esa
estec

European Space Research
and Technology Centre
Keplerlaan 1
2201 AZ Noordwijk
The Netherlands
T +31 (0)71 565 6565
F +31 (0)71 565 6040
www.esa.int

DOCUMENT

Executive Summary Report

OSMoSE
overall semantic modelling for system engineering

Prepared by	**OSMoSE Working Group**
Reference	**OSMoSE-ESR (GMV 24508/20 V1/20)**
Issue	**0**
Revision	**1**
Date of Issue	**23/11/2020**
Status	**Released**
Document Type	**Technical Note**
Distribution	**ESA Member States**

1 INTRODUCTION

1.1 Background

Space industry and Agencies have recognized already for quite some time the interest and added value of Model-Based System Engineering (MBSE) in streamlining the design, development, deployment and verification of space systems. There have been many initiatives during the past decades, aiming at defining models and tooling able to support the various needs of the system engineering process. MBSE is increasingly being used in operational projects and the next step is to use extensively MBSE all along the system life cycle, across disciplines and throughout the supply chain.

OSMoSE (Overall Semantic Modelling for System Engineering) arises from the need of enabling interoperability among model-based infrastructures to allow the exchange of information among different stakeholders. Namely, the solution to address interoperability at semantic level is to do information modelling at system specification level (i.e. the "what"), building a global conceptual data model for the Space System – the *Space System Ontology*.

1.2 Objective

The OSMoSE Ontology Governance project aims to define the governance of the Space System Ontology through the elaboration of a set of documentation that will guide the management and usage of this Ontology.

The Space System Ontology is governed by two groups:

- A *management steering group* (MB4SE Advisory Group) in charge of the management issues.
- A *design authority group* (OSMoSE working group) responsible for the technical concerns. This group makes all technical decisions (e.g. language selection, definition of the development lifecycle), and guides the elaboration of the global conceptual data model to ensure its capability to achieve interoperability.

1.3 Approach

The documentation has been elaborated in a collaborative approach among GMV, Large Space Integrators (LSI) and ESA. GMV was responsible for producing the documentation based on inputs and feedback received from LSIs and ESA. Furthermore, the documentation has been periodically reviewed by the design authority group during the OSMoSE Governance meetings. The final versions have been delivered to the management steering group for their review.

2 PROJECT ACHIEVEMENTS AND RESULTS

The following deliverables have been produced in OSMoSE Ontology Governance project:

Steering group Terms of Reference

The steering group *terms of reference* is a flow down of the *terms of reference* defined for the MB4SE Advisory group. It covers the following areas: i) general principles that regulate the group, ii) tasks and responsibilities, iii) group composition, iv) proceedings of the group and working groups and v) resources allocated to the group.

Some relevant issues defined in this document are illustrated below:

- The steering group relies on the voluntary participation of the organizations, and the group is open to participation by European organisations that are stakeholders in the system-engineering domain. Namely, participants belong to three categories: the European space system integrators, the European space equipment suppliers and the European space agencies (ESA and national Agencies).
- The steering group is responsible for establishing the work plans and agreeing the corresponding implementation plan for the Space System Ontology, providing inputs to the "Space System Ontology Definition", in particular for the development steps, the available inputs definition and the governance.
- The steering group will keep awareness regularly of the progress, status and performance of the Space System Ontology.

Design Authority group Terms of Reference

The design authority group is expected to assess those technical decisions that impact the Ontology development process and the scope of the universes of discourse, and contribute to the synergy across parallel activities, informing about any decisions and results directly connected to both activities.

The *terms of reference* covers three main areas:

- The group organization: General principles that regulate the group, the working group composition, the different roles that are played, the responsibilities of the group, the support processes that have to be agreed to create communication channels with the user and receive feedback, rules that regulate the decision making process and the contributions to the Ontology.
- The Ontology pre-requisites. General principles that apply to the Space System Ontology development.
- The group activities. Identification of the group activities together with their inputs and outputs. Namely, the group will take technical decisions about:
  - Language aspects
  - Scope of the ontology
  - Development plan
  - Development of the ontology
  - Validation of the ontology

- Evaluation of the analysis of the impacts on existing data models
- Tooling needs
- Configuration management
- Baseline proposal
- Maintenance of the ontology
- Management of the change: evolution to adopt the ontology
- The *terms of reference* enumerates the inputs needed and the outputs expected to cover all these aspects.

Project plan

The *project plan* includes all the information that the steering group is in charge of managing for controlling the development aspects of the Space System Ontology.

Four groups of Stakeholders are identified:

- *Ontology governors* in charge of controlling the Ontology development;
- *Ontology developers* in charge of developing the Ontology;
- *Interoperability developers* who use the Ontology to develop systems allowing interoperability at physical level; and
- *Users* who apply the Ontology through tools that enforce the interoperability, to develop space system programmes.

The *project plan* details the main areas of interest of each type of Stakeholder. Users play a key role during the development of the Ontology because it will be driven by the user needs, i.e. use cases. Hence, the utilisation of the Ontology must govern its development.

The *project plan* details the different principles that guide the development, including:

- Development policy
- Dissemination plan
- Quality and product assurance
- Programme of work

Concerning the legal aspects, they are documented in the *IPR Management* document.

An important part of this documents refers to the identification of potential risks during the development. The risks are group in 4 areas: Scope of the Ontology, development of the Ontology, tooling, and application of the Ontology. Although some preliminary mitigation actions are proposed, these risks shall be assessed, monitored and mitigated during the development.

Finally, the *project plan* defines the use cases that shall be considered during the definition of the Ontology. They compile the main interoperability scenarios of a space system development process among Stakeholders, disciplines and project phases. The use cases are inspired from the ECSS-E-ST-10C and have been organized according to the Space System Engineering activities: Requirements engineering, analysis, design and configuration, verification, management and planning, interface control, design files production, risks management, support to configuration control, change management and NC control. These use cases will allow the identification of the terms of interest of the Space System Ontology which will facilitate the definition of the scope of the different universe of discourse.

Development plan

The *development plan* specifies all the information that the design authority group is in charge of managing for the elaboration of the Space System Ontology.

One of the first issues to manage is agree on the scope and priorities of the Ontology:

- The Ontology shall address the System aspects of any Space Systems.
- Its scope is limited to the engineering data
- It shall focus on what is exchanged, addressing the level of detail needed by the exchanges and avoiding being bias by any MBSE methodology
- It shall model generic elements at system level and later be instantiated in different engineering domains

The development process is based on the definition of Universe of Discourse. Namely, the *development plan* identifies 8 Universes of Discourse, but this list might be extended to add new areas of development.

1. Requirements management
2. Mission and operation
3. Functional description of the static view
4. Functional description of the behavioral/dynamic view
5. Logical description
6. Physical description
7. Managing and planning
8. Support to configuration control, change management and NC control

These UoDs will be conceptualized using ORM and NORMA Pro. Additionally, transformation and translation tools will be also required to automatically generate the e.g. UML, Ecore, XML… representations of the Ontology.

The ORM model is the reference output of the OSMoSE working group, and will be produced together with a (partial) verbalization and a set of other representations certified compliant due to the use of automatic translation tools.

The *development plan* defines the modelling approach and the validation strategy. Concerning the former will be sustained by an iterative process where the "Global as a Whole" and "Locals as Views" modelling approach is adopted. The later will rely on i) population for positive and negative cases, ii) population of what can be done in the conceptual data model, iii) a case study to apply and demonstrate the Ontology concepts and iv) when modelling, the verification of each proposed conceptual definition shall include the verification of the meaningfulness and grammatical adequacy of the predicate reading.

Finally, the *development plan* defines quality and product assurance aspects, such as metrics that can be applied to the Ontology, the configuration, deployment and management plans, and principles to assess the impact on existing data models.

Ecosystem Status, Mitigation Plan and Website

Apart from the terms of reference and the plans, the OSMoSE Governance project has provided and established the status of the ecosystem in Europe, proposing and implementing solutions to consolidate it and mitigate the risks that have been identified in the project plan. Furthermore, the MB4SE/OSMoSE website has been created (https://mb4se.esa.int/) to explain the purpose of these groups and present their main activities and results. Additionally, it provides further resources related with both groups.

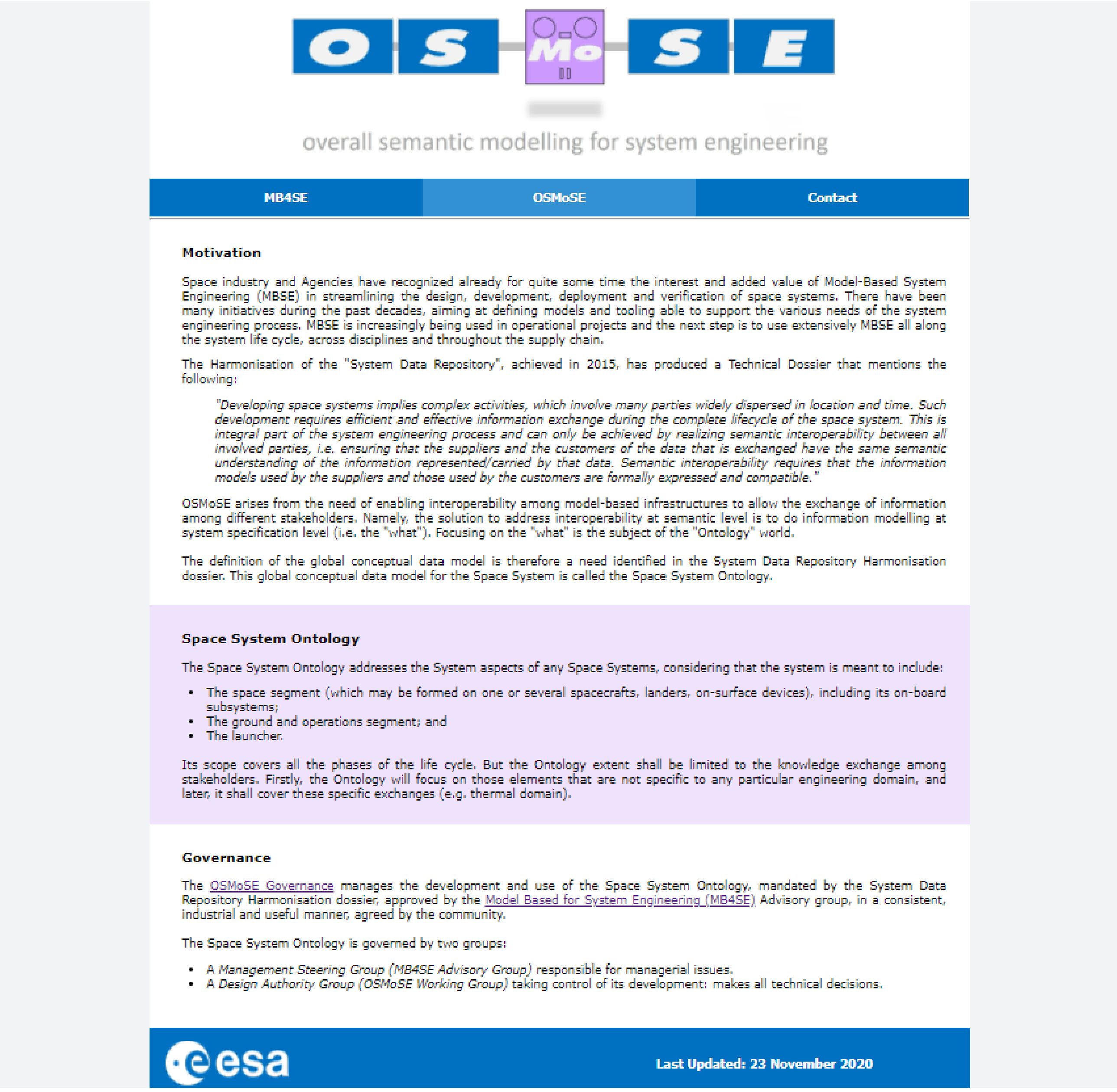

Figure 4-1: MB4SE/OSMoSE website

3 CONCLUSIONS

This activity has successfully provided the documentation needed for the governance of the Space System Ontology. The deliverables cover the different areas that the steering group and the design authority group are in charge of and the aspects that have to be considered along the development of the Space System Ontology. This provides a complete Ontology governance definition.

For more information contact to:
Elena Alaña Salazar (GMV Aerospace and Defence, S.A.U), ealana@gmv.com
Jorge Pacios Martínez (GMV Aerospace and Defence, S.A.U), jpacios@gmv.com

This ESA activity (contract No. 4000129931/20/NL/GLC/hh) has been carried out by the OSMoSE-GOV consortium integrated by GMV Aerospace and Defence S.A.U. acting as prime contractor, and Thales Alenia Space France, Airbus Defence and Space SAS, and OHB System AG as subcontractors. Technical Officer of the activity: Jean-Loup Terraillon together with Serge Valera.