Status of MBSE deployment in the European Space Industry

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mbse2022 - 2022-11-22

ESA is empowered

ESA Director General Agenda 2025:

"*In Europe, ESA has the unique ability to implement, together with industry, complex and ambitious space missions and programmes on an equal footing with other leading space agencies worldwide. We will ensure that this ESA strength and value is further reinforced.*"

"*ESA will therefore **digitalise its full project management**, **enabling** the development of digital twins, both for engineering by using Model Based System Engineering, and for procurement and finance, achieving full **digital continuity with industry**.*"

ESA internal organisation

- Leaders: Director General, Chief Digital Officer, Inspector General
- Teams:

➔ Corporate IT application team for project management (business goals, value streams, 80 partners interviewed) or for project control dashboard

➔ Project teams (e.g. Galileo, Ariane)

➔ Operation and Technology directorates for Engineering/Operation/Product assurance

A systematic, multi-level, cooperation

Digital Spacecraft Steering Committee

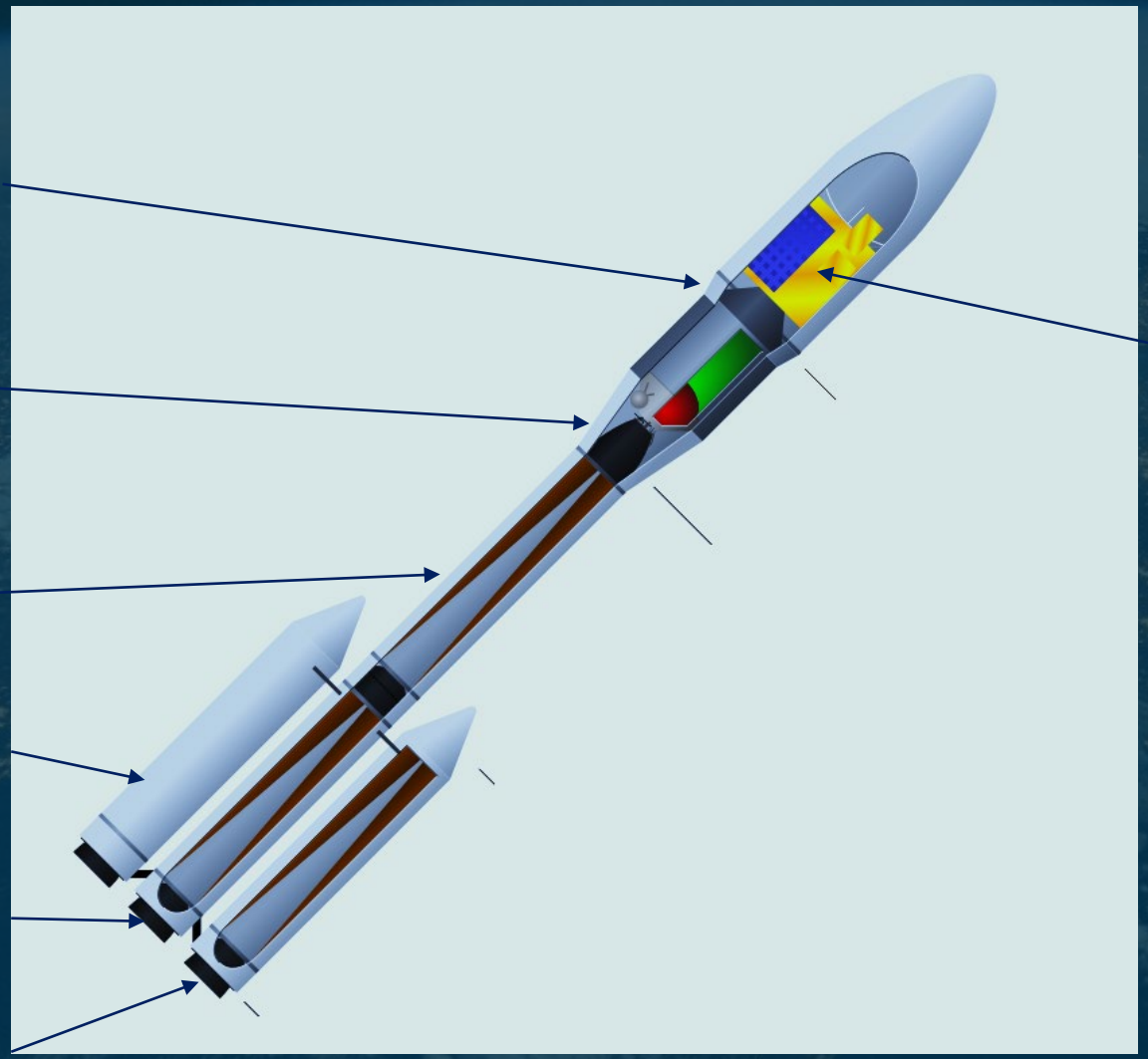
Digital Spacecraft Think Tank
(all other data)

MB4SE AG
(system engineering data)

Data Management

OSMoSE ontology

IT platform



Digital Spacecraft

The set of enablers allowing digital development of spacecraft:

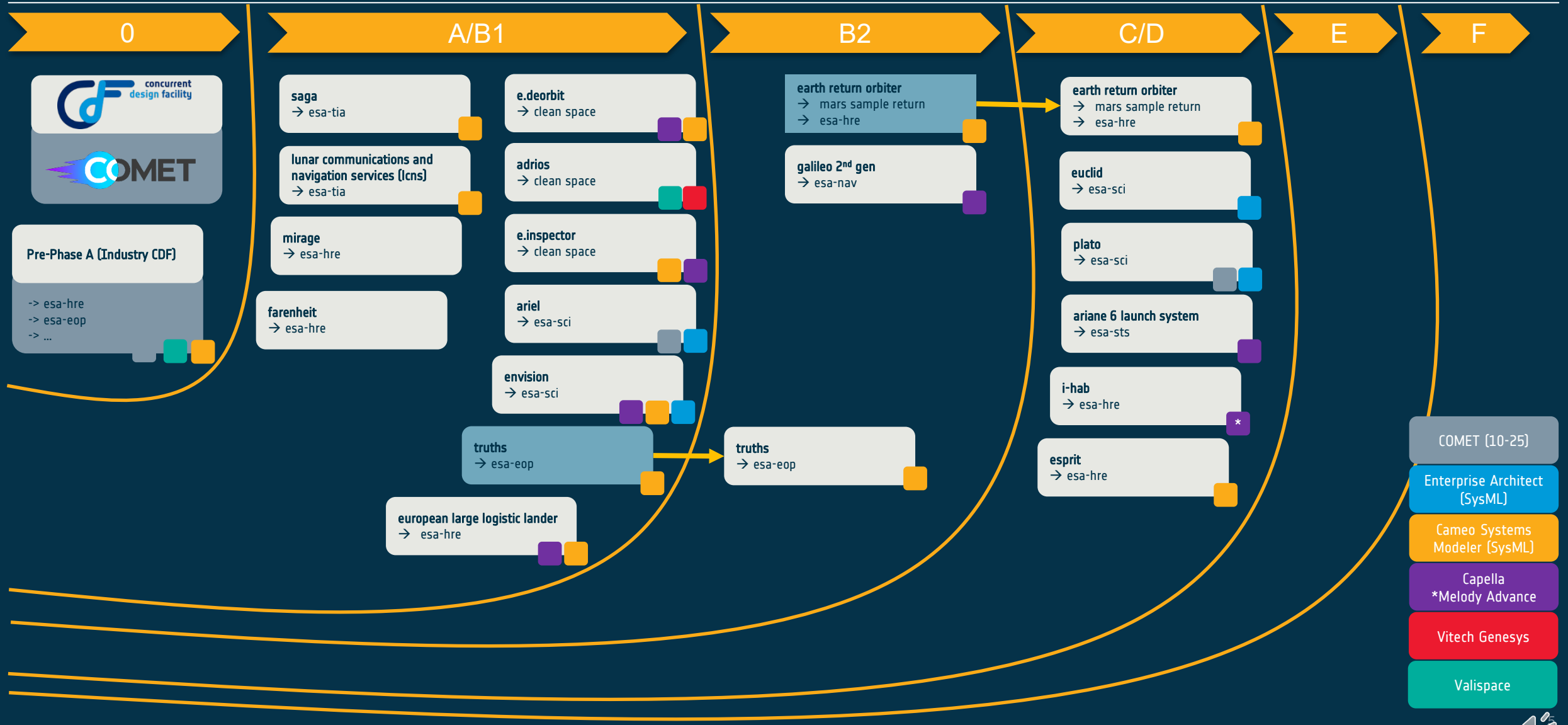
technology,
process,
datasets,
exchange formats,
exchange agreements
etc.

MBSE in Space Projects

Updated extract from Jamie Whitehouse's presentation in mbse2021

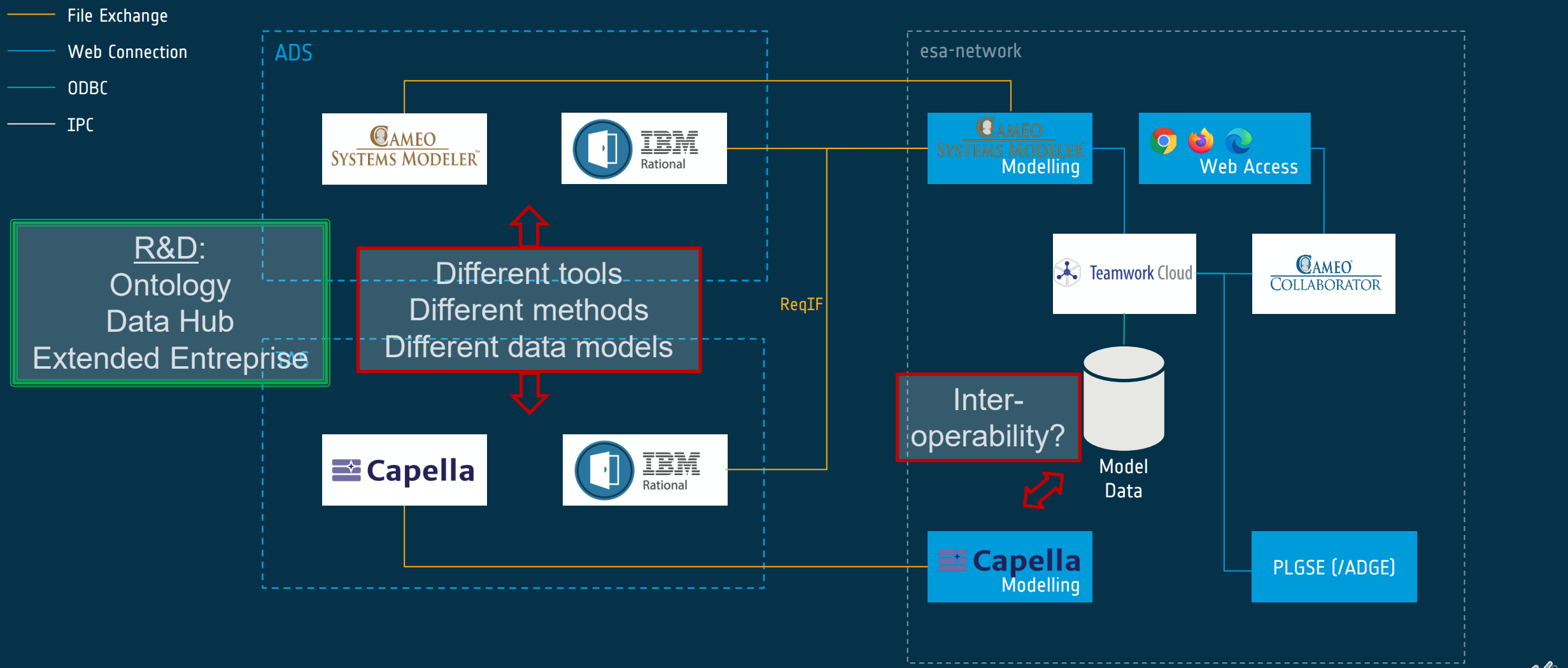
https://indico.esa.int/event/386/timetable/#5-mbse-at-esa-state-of-mbse-in

MBSE in ESA Missions Mission Overview



MBSE in ESA Missions European Large Logistics Lander (EL3)

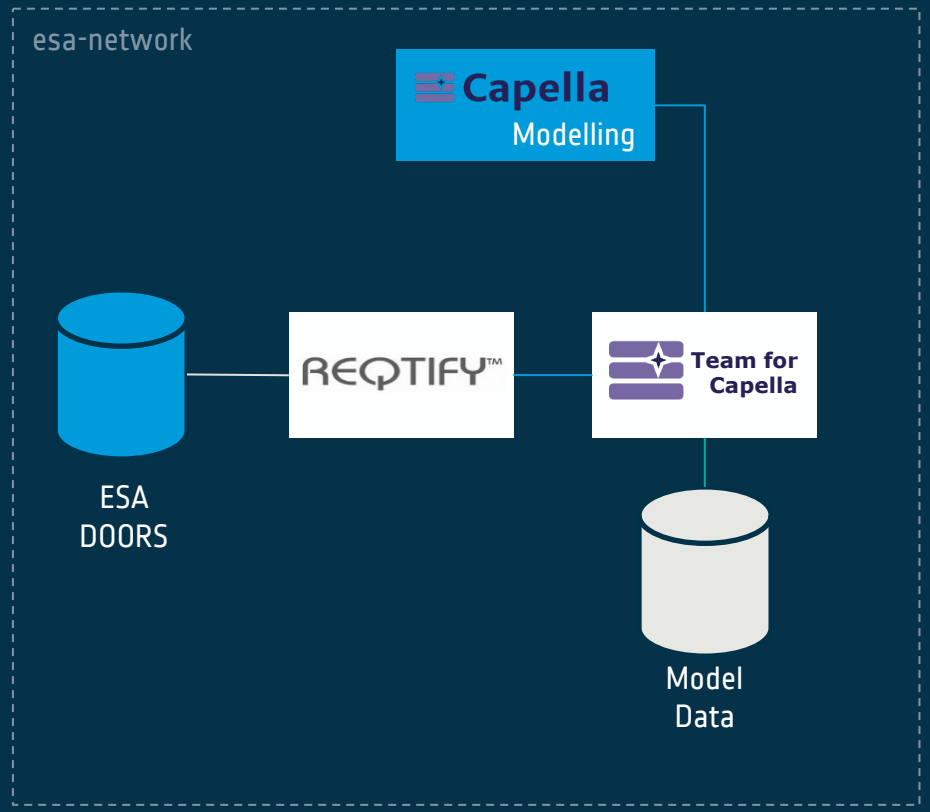
MBSE Architecture



MBSE in ESA Missions Galileo 2nd Generation (G2G)

MBSE Architecture

File Exchange
Web Connection
ODBC
IPC



- Different data access accreditation
- Model cut in pieces
- Challenging overall system engineering

See session 8 : MBSE for Galileo Second Generation, Catherine Morlet & Al

Chosen Solution

- TAS provides technical support → use of applications and methodologies used in TAS projects
- End-to-end requirements traceability from Reqtify tool
- Model server (Team for Capella) allows for collaborative work with model

R&D:
Data management
Security
Configuration management

MBSE in R&D

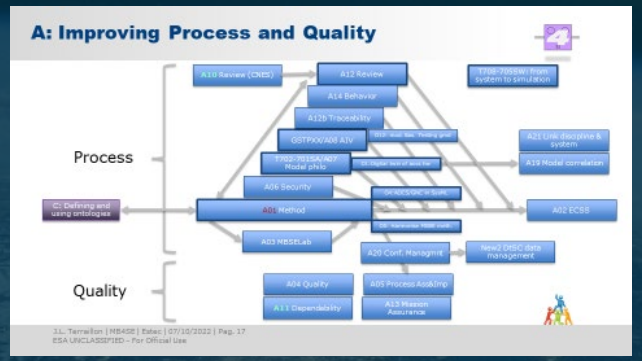
R&D status

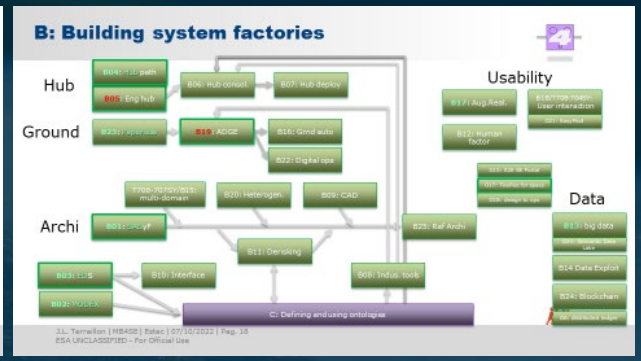
Budgets

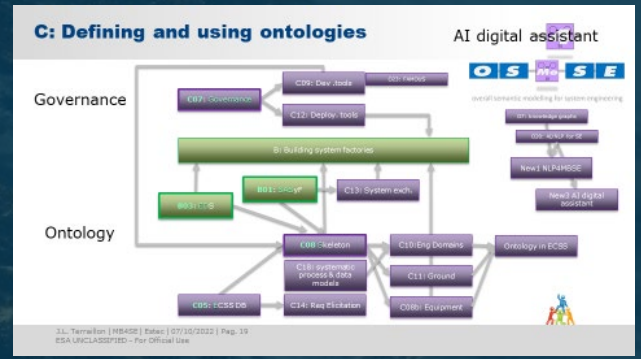
- About 14 M€ already invested in MBSE
- TDE plan of about 4 M€ for 22/23
- GSTP compendium of about 13M€
  optional R&D program for 23 onwards

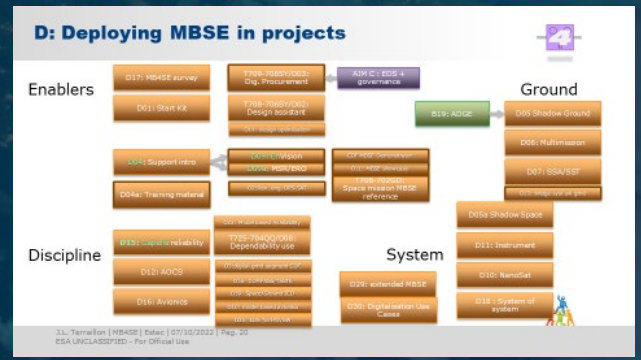
R&D goals

- A - Improving process and quality (*process, methods, life cycle, disciplines*)
- B - Building system factories (*its architecture, data hub, ground segment, usability, data exploitation*)
- C - Defining and Using ontologies (*Space System Ontology, semantic interoperability, knowledge graph, Natural Language Processing*)
- D - Deploying MBSE in projects (*enablers, deployment at system level, at discipline level, or for ground segment*)





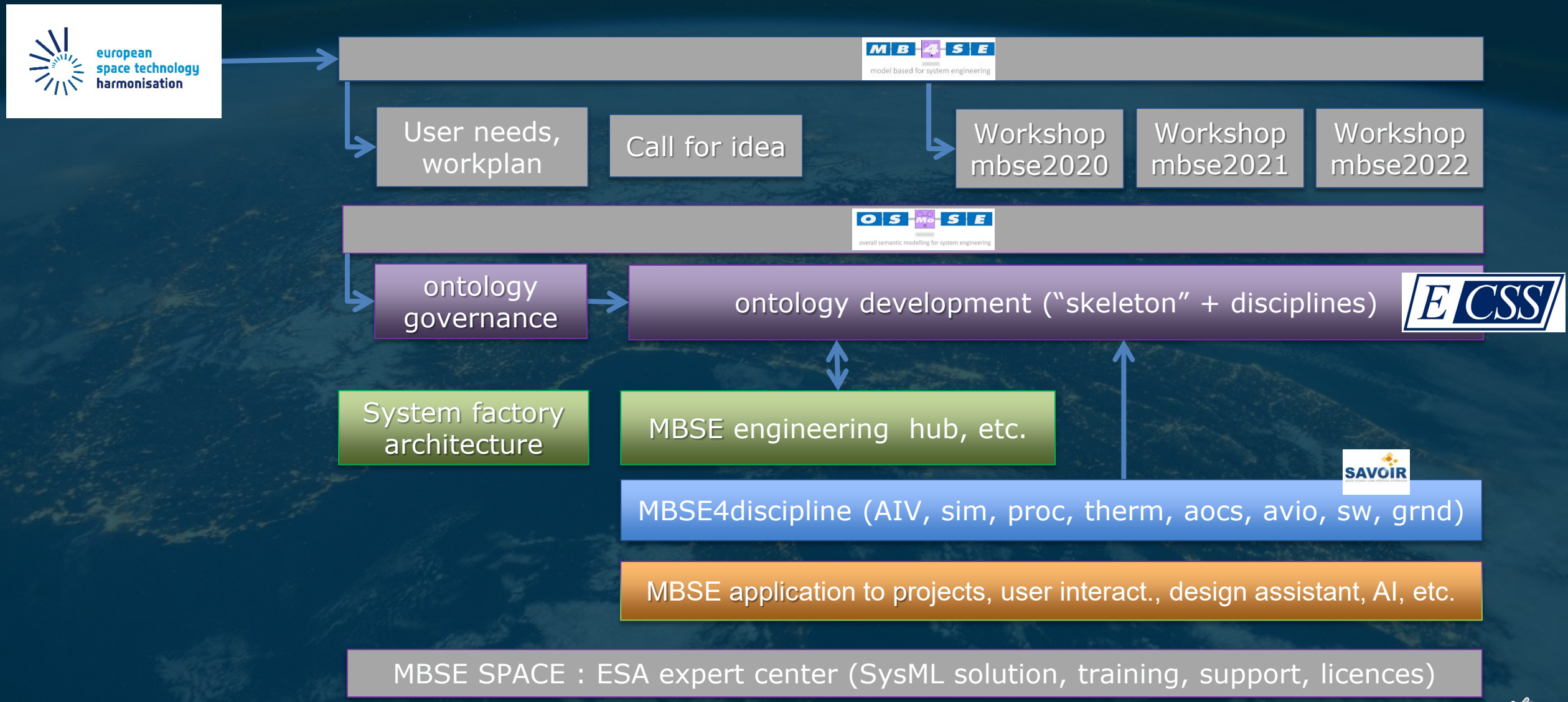




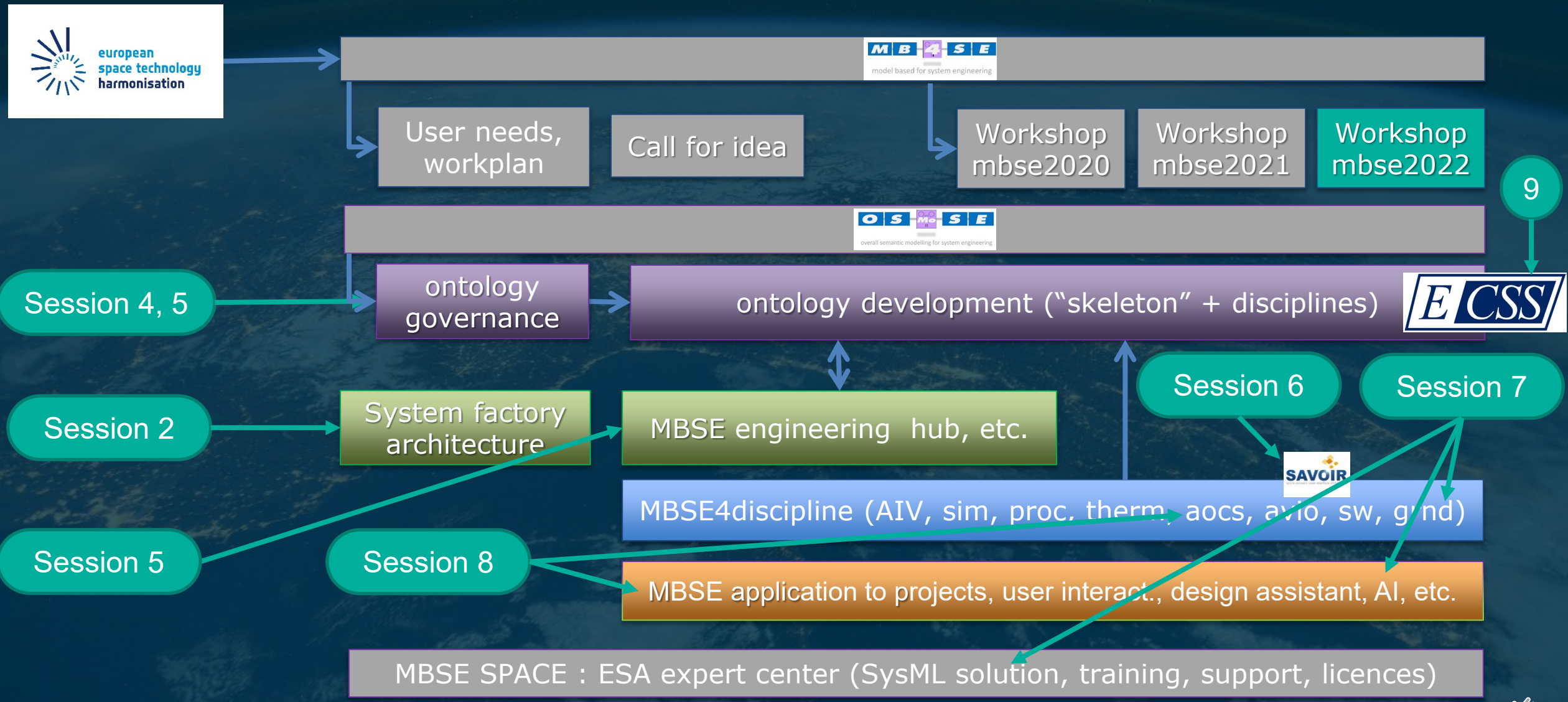
Harmonisation Technical Dossier and Roadmap can be requested to harmo@euroconsult-ec.com

https://www.esa.int/Enabling_Support/Space_Engineering_Technology/Technology_Harmonisation

MB4SE R&D Roadmap



MB4SE R&D Roadmap and mbse2022 program



Available output

MB4SE (https://essr.esa.int/project/mb4se-model-based-for-system-engineering)

- https://mb4se.esa.int (mb4se thumbnail)
- MB4SE User Needs: MB4SE-TN-001 i2 r2
- Harmonisation Technical Dossier and Roadmap: 2020.1_THD_MB4SE_v2.2

OSMoSE

- https://mb4se.esa.int (OSMoSE thumbnail)

https://mbse2021.esa.int OSMoSE session, recorded presentations

Digital Spacecraft (https://essr.esa.int/project/digital-spacecraft)

- https://mb4se.esa.int (Digital Spacecraft thumbnail)
- White paper : White Paper on Digital Space Systems i1 r3
- User Needs: DTSC_UserNeeds_Iss1_Rev2
- Process investigation: DTSC_Process_Investigation_Iss1_Rev2

Also in ESSR:

- System factory architecture (SASyF)

https://essr.esa.int/project/specification-and-architecture-of-a-system-factory-sasyf

- ESA SysML solution

https://essr.esa.int/project/esa-sysml-solution