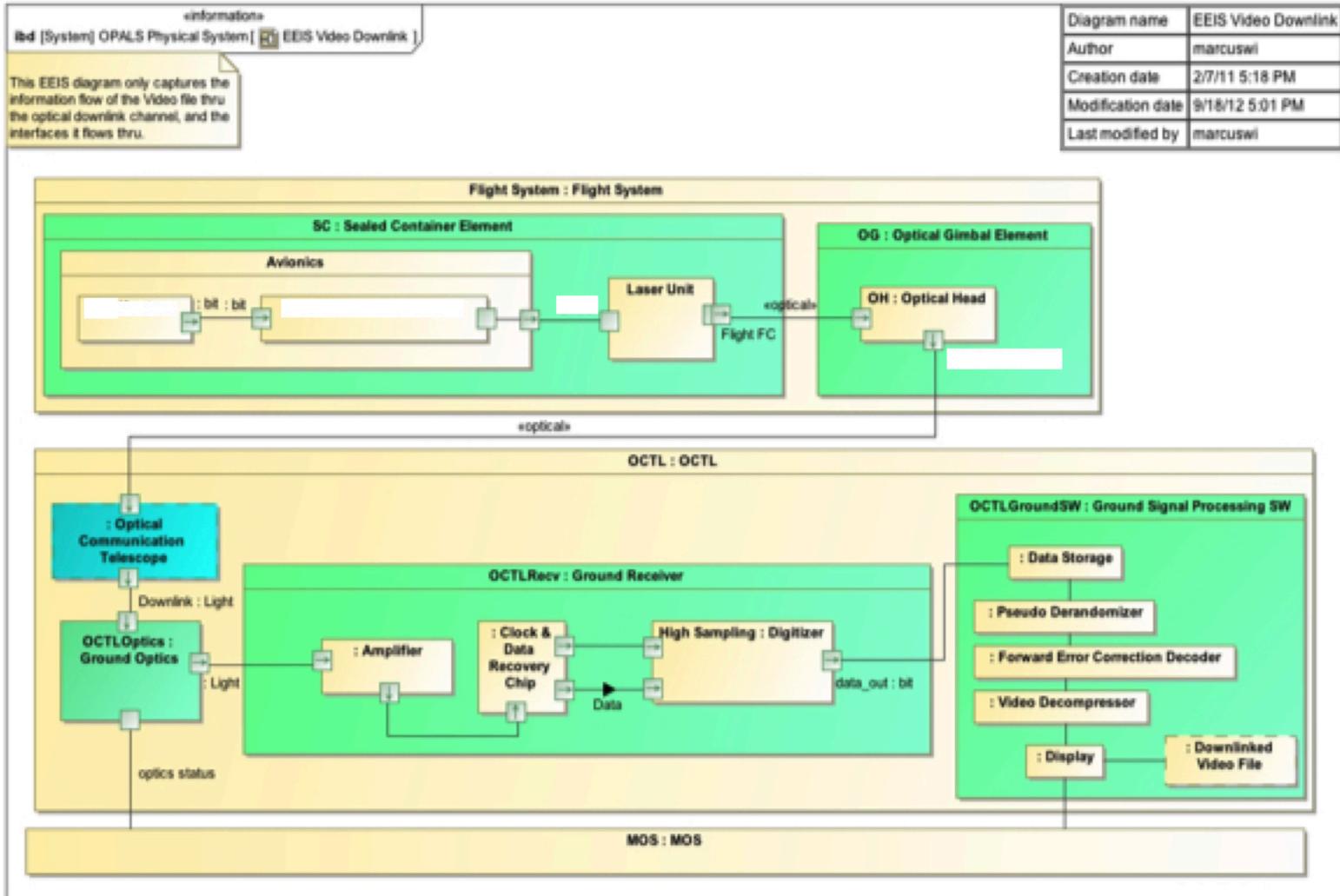


Future: A shared system model with multiple views, connected to discipline models

OPALS on the ISS



OPALS IBD



OPALS Avionics IBD

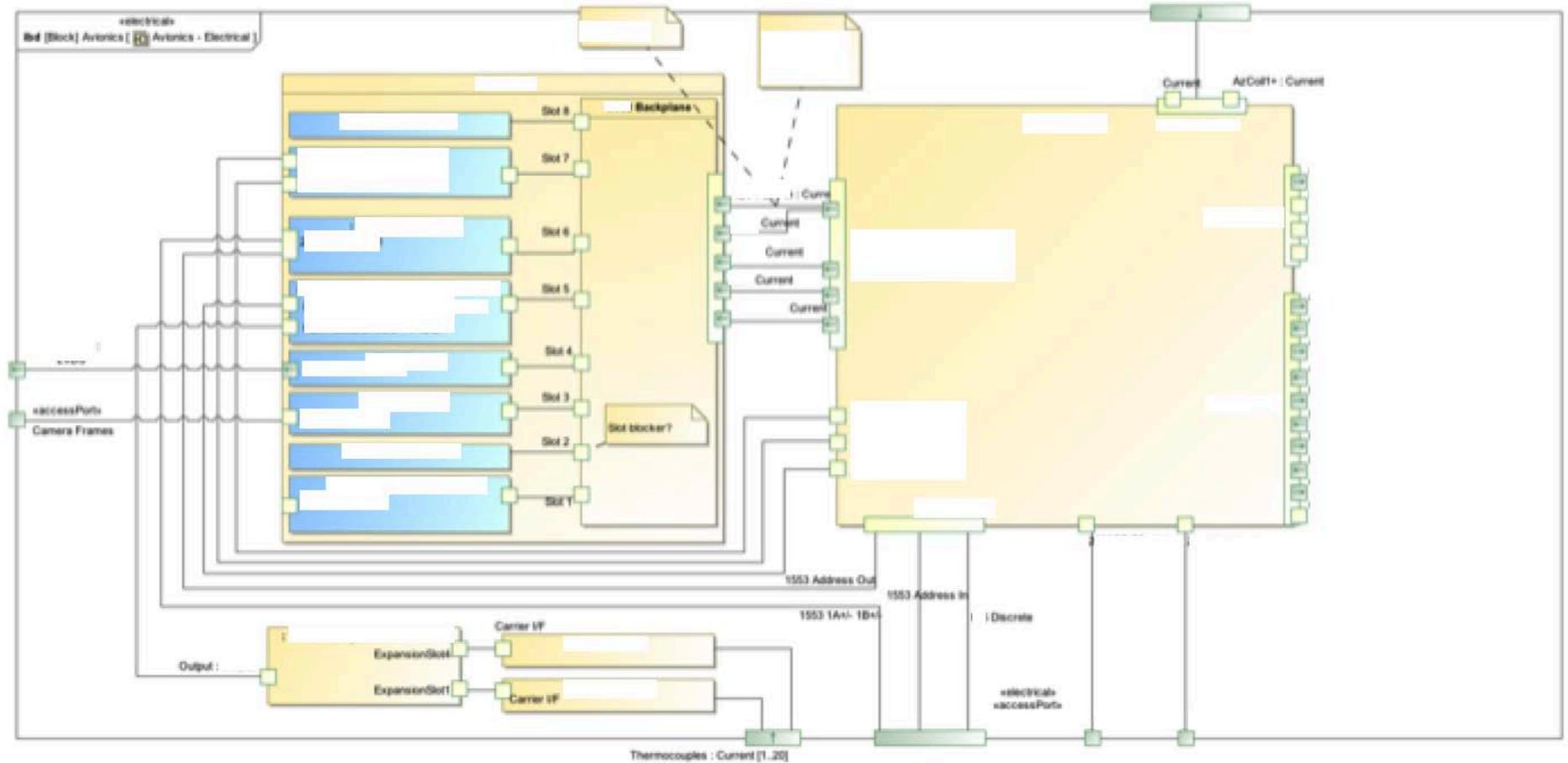


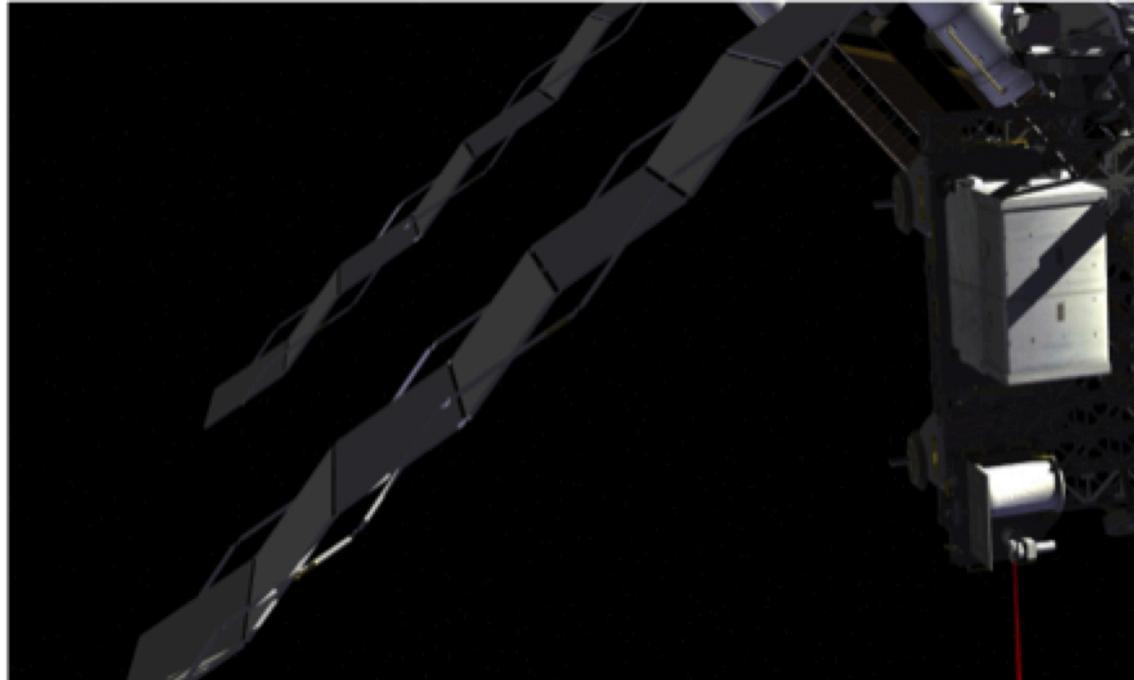
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Chapter 1. Introduction

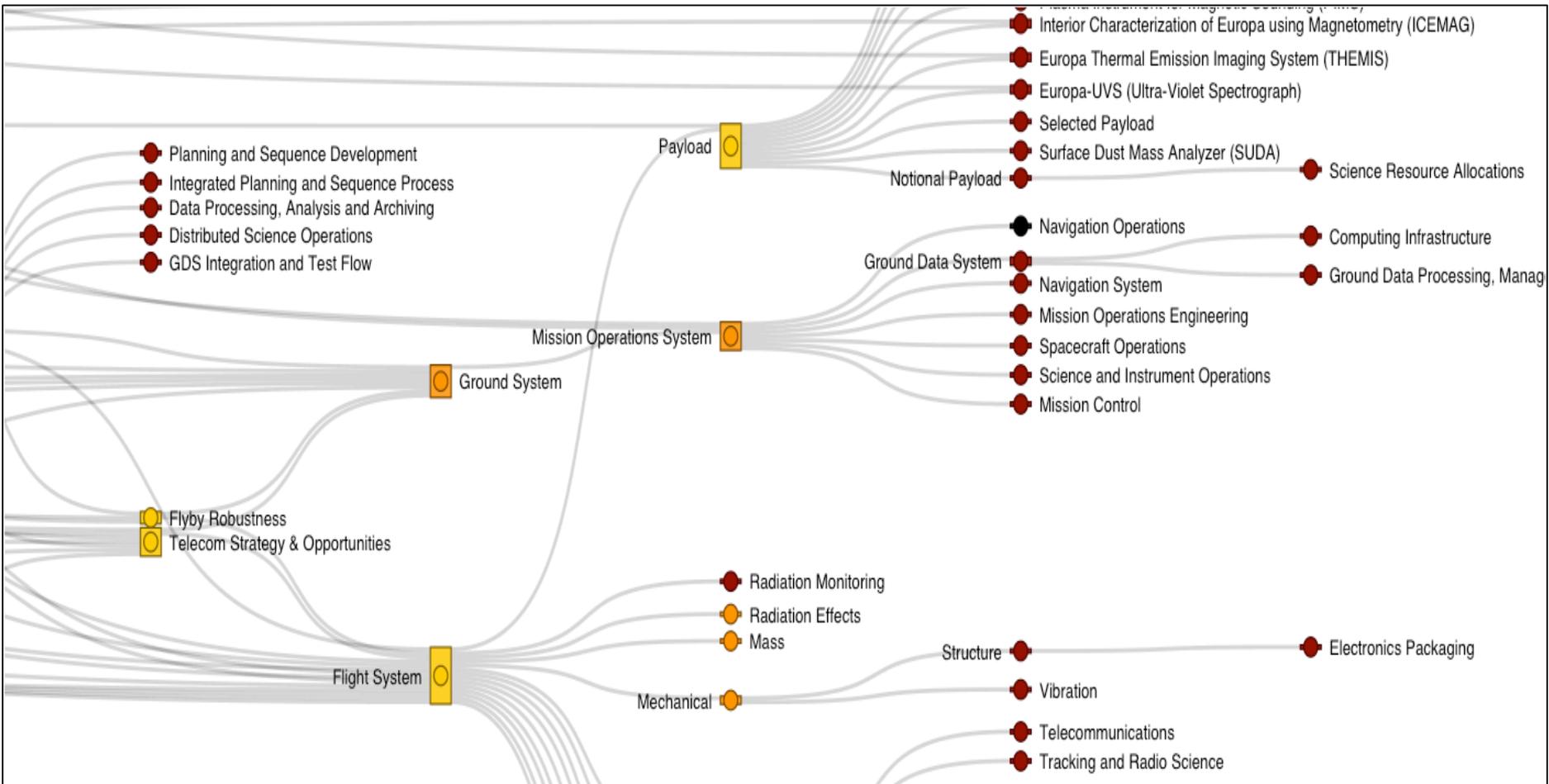
Figure 1.1. FrontPage



Europa Clipper Project

- Flagship mission that would study Europa, projected to launch in the 2020s.
- Top down MBSE support from project SE and project manager down to subsystem level
- Model-Based Architecting to support requirement development for L1-L3/L4
- Resource management (PEL, MEL, TEL)
- ‘Confederation’ of tools: CAD, Phoenix ModelCenter, STK, and other JPL-developed mission tooling

Visualization/Traceability on the Europa Clipper Project



In Summary --

- Model based approaches are a great way to allow the human curiosity to explore a system.
 - (I personally find it *fun* as well)
- Must be structured and goal driven, but much flexible goals allow course adjustments
- Increase the understanding of a complex system, and improve upon returned value.

Thank you, AHS!