# DLR'S MB4CE: A SYNERGY BETWEEN PROCESS AND TOOL DEVELOPMENT

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**DLR's Concurrent Engineering (CE) process** was co-designed with a custom, open-source **MBSE** tool—**Virtual Satellite**. Present work focuses on drastically lowering the tool's **adoption barrier** by making it more **intuitive**, extending process **support**, and integrating complementary **tools**.

## 1. Background

The **CE process** at the Concurrent Engineering Facility (CEF) and the **MBSE tool** Virtual Satellite are developed in close cooperation at DLR. It is also strongly interconnected with its **users**. This ensures a **continuous feedback loop**, making the tool seamlessly fit the process and the needs of the users.

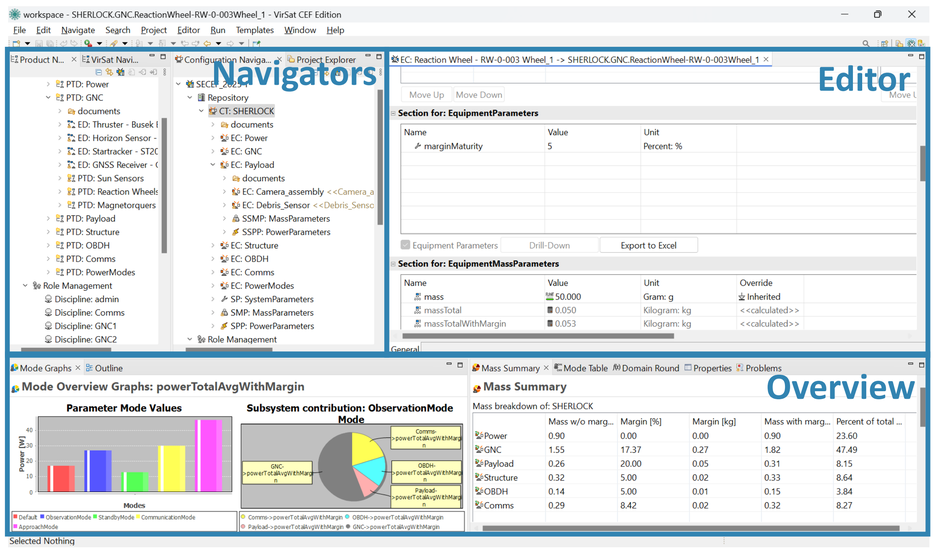
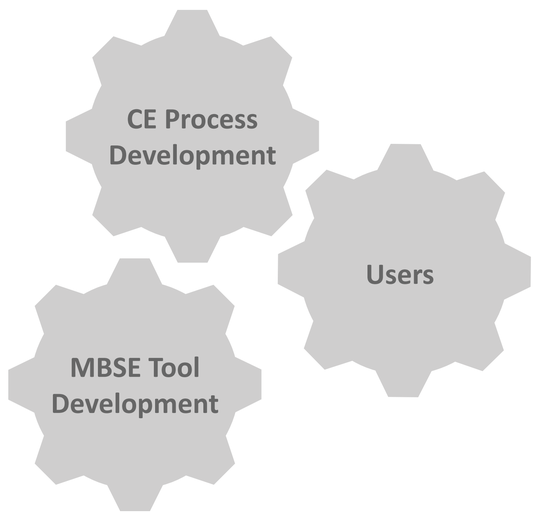



**Figure 1: The interface of the latest version Virtual Satellite 4, based on the Eclipse Rich Client Platform (RCP) and implemented in Java [1].**




## 3. Identified objectives

- A more intuitive and user-friendly interface
- Simplified collaboration functionality, making sharing a project easier
- Secure on-site and remote access
- Extension of domain-specific concepts
- Tracking of design evolution and user activity
- Interoperability between multiple CE centres
- Integration of complementary tools (CAD model, requirements, orbit model, parts library)
- Check of budget calculation consistency
- Optimisation and decision-making support
- Integration of AR and AI

## 2. Method

A **major update** of Virtual Satellite is forthcoming. To this end, a **joint workshop** was convened with the CEF core team and the Virtual Satellite team. Over three days, **key needs and desired features** were presented, and their technical feasibility, integration impact, and rough effort estimates were discussed. The result was a consensus-built **priority list with objectives** that aligns the tool's new features directly with the evolving needs of the Concurrent Engineering process.

To put Virtual Satellite in perspective, two review studies have been considered where the **strengths of Virtual Satellite** and two alternative MBSE tools, ValiSpace and Capella, were **compared**, further identifying any gaps that can be addressed.

**Table 1: Strengths of Virtual Satellite and two alternatives, Valispace and Capella [2,3]**

| Virtual Satellite | ValiSpace | Capella |
|---|---|---|
| • Many functionalities and visualisation capabilities<br>• Quick and easy to model different configurations | • User-friendly interface<br>• Collaboration easy to set up | • High level of abstraction can be achieved<br>• User guidance through applied method |

## 4. Virtual Satellite 5

Although still in development, Virtual Satellite 5 in its current status has already the following features:

- ✓ updated user interface with a cleaner look
- ✓ a dedicated "Analyze" tab, giving the user more control of the output
- ✓ interactive and detailed charts
- ✓ web-based application, such that collaborators can be added by sharing a link
- ✓ real-time collaboration

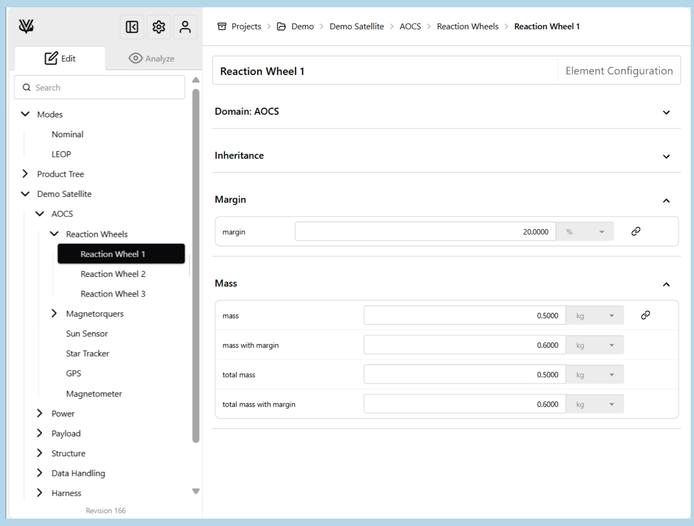


**Figure 2: Interface of Virtual Satellite 5 - Edit View**

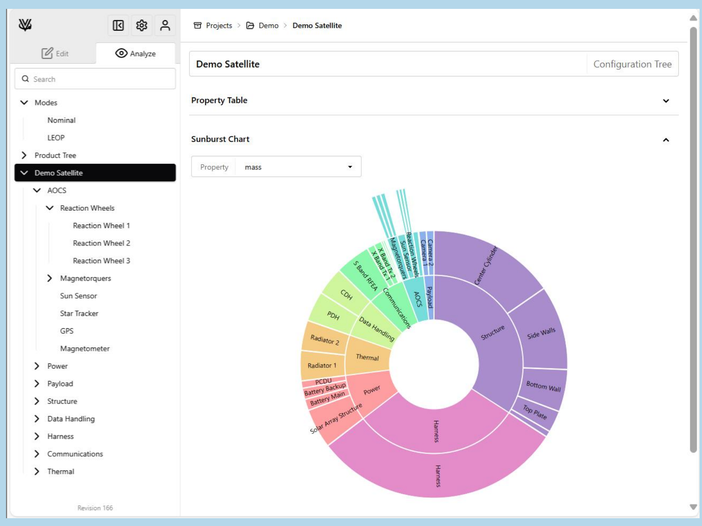


**Figure 3: Interface of Virtual Satellite 5 - Analyze View**

While Virtual Satellite 4 has a built-in **requirements management** module, it was decided to separate this into its own tool going forward: **AutoReq**, developed as a web-based application and optimized for concurrent use. AutoReq is planned to be connected to Virtual Satellite: data will be **easily shared** and requirements can be directly **linked** to the relevant design parameters.

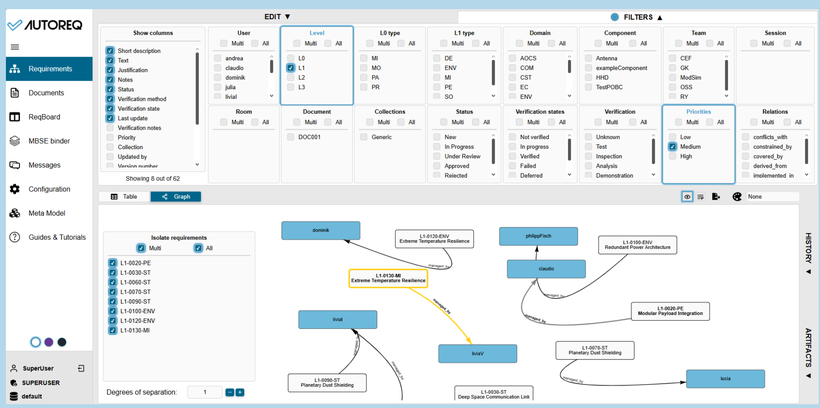


**Figure 4: Interface of AutoReq**

**Want to know more? Let's connect!**

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[1] P. M. Fischer, M. Deshmukh, V. Maiwald, D. Quantius, A. M. Gomez, A. Gerndt. Conceptual data model: A foundation for successful concurrent engineering. *Concurrent Engineering*. 2017;26(1):55-76.

[2] M. Otto (2022) *Capabilities and Boundaries of Model-Based Systems Engineering Tools: An Evaluation of Virtual Satellite and Capella for Space Application.* Bachelor Thesis, Technische Universität Berlin.

[3] A. Kinder, E. Trejo Portal, H. Weber, L. Kohring, L. Omameh, N. Krafzik, P. Gluderer (2021) *MBSE for an Europa Ice Explorer Demonstration Mission*. Bachelor Project, Universität Bremen.

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