Status of MBSE deployment at ESA

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1. INTRODUCTION

The **ESA Agenda 2025**[1] is a document prepared by the European Space Agency Director General when he took up duty, and indicating to the Space Community, and in particular the ESA Member's States Delegations, the directions for the next four years. It says in particular:

- "*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.*"

Digitalisation is the process of representing all the artefacts of space systems under a (structured) digital representation on which computers can reason and elaborate. The most explicit example of such digitalisation process is the Model Based technique, where the information, traditionally contained in the form of documents, is instead expressed in a set of data structured into a model. Computers can be programmed to navigate and search into the models, and create relations between associated data, allowing to discover more properties, and to derive added value such as traceability, optimisation, technical budgets, trends, and knowledge.

Digitalisation includes also e.g. databases or excel sheets, or any format where data is structured, curated and associated to a semantic that allows to unambiguously understand it with a computer. This transformation relies on common standards and new infrastructures that facilitate the exchange of data but also the collaboration along the whole supply chain.

Model Based System Engineering (MBSE) is the focus of this paper. Deploying MBSE in space projects involves the space European community through a number of European joint agency-industry working groups led by ESA, in particular the MB4SE Advisory Group[2,]

This group has been established in 2019 with the objective to deploy Model Based System Engineering in Space projects. It includes five space agencies (ESA, CNES, DLR, ASI, and UKSA) and four Large Systems Integrators

[1] ESA AGENDA 2025: Make space for Europe - https://download.esa.int/docs/ESA_Agenda_2025_final.pdf

[2] https://mb4se.esa.int

(ADS, TAS, OHB, and ArianeGroup). It advises ESA on the technical aspects of MBSE research and development, and mainly on interoperability of tools, through the seamless exchange of the associated data.

The MB4SE AG serves as Steering Group of the *OSMoSE Governance*[3] group. The "Overall Semantic Modelling for System Engineering" initiative arises from the need of enhancing the way information and knowledge is exchanged among the stakeholders involved, enabling efficient interoperability among model-based infrastructures used. The OSMoSE initiative addresses interoperability at semantic level, merging all stakeholder's concepts into a global conceptual data model resulting in the so-called Space System Ontology.

Together with MB4SE AG and OSMoSE, ESA has started to embark in MBSE through (i) a substantial R&D plan, and (ii) its progressive introduction in space projects.

2. THE R&D ROADMAP

The presentation will show the progress made in the R&D roadmap since the previous presentation in 2019, indicating how activities have progressed, how the OSIP MB4SE campaign has supported the community, how the agreed 5 years roadmap has been used to prepare the specific TDE and GSTP plans for 2023+.

3. THE INTRODUCTION IN PROJECTS

The presentation will show the status of the introduction of MBSE in space projects, according to their development phase. Most of them benefitted from the financial support of the "discovery" program, through the introduction of many ESA statement of work of a specific work package related to the use of MBSE.

4. CONCLUSION

The presentation will put the MB4SE project into the wider scope of ESA digitalisation, complementing system engineering with all engineering disciplines and product assurance, investigating the informatics support that it would require as an (extended) Entreprise, raising the issue of "data management", in order to change our way of working from a pure Customer-Supplier relationship towards a contractually framed digitalised co-engineering…

[3] https://mb4se.esa.int/OSMOSE_Main.html