



# *TruePLM (ISO 10303 Repository) & Digital Twin Workshop*



*From IDEATION to MANUFACTURING and OPERATIONS*

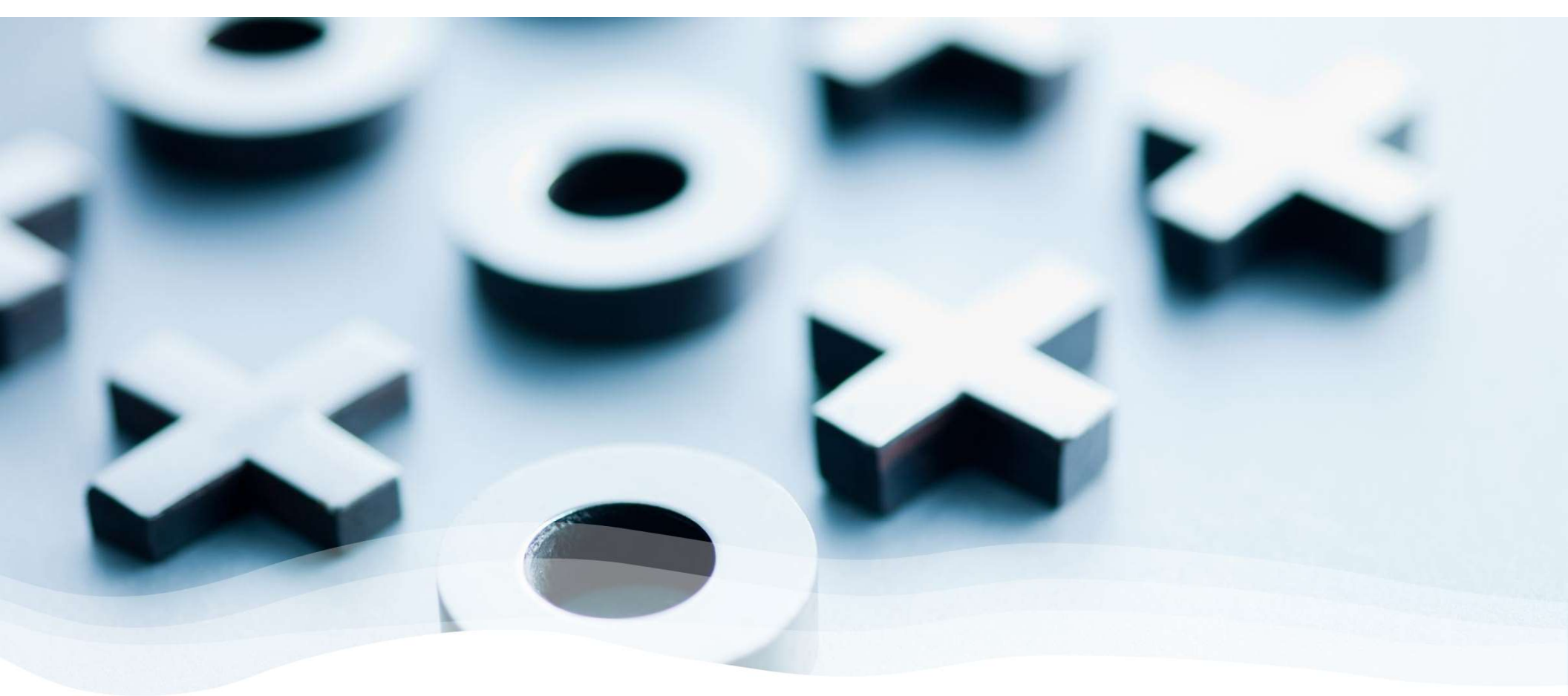
# Agenda

12th May 2022  
0900 – 1200 pm

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- PLM... What's this?
- Space Application, TruePLM and ECSS
- Why should Space Engineers use TruePLM?
- What are the benefits?
- Digital Twin
- Hands-on (1100 -1200pm)

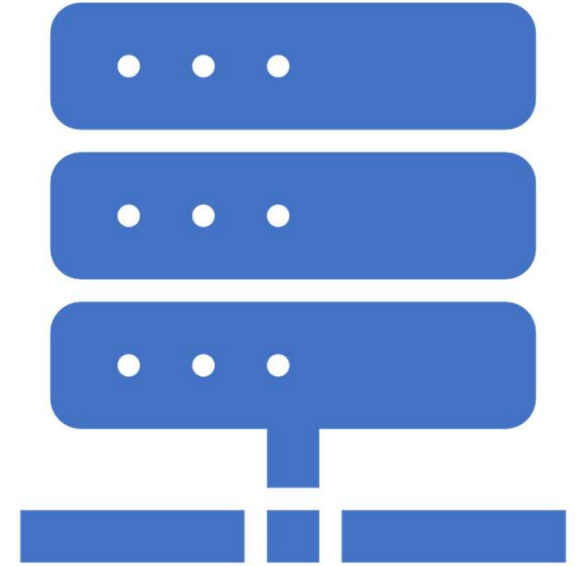




Kjell Bengtsson

# Brief Intro: ISO 10303

PLM...  
What's this?



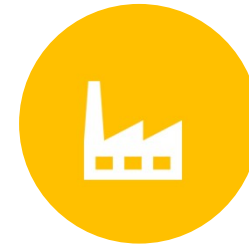
# PLM: Product Lifecycle Management



CONCEPT



DESIGN



MANUFACTURING



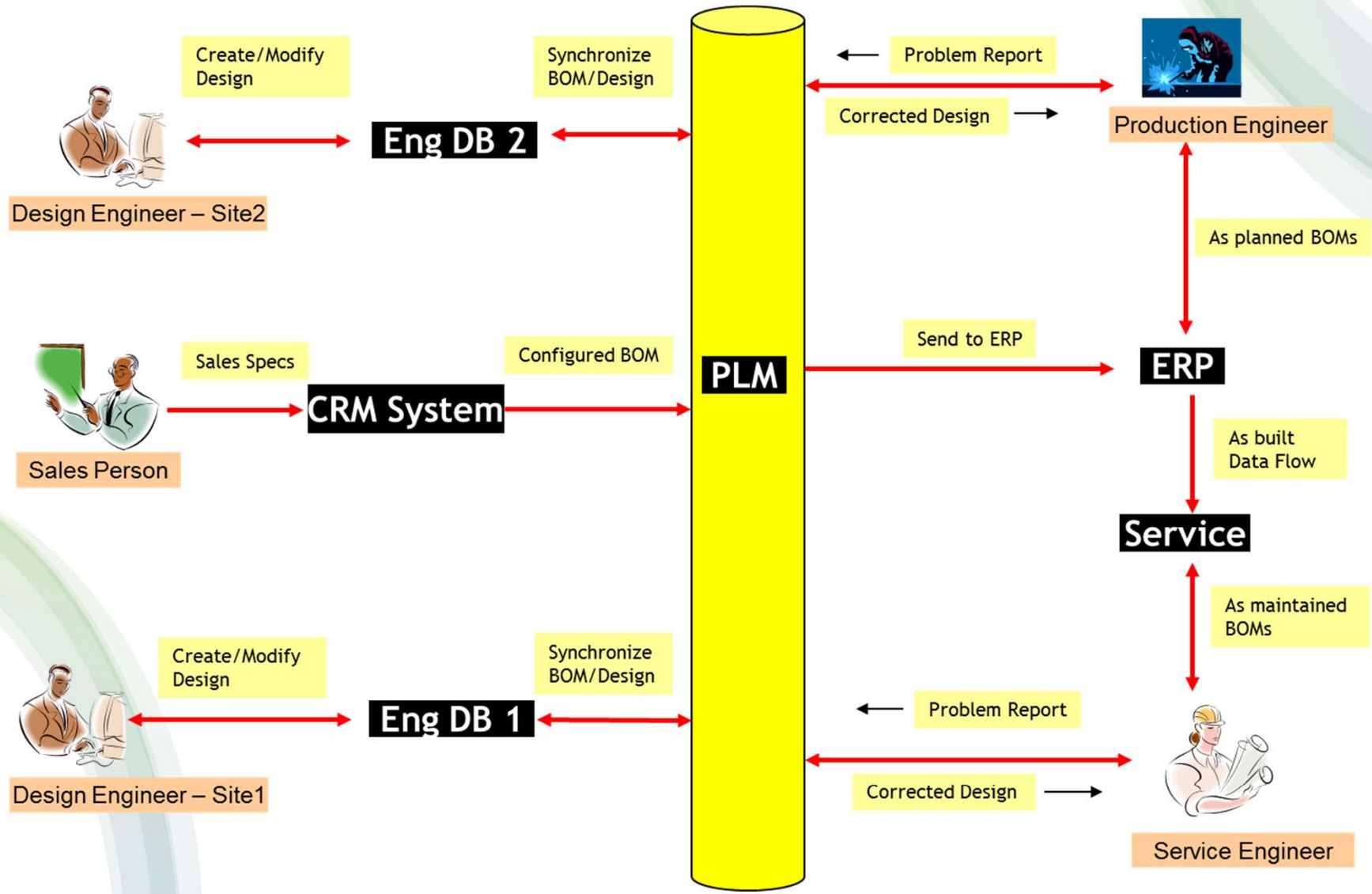
TESTING



OPERATION



# PLM Workflow in Space Industry

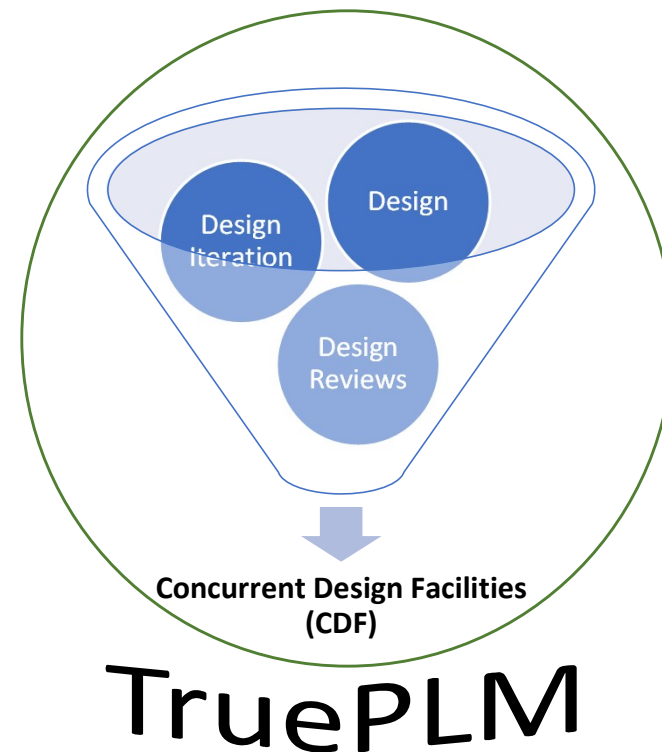


The image features three large, white satellite dishes positioned in a dark, rocky landscape under a deep blue, starry night sky. The dishes are mounted on metal structures and are angled towards the sky. The background is filled with numerous bright stars, creating a sense of vastness and space. The overall tone is dark and futuristic.

# Space Application, TruePLM and ECSS

# Standards and PLM role in Concurrent Engineering

- As per **ECSS** (European Cooperation for Space Standardization), **standard model-based data exchange** in early design phases is **essential to Space Community** that allows more effective design collaboration and iterations. TruePLM finds the way by providing a standard based repository for Data exchange, storage, and archival that supports Concurrent Engineering.
- Also covers all the product lifecycle phases.





# Supporting ESA Design Framework: ECSS Standards

The screenshot displays a software interface with two main panels. The left panel, titled 'TYPES OF REFERENCE DATA', lists various categories under the 'Project phase' heading, including Discipline, Source of information, Document status, Document type, Document properties, Subdomain roles, Breakdown relationship roles, Organisation roles, and Breakdown element type. The right panel, titled 'REFERENCE DATA VALUES', shows a table with a 'Value' column. The first row contains the value '0'. A red box highlights a list of project phases: Mission Engineering, Design & Analysis, Test and Validation, Production, Operations, and Post-Mission. A modal dialog titled 'Current project phase' is overlaid on the right, showing the 'Name' as 'project\_phase' and the 'Value' as 'Mission Engineering' with a dropdown arrow. The dialog includes 'OK' and 'CANCEL' buttons.

Value
0
Mission Engineering
Design & Analysis
Test and Validation
Production
Operations
Post-Mission

**Current project phase**

Name  
project\_phase

Value  
Mission Engineering

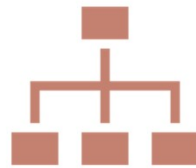
OK CANCEL

ECSS terminology + TruePLM reference data = Space Application

# TruePLM Web client Capabilities



Product data exchange,  
sharing and archiving



Breakdown Structure



Upload data via ISO  
10303 STEP files  
(AP239, AP242 etc.)



Why should  
Space Engineers  
use TruePLM?

# Industry Challenges

- Space industry come across challenges such as....



Integration of  
complex  
space  
systems  
environment

Documents  
Management

Regulatory  
Compliance

Centralized  
system



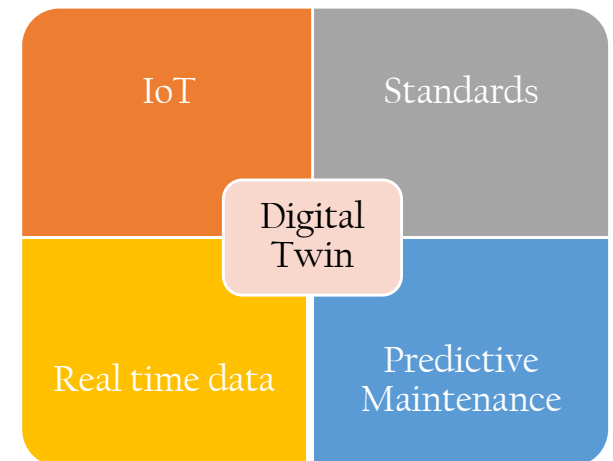
# Space User requirements addressed by TruePLM

General system objective

- Project lifetime scope
- Configuration control tool
- Presentation of system data in tree structures
- Baseline
- Project Phase Control
- Requirement

Offers

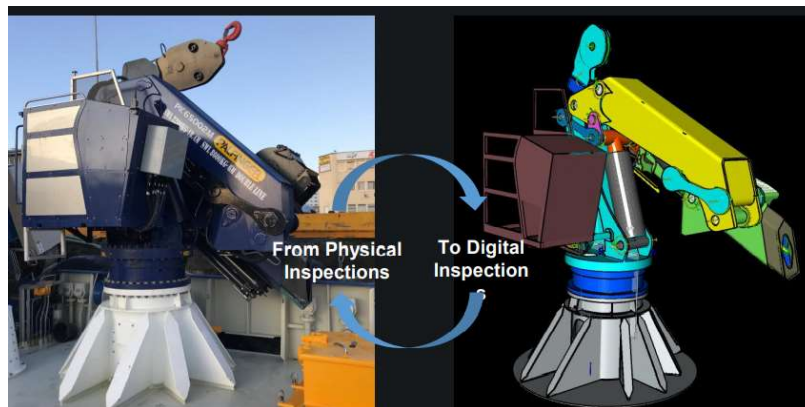
- Locking of in-work data
- Versioning of data
- Search for product data
- Access Control
- File Document Management
- Notification
- CAD Visualization



What are  
the  
benefits?



# Benefits as an end user



## Project Set -up

- Data packaging and review
- History tracking
- Project overview

## Project Data Management

- Handover Archiving
- Feature extraction
- Concurrent Engineering support



## Benefits

Capabilities

ISO 10303 (STEP) PLM repository

IoT using Arrowhead Framework

Baseline

Reference Data Configuration

Model Based STEP standard reference to ECSS

Standardized repository for managing data exchange

Digital Twin Implementation

Preliminary or Critical design review to improve the product performance

Operations at multiple ground stations or launched station synchronization to avoid repetitive work

Project Phase, versioning and requirements management as per Space standards

Data for CAD, different space stations possible to exchange without losing design intent

Predictive or Preventive Maintenance of Space products for example monitoring behavior of the initial design or launched ISS

Initial Phase of the design iterations are managed and reuse the template using Baseline to reduce time loss for the similar mission projects

Ground Station 1 or 2 work of mission or project development sync with a centralized Ground station

Monitor the project development during entire lifecycle such as Design, Manufacturing, Operation etc.. By means of PLCS standardized repository

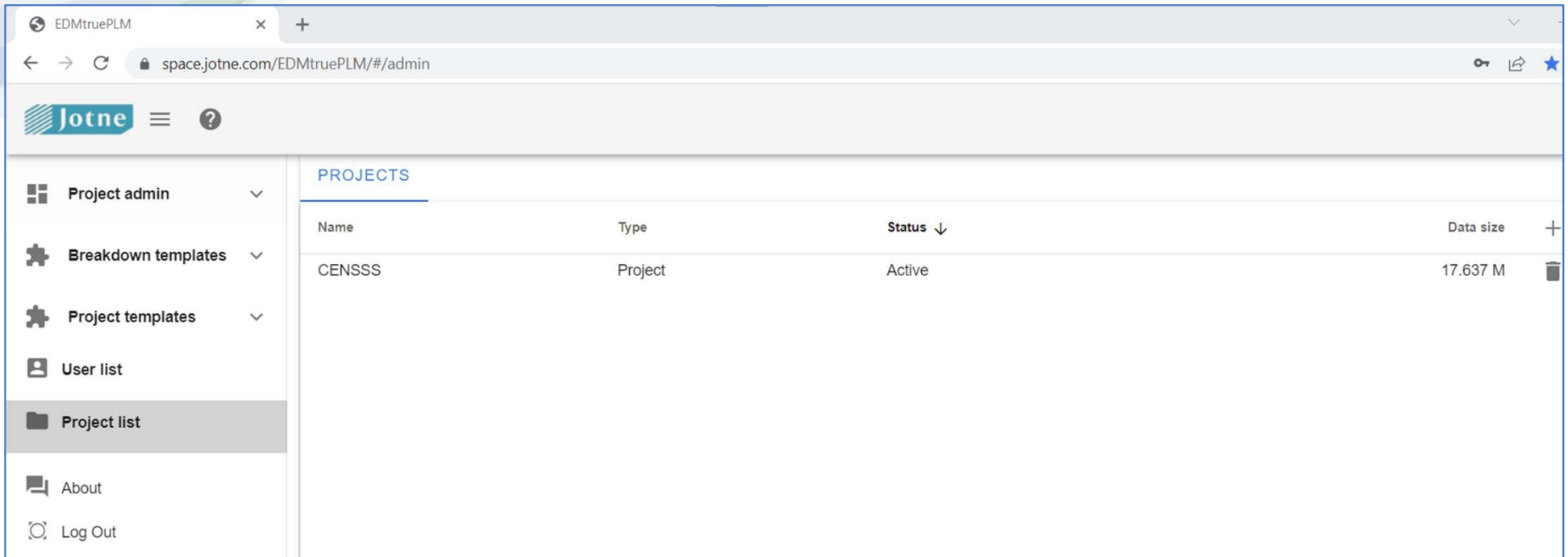
Space Engineers





## Web Interface

# How can I manage my project?



The screenshot shows a web browser window with the URL `space.jotne.com/EDMtruePLM/#/admin`. The page features a sidebar with navigation options: Project admin, Breakdown templates, Project templates, User list, Project list (highlighted), About, and Log Out. The main content area is titled 'PROJECTS' and contains a table with the following data:

Name	Type	Status ↓	Data size
CENSSS	Project	Active	17.637 M

- New Projects and Users are created via admin login (superuser).
- Access is tailored for each individual project.

# What are the roles of the user?

The screenshot shows the Jotne user management interface. A 'Create user' dialog box is open, displaying the following fields:

- Name (Value is required)
- Password (Value is required)
- Real name
- E-mail
- Organization

The background shows a table of users with columns: Name, Real name, E-mail, and Organization.

Name	Real name	E-mail	Organization
admin	Administrator		Jotne
sindre	Sindre Herstad		Orbit NTNU
ivar	Ivar Egeland		Eidel
tor	Tor Berger		UIO
svein	Svein-Erik Hamran		UIO
lewis	Lewis Williams		UIO
deniz	Deniz Ölçek		UIO
kristoffer	Kristoffer Langstad		UIO
skauil	Torbjørn Skauil		UIO
sverre	Sverre Brovoll		UIO

The screenshot shows the Jotne user management interface. A 'Add user to project' dialog box is open, displaying the following fields:

- User: svein
- Role (dropdown menu):

The role dropdown menu is open, showing the following options:

- Subdomain leader
- Project manager
- Project admin
- Project member
- Document manager
- Rdl manager

The background shows a table of users with columns: Name, Role.

Name	Role
admin	Project manager
sindre	Project member

You can create project using.... (Use during Hands-on)

The image shows a screenshot of the Jotne software interface. On the left, a sidebar menu is visible with the 'Administration' section expanded. The 'Create project' option is highlighted, and a blue arrow points from it to a 'Create project' dialog box on the right. The dialog box contains the following fields:

- Name:** A text input field.
- Description:** A text input field with a small icon at the end.
- Folder:** A dropdown menu.
- Template:** A dropdown menu.

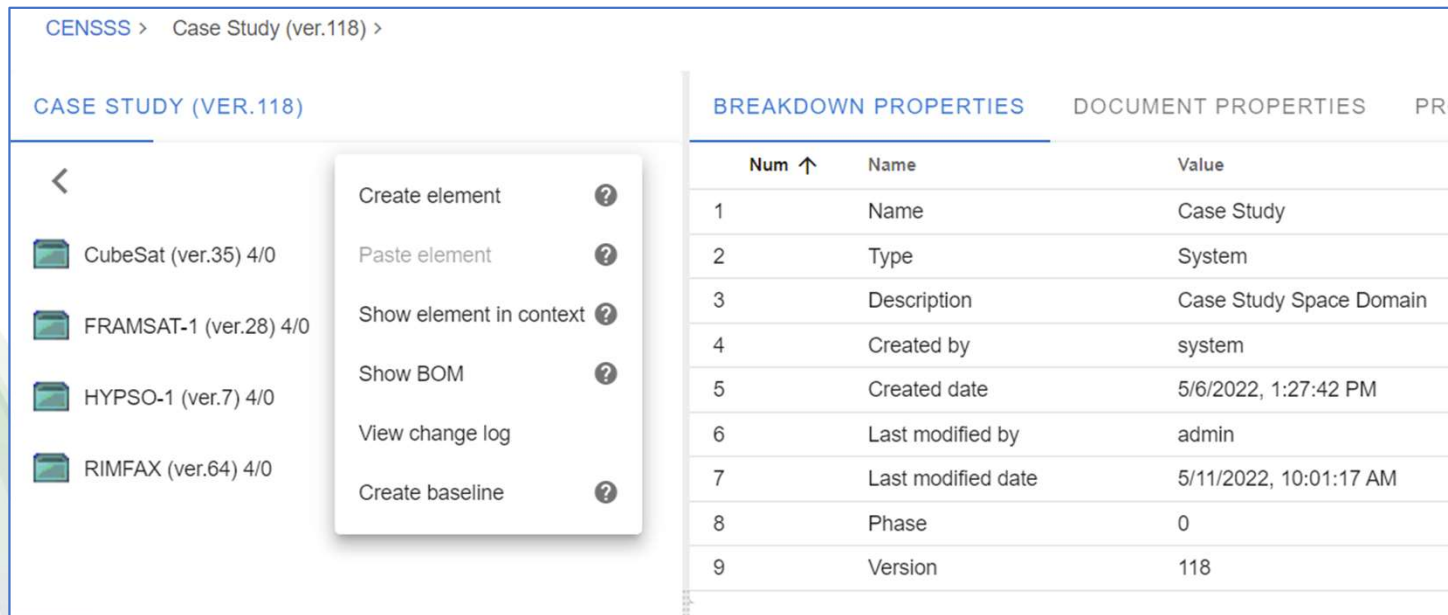
At the bottom of the dialog box, there are two buttons: 'OK' and 'CANCEL'.



# How do I manage my Mars or Moon mission project?

## Breakdown structure

Breakdown elements can be created using create element tab shown below. This helps to create project structure as per the needs.



The screenshot displays a software interface for managing a project. The top navigation bar shows 'GENSSS > Case Study (ver.118) >'. Below this, the main area is divided into two sections: 'CASE STUDY (VER.118)' on the left and 'BREAKDOWN PROPERTIES' on the right. The 'CASE STUDY (VER.118)' section shows a list of project elements: CubeSat (ver.35) 4/0, FRAMSAT-1 (ver.28) 4/0, HYPSON-1 (ver.7) 4/0, and RIMFAX (ver.64) 4/0. A context menu is open over the 'CubeSat' element, listing actions: 'Create element', 'Paste element', 'Show element in context', 'Show BOM', 'View change log', and 'Create baseline'. The 'BREAKDOWN PROPERTIES' section shows a table with 9 rows and 3 columns: 'Num', 'Name', and 'Value'.

Num ↑	Name	Value
1	Name	Case Study
2	Type	System
3	Description	Case Study Space Domain
4	Created by	system
5	Created date	5/6/2022, 1:27:42 PM
6	Last modified by	admin
7	Last modified date	5/11/2022, 10:01:17 AM
8	Phase	0
9	Version	118



# How does a design engineer configure the project structure? Breakdown element type

Here user can manage a project metadata such as breakdown element type or user defined properties of a created breakdown element. Breakdown Element type are created by clicking on the Gear symbol on the right corner.

The screenshot displays the Jotne EDMtruePLM web application interface. The main content area shows the 'BREAKDOWN PROPERTIES' tab for a project named 'RIMFAX (VER.64)'. A table lists the properties:

Num	Name	Value	Type
1	Name	01 Concept	T
2	Type	Module	T
3	Description	Initial Phase	T
4	Created by	admin	T
5	Created date	5/11/2022, 9:33:25 AM	T
6	Created modified by	admin	T
7	Created modified date	5/11/2022, 9:33:25 AM	T
8	Created modified by	admin	T
9	Created modified date	5/11/2022, 9:33:25 AM	T

An inset window titled 'Reference data definitions' is open, showing the configuration for 'Breakdown element type'. It is divided into two sections:

- TYPES OF REFERENCE DATA:** A list of reference data types including Project phase, Discipline, Source of information, Document status, Document type, Document properties, Subdomain roles, Breakdown relationship roles, Organisation roles, Breakdown element type (selected), and Breakdown element properties.
- REFERENCE DATA VALUES:** A table listing the values for the selected 'Breakdown element type': Value, Folder, Module, Product\_definition, Requirement, System, and Unit. Each value has a '+' icon to its right, indicating it can be expanded.

# How do I configure my project..?

## Breakdown user defined properties

This definition is used for creating user defined properties such as acceleration, altitude, volume, position list, orbit specification etc. for different type of a breakdown element type.

The screenshot displays a software interface for configuring breakdown element properties. The main workspace is divided into several sections:

- Navigation Menu (Left):** Lists various reference data types, with 'Breakdown element properties' highlighted.
- REFERENCE DATA VALUES (Top):** Shows a dropdown menu for 'Node type' set to 'Mission' and an 'Order elements by' dropdown.
- Table (Center):** A table with columns: Name, Inherited from, Type, Values/Expression, Units, RO. A row for 'Timeline' is visible, with Type 'Text' and RO checkbox.
- Case Study (Bottom):** Shows a tree view of 'RIMFAX (VER.64)' with sub-items: '01 Concept (ver.120) 2/0', '02 Design (ver.83) 2/0', '03 Manufacturing (ver.58) 2/0', and '04 Operation (ver.59) 3/0'.
- PROPERTY TABLES (Bottom Right):**
  - BREAKDOWN PROPERTIES:**

Num ↑	Name	Value
1	Name	01 Concept
2	Type	Mission
3	Description	Initial Phase
4	Created by	admin
5	Created date	5/11/2022, 9:33:25 AM
6	Last modified by	admin
7	Last modified date	5/11/2022, 10:46:06 AM
8	Phase	0
9	Version	120
  - USER DEFINED:**

Num ↑	Name	Value
1	Timeline	2022-2026

A 'Create new property' dialog box is open in the top right corner, featuring a 'Type' dropdown, a 'Name' input field, a 'read only access' checkbox, and 'OK' and 'CANCEL' buttons.

# Define the project or product specific properties Breakdown Elements and Properties

Continental > Continental (ver.115) > Kyklos\_Continental Pilot > Sensor >

SENSOR (VER.6)

BREAKDOWN PROPERTIES DOCUMENT PROPERTIES PRODUCT PROPERTIES

Num ↑	Name	Value	Type	
1	Name	24v ok	T	✎
2	Type	Bool sensor	T	✎
3	Description	Sensor	T	✎
4	Created by	cont_kyklos	T	
5	Created date	1/26/2021, 3:43:50 PM	T	
6	Last modified by	cont_kyklos	T	
7	Last modified date	1/26/2021, 3:43:50 PM	T	
8	Phase	0	T	
9	Version	8	T	

USER DEFINED

Num ↑	Name	Value	Type	
1	Bool sensor data list	101821 items	A	T ↓ ×
2	serial number	DB100.DBX2.0	T	✎ ×

Navigation sidebar items:

- <
- 24v ok (ver.8)
- A Automatic (ver.10)
- Cam Right Inspect OK (ver.14)
- Cam left inspect OK (ver.12)
- Cleaning (ver.16)
- Cyl press origin pos (ver.18)
- Cyl press work pos (ver.20)
- Drawer lock (ver.22)
- Drawer origin pos (ver.24)

Capability to collect and view real-time data

# How do I comply with ECSS traceability? Versioning and Baseline Comparison

Old versions may be revisited (read-only), baselined and compared

The screenshot shows the Jotne web application interface. At the top, there is a navigation bar with the Jotne logo and a 'Make comparison' button. Below the navigation bar, the main content area displays 'CASE STUDY (VER.120)' with a folder icon. Underneath, there is a section for 'Case Study (ver.115)' with a vertical ellipsis menu. To the right, there are tabs for 'BREAKDOWN PROPERTIES', 'DOCUMENT PROPERTIES', and 'PRODUCT PROPERTIES'. The 'BREAKDOWN PROPERTIES' tab is active, showing a table with columns 'Num', 'Name', 'Value', and 'Type'. The table content is empty, with the text 'No data available' centered below the columns.

This screenshot shows a dropdown menu for version selection. The menu is open, displaying a list of versions: Ver. 115, Ver. 120, Ver. 119, Ver. 118, Ver. 117, Ver. 116, Ver. 115 (highlighted), Ver. 114, and Ver. 113. The background shows the 'CASE STUDY (VER.120)' project overview.

The 'Version / Baseline comparison' dialog box is shown. It has a title bar with a question mark icon. Below the title, there are two selection fields. The first field is labeled 'Version 1' and has 'Ver. 120' selected. The second field is labeled 'Baseline 1' and has 'Baseline 1' selected. At the bottom of the dialog, there are 'OK' and 'CANCEL' buttons.

The 'Comparing project data versions' dialog box is shown. It has a title bar with the text 'Comparing project data versions'. Below the title bar, there are two tabs: 'VERSION 117' and 'VERSION 120'. The 'VERSION 117' tab is active, showing a list of project data items: 'Requirement (ver.110) 1/1' and 'Technical Documents (ver.67) 3/0'. To the right, there is a 'LIST OF DIFFERENCES' table comparing 'VERSION 117' and 'VERSION 120'. The table has columns for 'Name', 'Element', 'Difference', 'Version (left)', and 'Version (right)'. Below the table, there is a 'DETAILS' section showing property values for the two versions.

Name	Element	Difference	Version (left)	Version (right)
20190523 FM Ebox JPL to FFI for rework	Folder	Modified	117	118
01 Concept	Mission	Modified	65	120

Property name	Value - Left version	Value - Right version
<b>General</b>		
Name	01 Concept	01 Concept
Description	Initial Phase	Initial Phase
Last modified by	admin	admin
Last modified date	2022-05-11 07:33:25	2022-05-11 08:46:06
Phase	urn:rdi:epm-std:0	urn:rdi:epm-std:0
Type	Module	Mission
Version	65	120



# How do I manage PDR or CDR Baseline




CENSSS > Case Study (v...)

REVIEW (VER.62)

- CDR (ver.127) 0/1
- PDR (ver.128) 0/1

- Paste element
- Paste element as relating
- Paste element as related
- Add organisation
- Put product
- Generate document
- Add data file
- Paste data file
- Show element in context
- Show BOM
- View change log
- Create baseline**
- Subdomain info
- Subdomain management
- Import from STEP PDM-file
- Import AP242 BO model
- Import from Req-IF file

### Baselines

Baseline ID	Date created	Created by	Description	Root	
Thermal PDR	2022-05-11 13:05:01	admin	PDR for Antenna	PDR (ver.128)	  

CENSSS > Baseline > Thermal PDR >

**PDR (VER.128)**

Thermal load case considerations (rev.1 ver.001)

BREAKDOWN PROPERTIES		DOCUMENT PROPERTIES	PR
Num ↑	Name	Value	
1	Name	PDR	
2	Type	Module	
3	Description	Preliminary Design Review	
4	Created by	admin	
5	Created date	5/11/2022, 9:30:54 AM	
6	Last modified by	admin	
7	Last modified date	5/11/2022, 3:03:00 PM	
8	<b>Phase</b>	<b>Design &amp; Analysis</b>	



# Plenty of documents such as technical, specification and many more.. How do I control the changes..??

## Document Management

CENSSS > Case Study (ver.120) > RIMFAX > 01 Concept > Requirement > Ebox >

EBOX (VER.81)

- Create requirement
- Add data file
- Paste data file
- Show element in context
- Show requirement tree
- Import from Req-IF file

Num ↑	Name
1	Name
2	Type
3	Description
4	Created by
5	Created date
6	Last modified by
7	Last modified date
8	Phase
9	Version

### Add data file

FILE PROPS USERS

\_\_\_\_\_

Title \_\_\_\_\_

Description \_\_\_\_\_

OK CANCEL

CENSSS > Case Study (ver.120) > RIMFAX > 01 Concept > Requirement >

EBOX (VER.81)

- Checkout file
- Undo checkout
- Checkin file
- Set file read only
- Download
- Open
- View history
- Delete
- Copy file
- Cut file
- Paste file as affected
- Paste file as affecting
- Sticky notes
- Dependencies

Num ↑	Name
1	Name
2	Type
3	Description
4	Created by
5	Created date
6	Last modified by
7	Last modified date
8	Phase
9	Version

# Control the relationship?

## Document dependencies

CENSSS > Case Study (ver.120) > RIMFAX > 01 Concept > Requirement > Ebox >

EBOX (VER.81)

BREAKDOWN PROPERTIES

Num ↑	Name
1	Name
2	Type
3	Description
4	Created by
5	Created date
6	Last modified by
7	Last modified date
8	Phase
9	Version

USER DEFINED

Num ↑	Name
-------	------

Context menu options:

- Checkout file
- Undo checkout
- Checkin file
- Set file read only
- Download
- Open
- View history
- Delete
- Copy file**
- Cut file
- Paste file as affected
- Paste file as affecting
- Sticky notes
- Dependencies

CENSSS > Case Study (ver.120) > RIMFAX > 01 Concept > Requirement >

REQUIREMENT (VER.110)

BREAKDOWN PROPERTIES

Num ↑	Name
1	Name
2	Type
3	Description
4	Created by
5	Created date
6	Last modified by
7	Last modified date
8	Phase
9	Version

USER DEFINED

Num ↑	Name
-------	------

Context menu options:

- Checkout file
- Undo checkout
- Checkin file
- Set file read only
- Download
- Open
- View history
- Delete
- Copy file
- Cut file
- Paste file as affected**
- Paste file as affecting
- Sticky notes
- Dependencies

### Dependencies

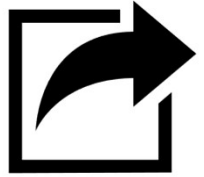
#### Affected files

RIMFAX-GPBOX-PR-010 Gold Plating of Electronics box



# I have design data and want to share ...

## Step Data Import and Export



CENSSS > Case Study (ver.121) > RIMFAX > 02 Design > Model Data >

MODEL DATA (VER.87)

- Create element
- Paste element
- Paste element as relating
- Paste element as related
- Add organisation
- Put product
- Generate document
- Add data file
- Paste data file
- Show element in context
- Show BOM
- View change log
- Create baseline
- Subdomain management
- Import from STEP PDM-file
- Import AP242 BO model
- Import from Req-IF file
- Export to zipped folder

BREAKDOWN PROPERTIES

Num ↑	Name
1	Name
2	Type
3	Description
4	Created by
5	Created date
6	Last modified by
7	Last modified date
8	Phase
9	Version

USER DEFINED

Num ↑	Name
1	material property-der
2	material property-ma name

STEP (AP239, AP242 etc.) data import and export.  
Export from the root node

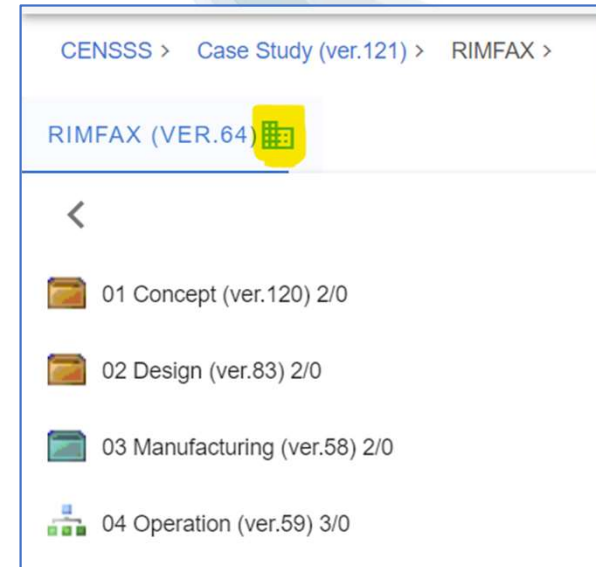
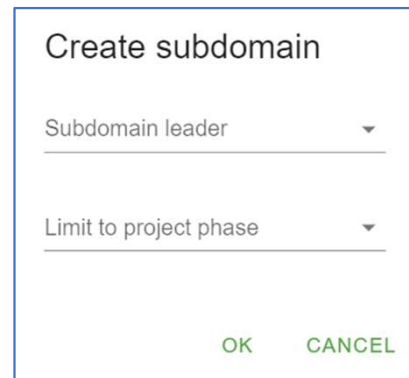
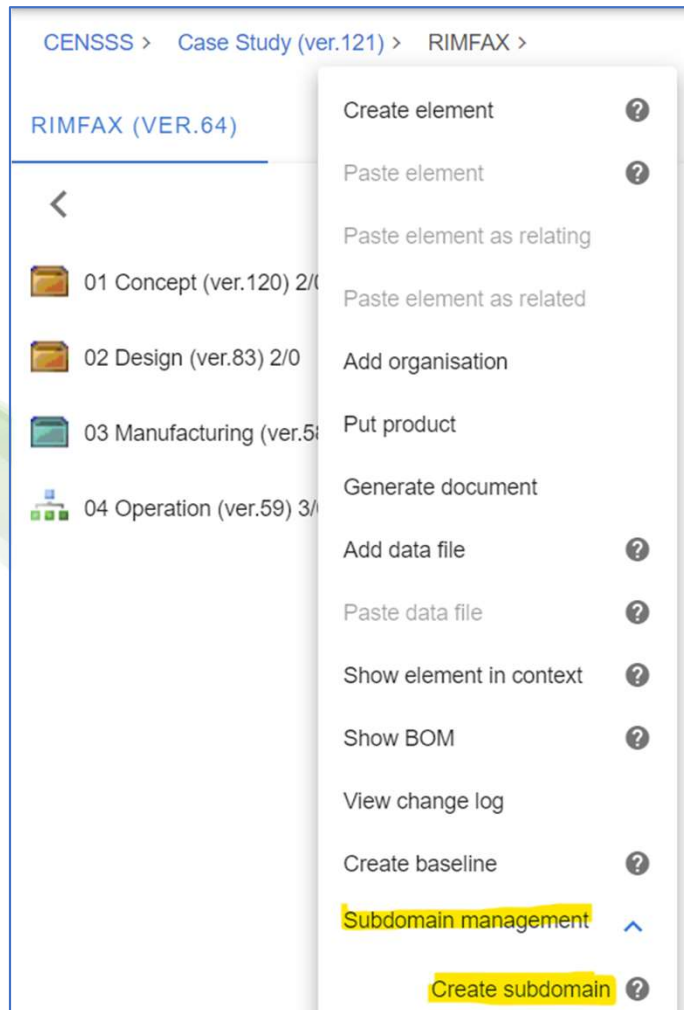
CENSSS >

CASE STUDY (VER.121)

Case Study (ver.121)

- Rename element
- Rename by attribute
- Edit element
- Ver. 121
- Export to STEP PDM-file
- Export structure to text file
- Export project to DEX
- Import CSV file
- Current project phase

# ! NDA documents... how can I control the access rights..? Subdomain



- Project Management with Subdomain functionality.
- Access rights for individual assemblies or product structure branches can be managed using subdomains.

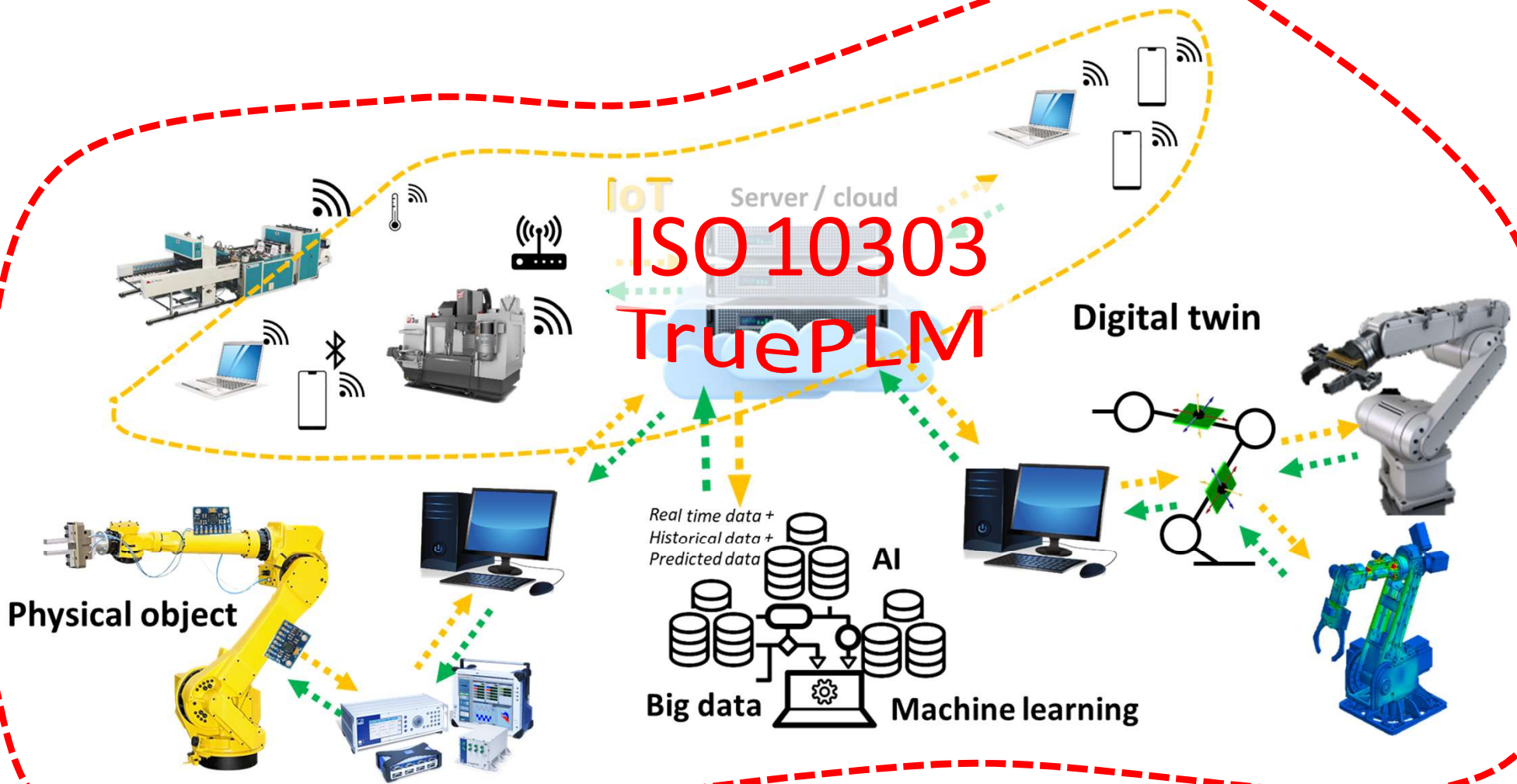


A bundle of fiber optic cables is shown against a light gray background. The cables are arranged in a way that they appear to be coming together from the sides and meeting at a central point. A white rectangular box with a thin black border is superimposed over the center of the cables. Inside this box, the words "Digital Twin" are written in a clean, black, sans-serif font.

# Digital Twin

ISO 10303 repository => Digital Twin

Industry 4.0



- A Digital Twin needs to store aspects of an operational product
- PLM enables support for many types of Digital Twins

# DEFINE – Digital Twin for validation

modEls For AIT eNviroMEnt™

Deliverable D7:  
Converters and fusion functions - Software Release Document



Prepared by  
Reference  
Issue  
Revision  
Date of Issue  
Status  
Document Type  
Version

Joint EPM Technology  
ESA-TEC-DEFINE-SReID-0001  
1  
0  
2021-02-22  
Final  
Software release document  
DEFINE project

© Agency, 2021

European Space Agency  
Agence spatiale européenne

Advances in Engineering Software 127 (2019)

Contents lists available at ScienceDirect

Advances in Engineering Software

journal homepage: [www.elsevier.com/locate/advengsoft](http://www.elsevier.com/locate/advengsoft)

Research paper

Relating structural test and FEA data with STEP AP209

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ARTICLE INFO

ABSTRACT

Keywords:  
ISO 10303  
Data Analysis  
Structural testing  
Data exchange  
Simulation data management

This paper proposes a method for incorporating FEA data and structural test data into a digital model based on the ISO 10303 STEP Standard [1]. The proposed method and elements defined in STEP AP209 Edition 2 [2] to provide traceability between information such as sensor and finite elements, test and FEA load cases, and it also presents an introduction to STEP and AP209e2, and discusses how it fits into the Management environment.



- PhD paper here:  
<https://www.sciencedirect.com/science/article/pii/S0965997818301947>

A central circular graphic resembling a camera lens with a black aperture in the middle. The lens is surrounded by a dark blue background with faint concentric circles. There are colorful light flares and streaks, primarily in shades of green and blue, emanating from the lens area.

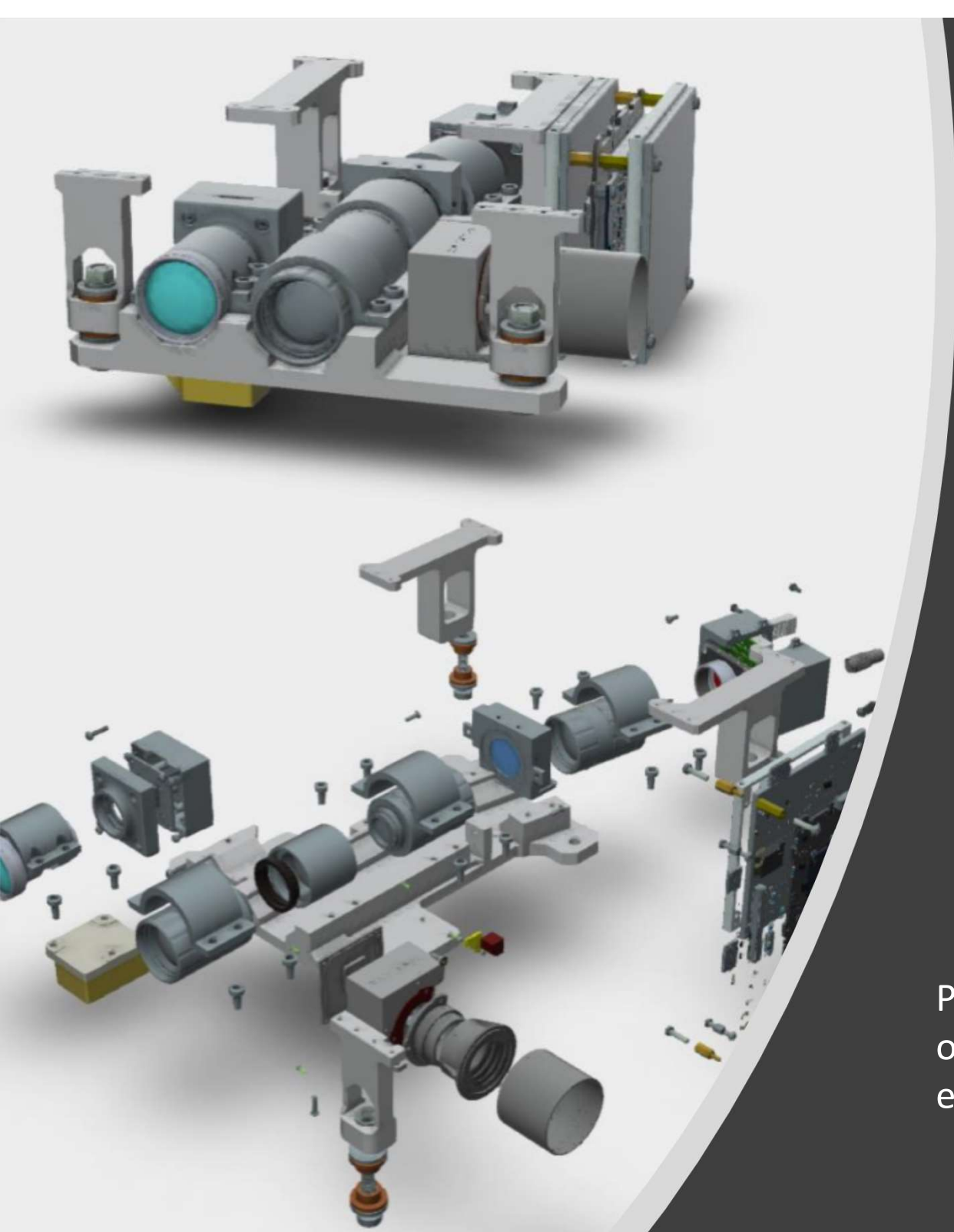
Hands-on

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How do you want to use TruePLM to manage your project..?  
Starting point will be ..to create the Product breakdown structure automatically using your CAD Step file...

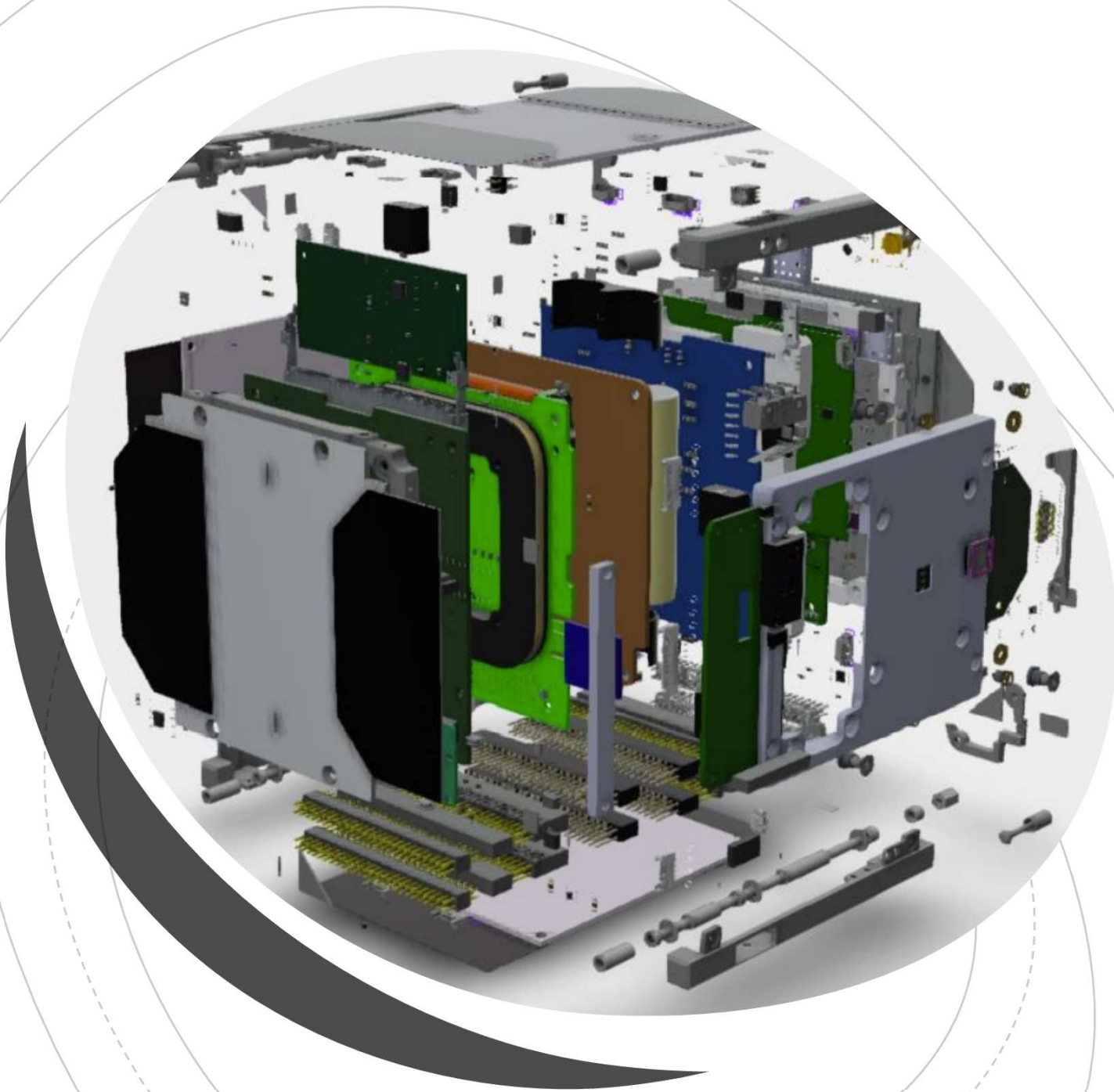
- Refer below links to access PLM
  - <https://space.jotne.com/EDMtruePLM/#/login>
- User Credentials shared earlier, please use that.
- You can refer data from your current ongoing or past projects
- Steps to be followed:
  - Create project
  - Configure your project using reference data
  - Create Breakdown structure (May be referring your own folder structure)
  - Import Step File
  - Add document or files relevant for various engineering disciplines
  - Play around the TruePLM functionalities with respect to Space application...
    - Search, export, compare versions, phase, relationships and anything more please ask..!!!



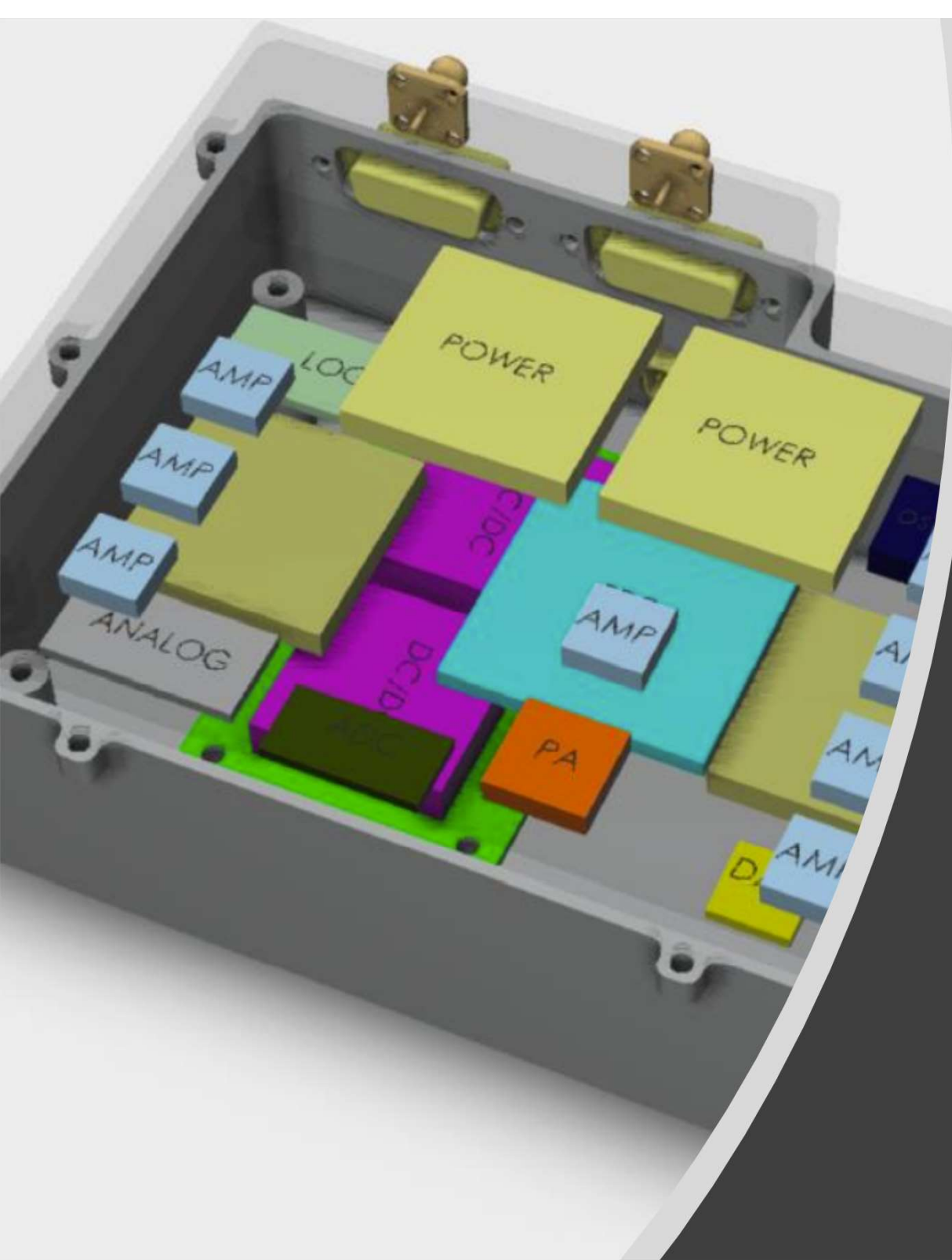


# HYPSONO-1 Digital Twin

Problem statement: To monitor optical performance due to thermal elastic behavior in operation



FRAMSAT-1  
Telemetry and  
data  
harmonization



# RIMFAX Configuration Management

