2017 IEEE International Symposium on
SYSTEMS ENGINEERING
ISSE 2017
Vienna, Austria – October 11-13, 2017

WORKSHOP

Practical insights into web-based, collaborative engineering of complex hardware systems

Goals

- Learn how modern web technologies can help you streamline your engineering processes
- Gain practical insights into web-based tools
- ?

Outline

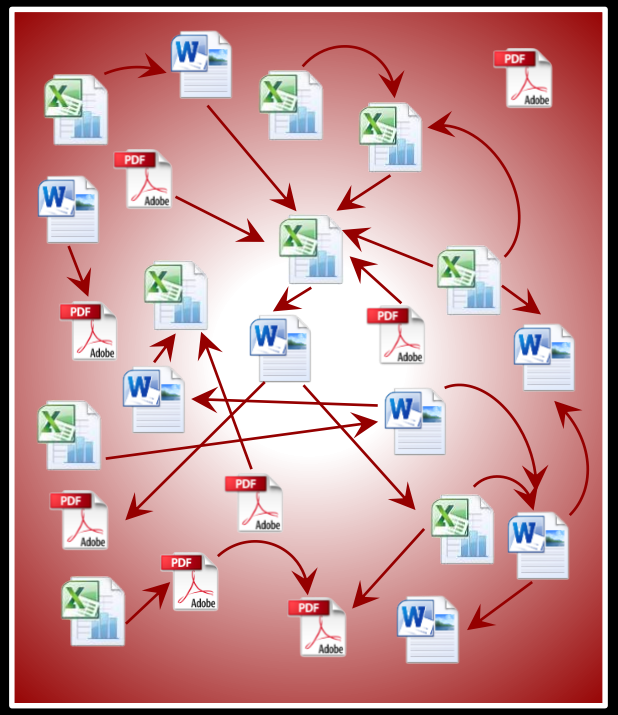
- MBSE and current approaches (~30 min)
- Web based tools and platforms (~20 min)
- Modeling in Valispace (~10 min)
- Hands-on exercise with Valispace (~40 min)
- Conclusions (~10 min)

Intro

- What is your name?
- What industry do you work in?

SATELLITE ENGINEERING

WHAT WE THOUGHT WE WOULD DO



WHAT WE REALLY DO

MBSE and current approaches

Brainstorming exercise

What comes to your mind when you hear "Model Based Systems Engineering"?

Currently used MBSE tools

- NoMagic MagicDraw
- Artisan Studio
- IBM Rhapsody
- Sparx Systems Enterprise Architect
- InterCAX ParaMagic
- Microsoft Visio

Drawbacks of current MBSE systems

- Still mostly an academic field
- Application today only useful in early phase studies
- After early studies the models are abandoned
- Requires time and effort spent on training
- Models don’t prevent inconsistencies
- MBSE tools are not flexible enough

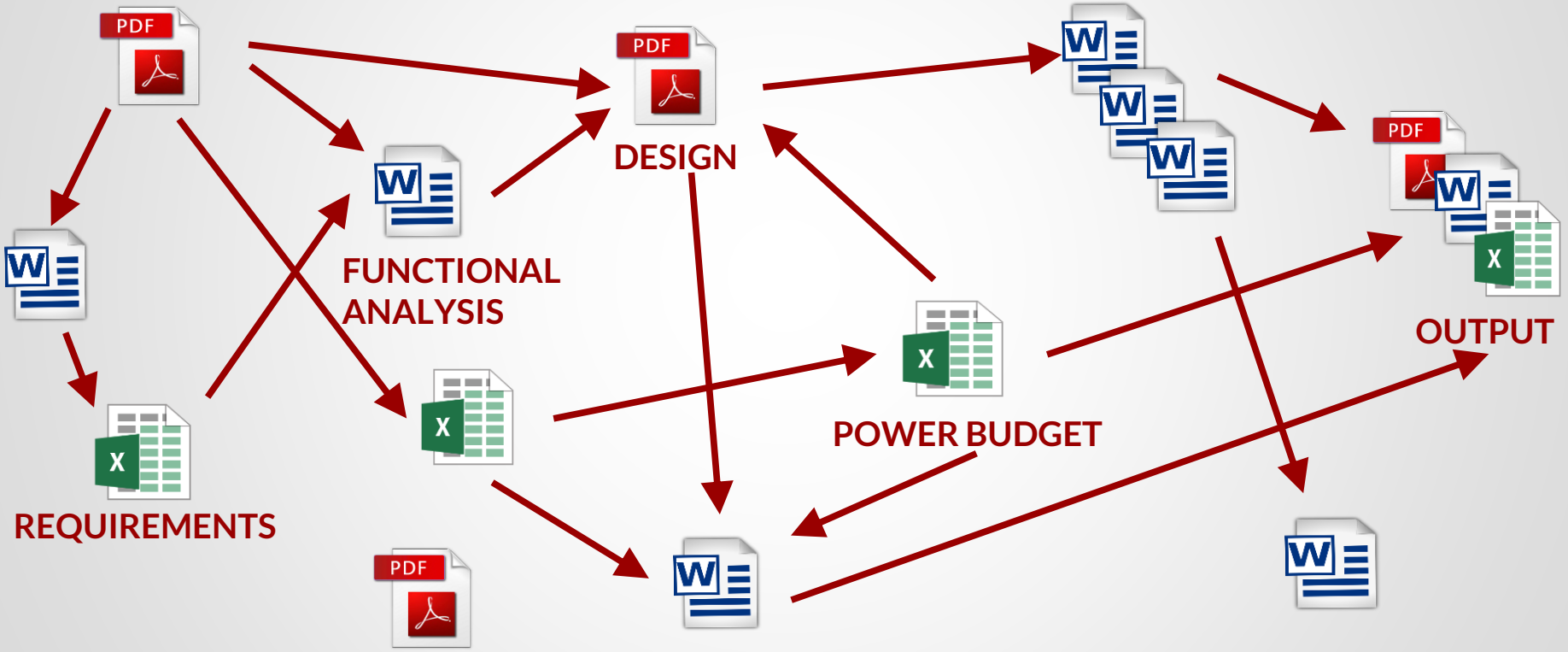
Drawbacks of current MBSE systems

*"A fully operational MBSE process with a corresponding tool set has **not yet been realized in space projects today**."*
(Eisenmann et. al. 2009)

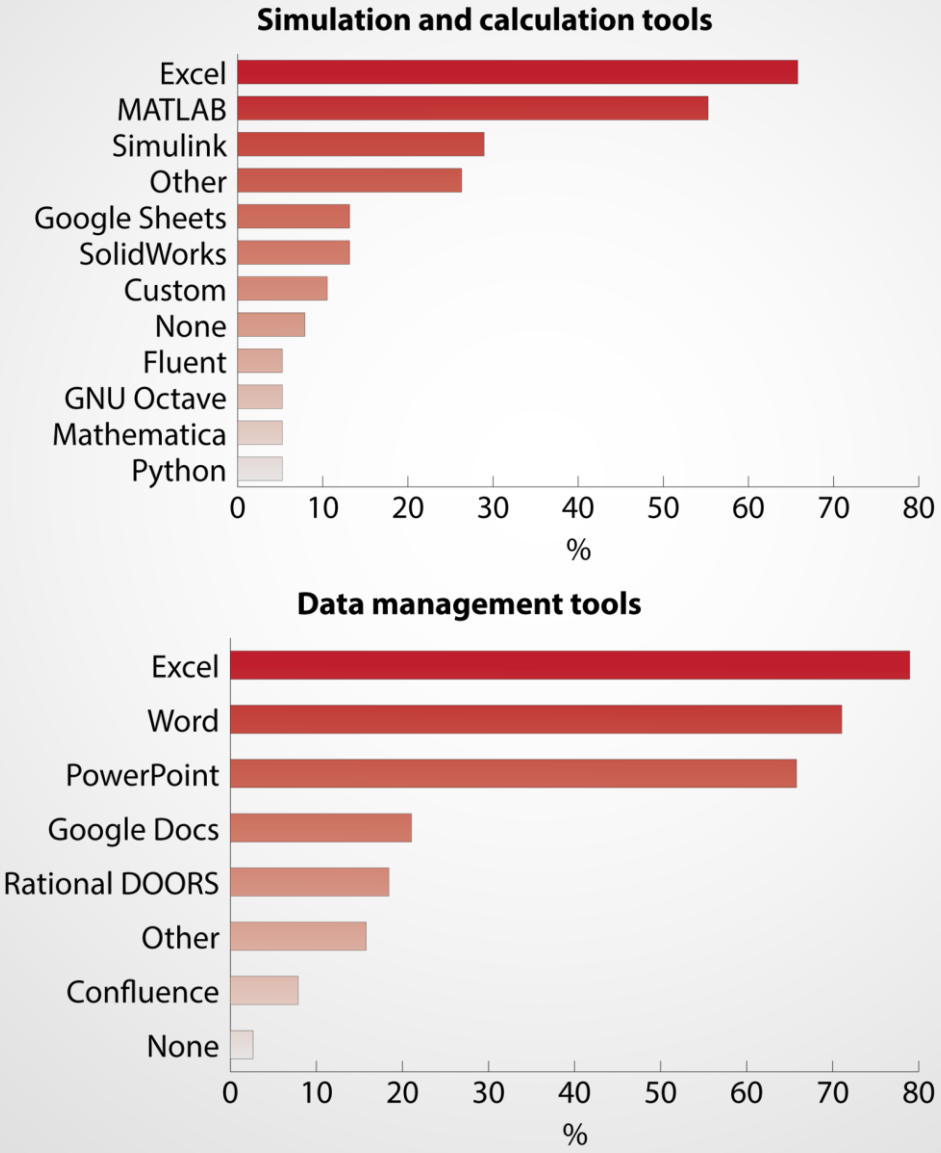
*There is a "**lack of perceived value** of MBSE"* (Motamedian 2013)

*"**MBSE needs significant evolution** for interoperability significantly for a 'plug and play' of different tools."*
(Eisenmann et. al. 2015)

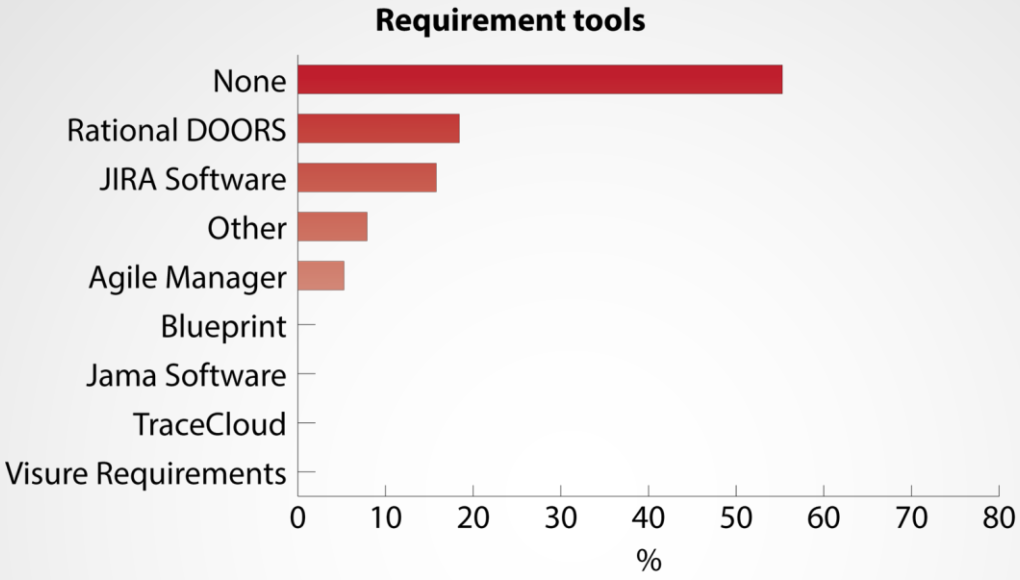
MBSE in industry?

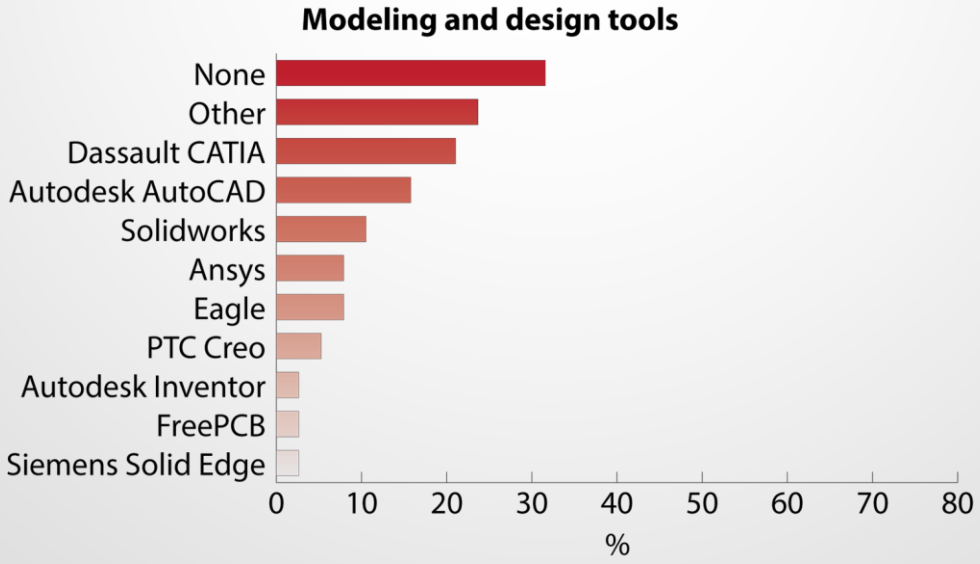


Short survey: tools used in industry



Short survey: tools used in industry

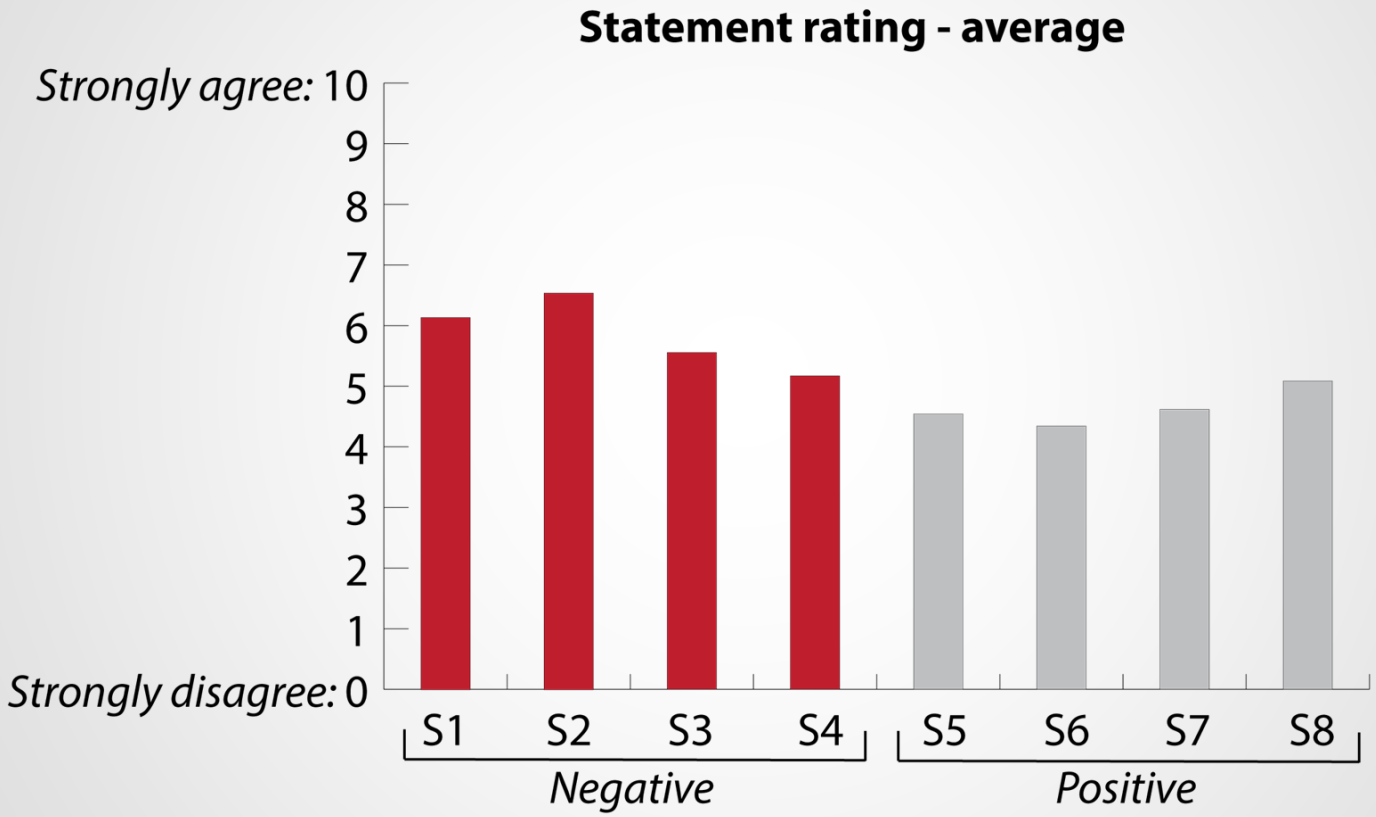




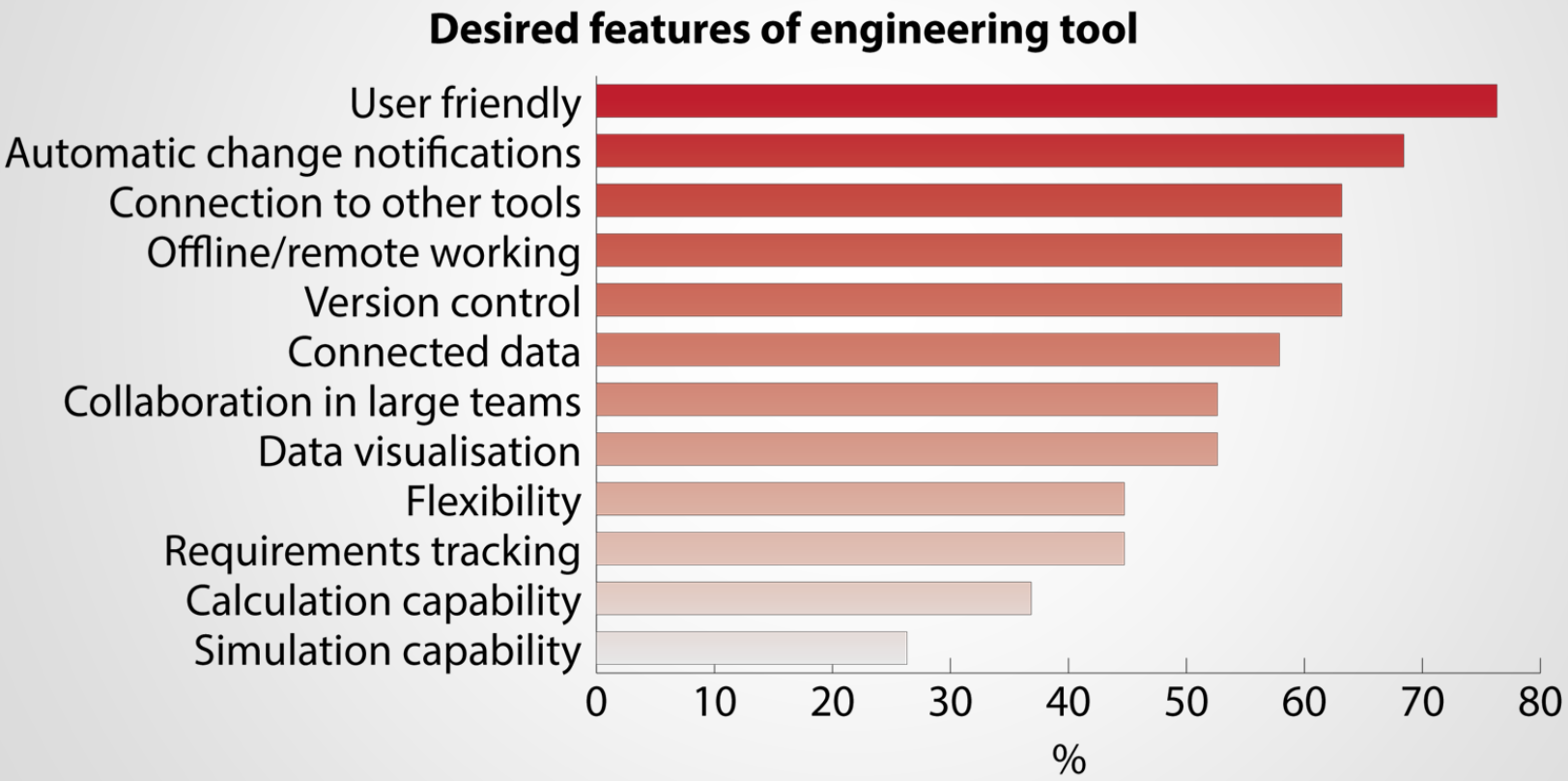
Short survey: statements

- In my current project I often see inconsistencies in the documentation.
- I often copy-paste data between the different tools I use (e.g. emails, Excel, Word, MATLAB).
- I spend much of my time writing engineering reports and documentation.
- In our team there are often misunderstandings about what the current technical baseline is.
- I always receive a notification about a change in the project data.
- In my current project it is easy to get an overview of the product development.
- In my current project it is easy to find data that I need for calculations or presentations.
- In my current project the project data is well organised.

Short survey: statements



Short survey: desired features



Web-based tools and platforms

Why web-based?

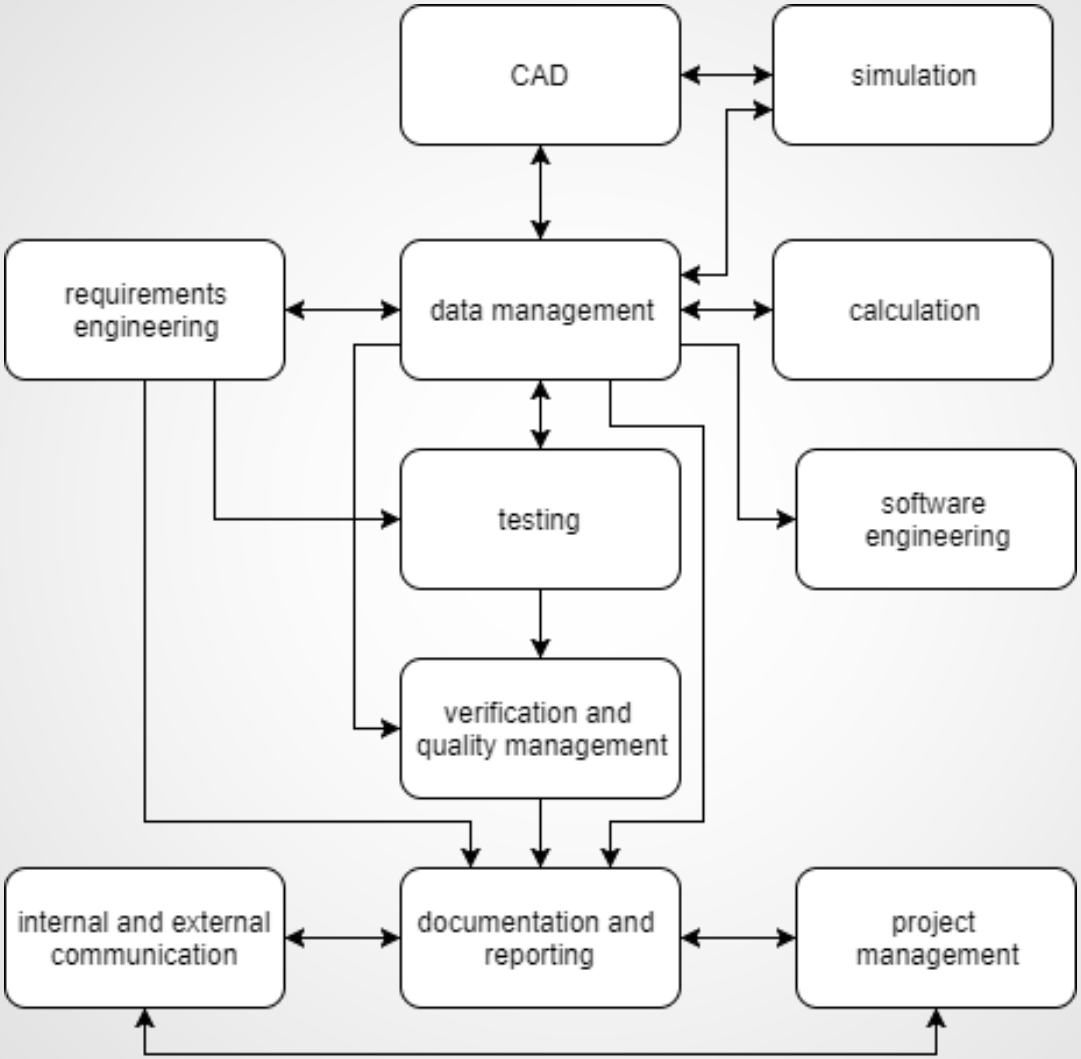
- **Concurrency**
  - **Real-time**, concurrent access to data for all users
  - Data consistency by design: **“Single source of truth”** (contrary to file-based systems)
  - **User-friendly** with short learning curve
  - **Tools can interact without user intervention**

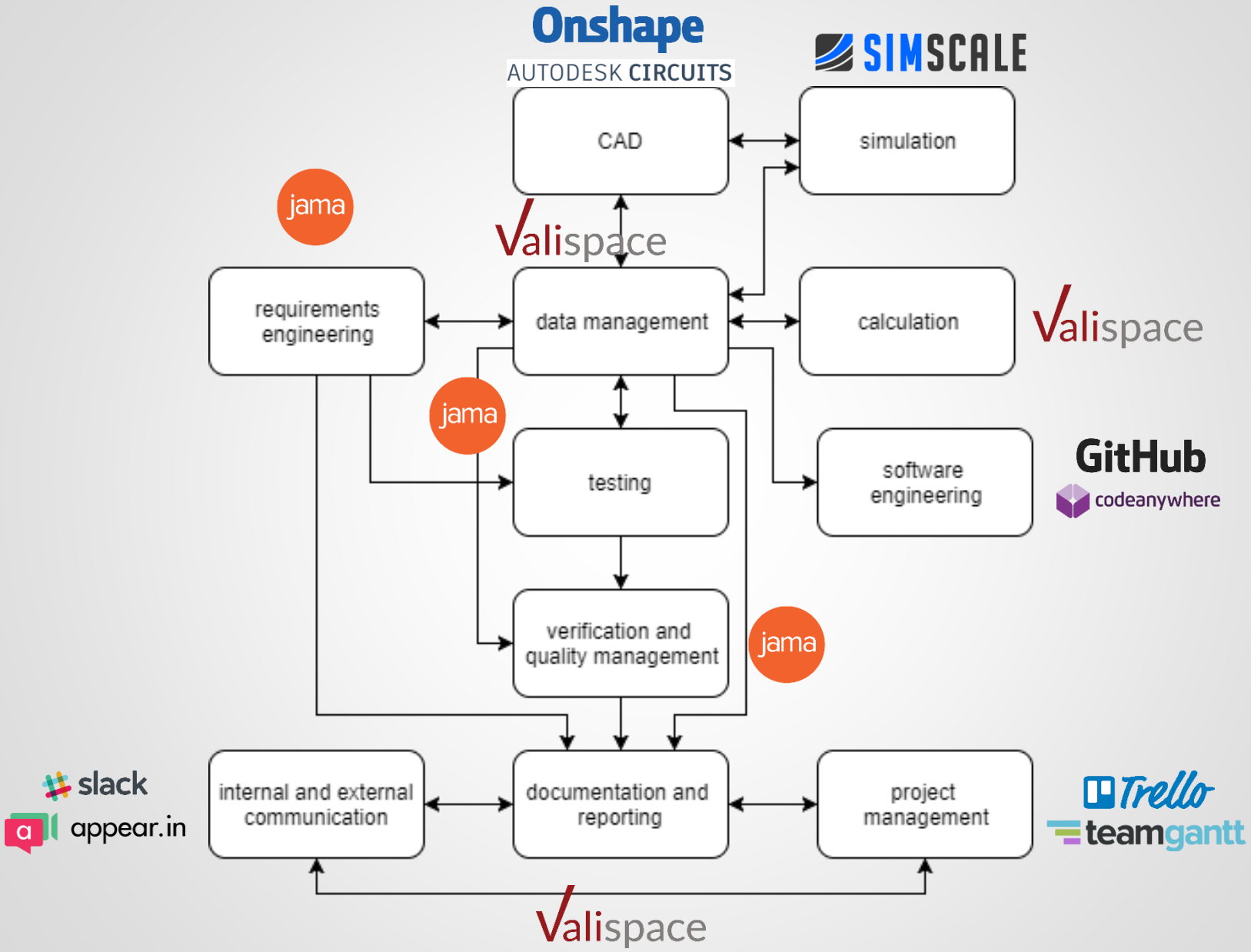
- **Data driven**
  - Information is stored, processed and made available as **data** (not text)
  - Allows for access, search, filter, sort, **calculations**, re-use etc.
  - Proprietary, non-standardized models are **better than no models at all** („hidden MBSE“)
  - **Standardized APIs** (e.g. REST)

Tool stack

„In computing, a solution stack or software stack is a
set of software subsystems or components needed to create a
complete platform
such that no additional software is needed to support applications.” *

*https://en.wikipedia.org/wiki/Solution_stack


CAD
simulation
requirements engineering
data management
calculation
testing
software engineering
verification and quality management
internal and external communication
documentation and reporting
project management


Onshape
AUTODESK CIRCUITS
SIMSCALE
CAD
simulation
jama
Valispace
requirements engineering
data management
calculation
Valispace
jama
testing
software engineering
GitHub
codeanywhere
verification and quality management
jama
slack
appear.in
internal and external communication
documentation and reporting
project management
Trello
teamgantt
Valispace

Interoperability

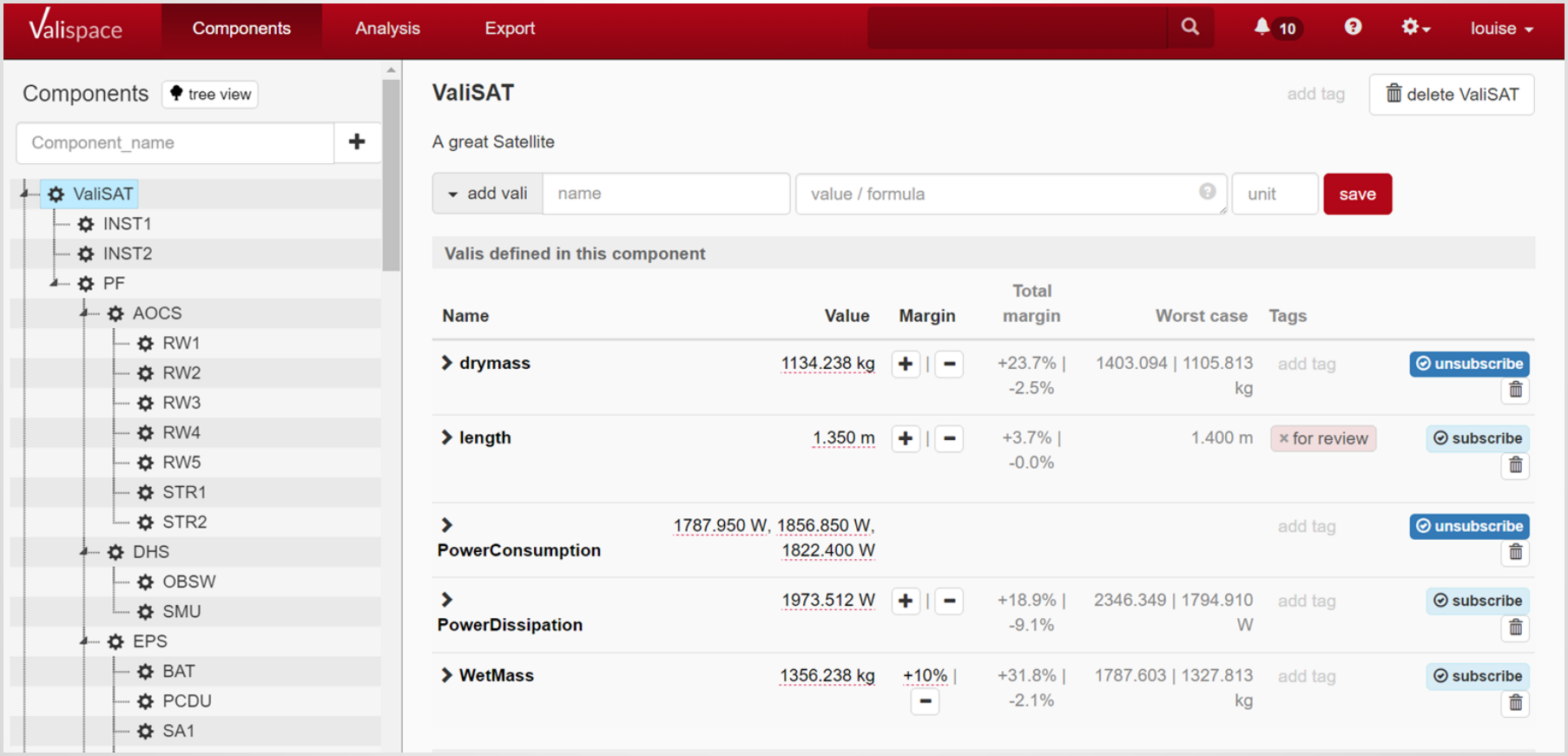
- Most web-based tools implement „REST“-API
  - Allows for **automatic** read-, write-, list-, update- and delete-functionality
  - Many vendors build tool integrations themselves

    (e.g. Onshape → Simscale)
  - Some vendors allow users / other vendors to build integrations (e.g. Slack)
  - Dedicated services exist to combine web-tools (e.g. IFTTT)

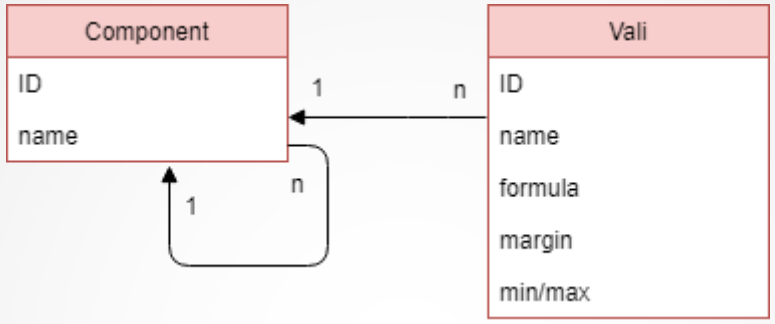
Modeling in Valispace

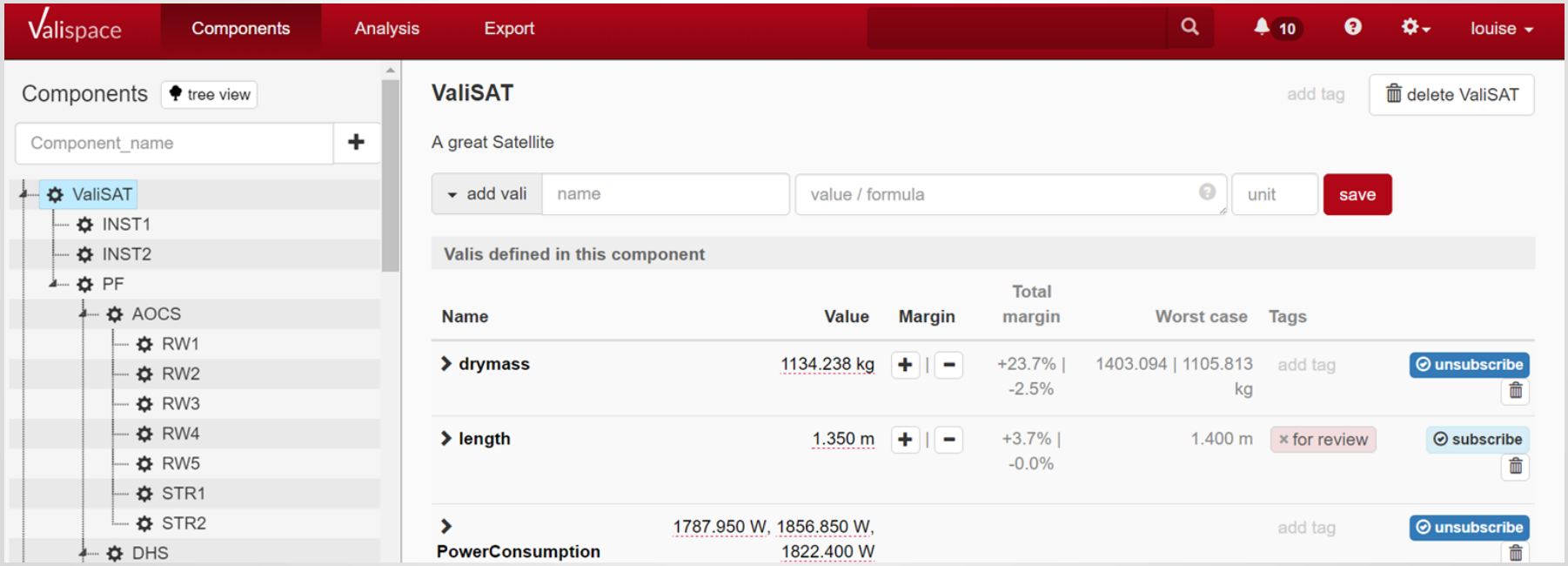
Modeling with Valispace

Valispace is a COTS software developed for use throughout the development cycle of a hardware project.



Structure and parametric modeling



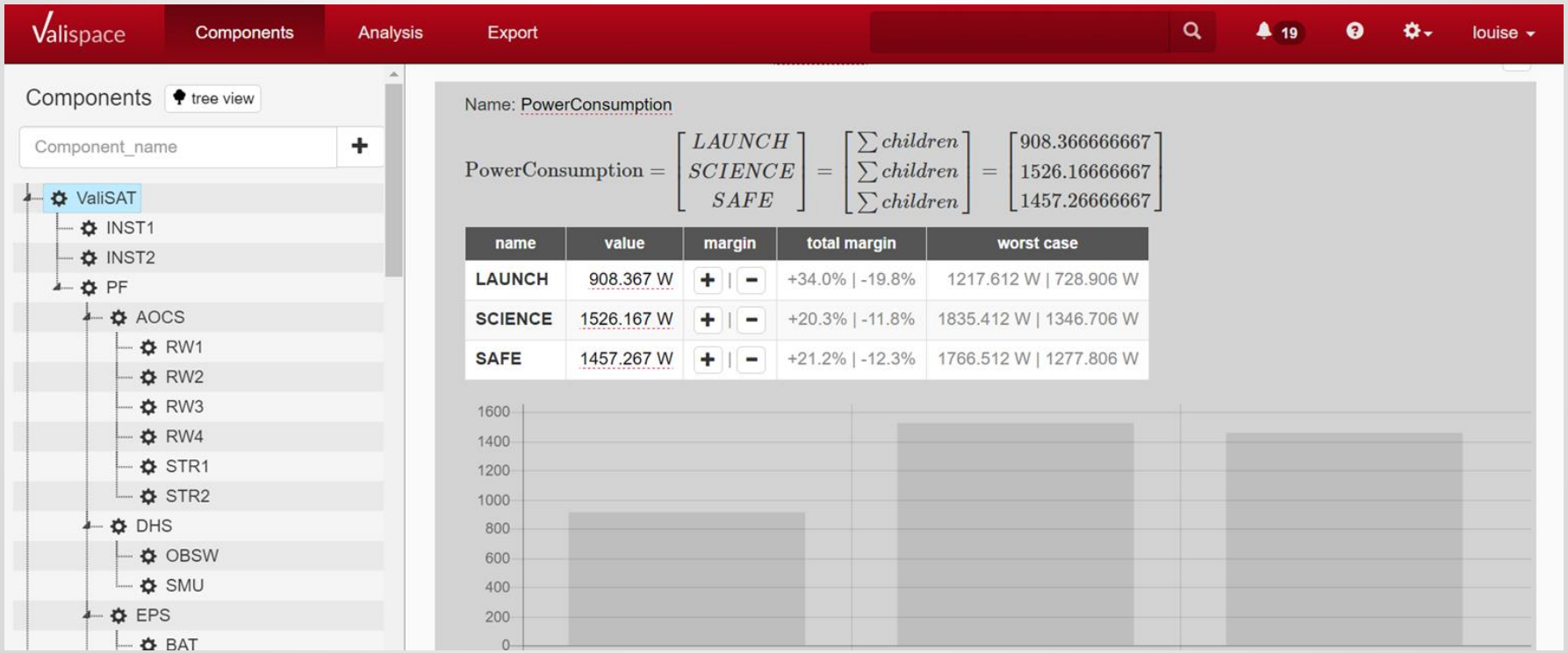


Modes/states modeling

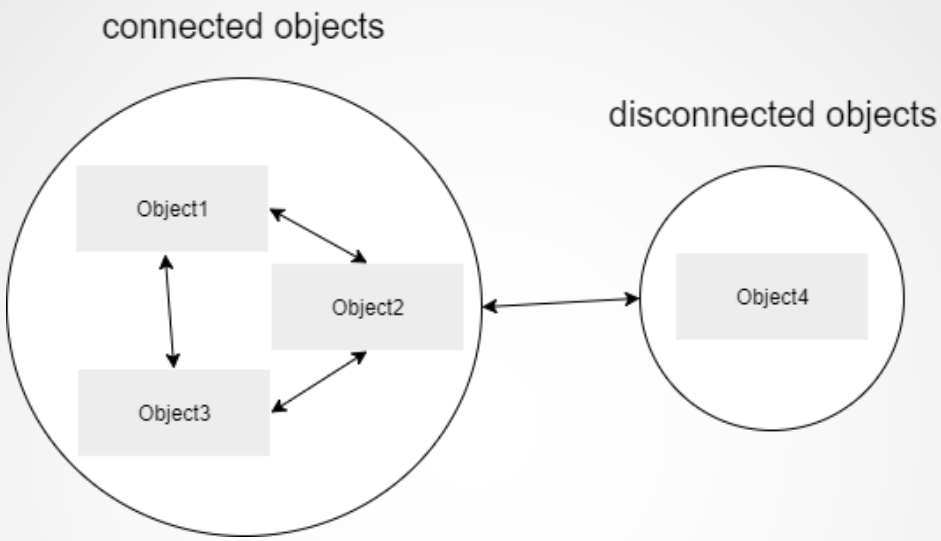
$$\begin{bmatrix} LAUNCH \\ SCIENCE \\ SAFE \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} ON \\ OFF \\ STANDBY \end{bmatrix}$$

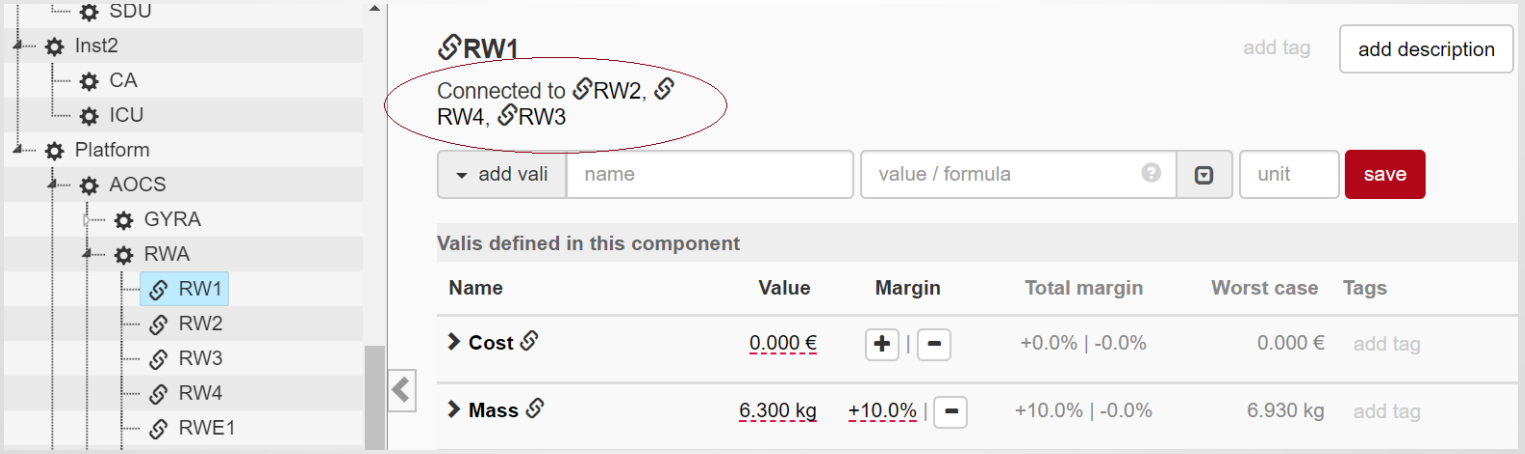
Satellite power consumption

OBC power consumption



Connected copies





Hands-on exercise with Valispace

Conclusions