Domain-specific ontology for digital continuity: Thermal Engineering case

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Workshop Objectives: T-4

1. Introduction

OSMoSE (**O**verall **S**emantic **Mo**delling for **S**ystem **E**ngineering) promotes the digital continuity and interoperability among stakeholders that are using different tools and methods[1]. OSMoSE develop the “skeleton” of the Space System Ontology (SSO), which is considered as a top-level ontology for the space system that will integrate domain-specific ontologies that are called Universe of Discourse (UoD). Currently, OSMoSE project is undergoing and different UoDs are under development as well. The integration of these UoDs and OSMoSE top ontology greatly contributes to the digital continuity and interoperability issues in ESA digitalization.

To model these UoDs, this paper proposes a multi-viewpoint approach to extract and model the semantics of space systems from the various domain perspectives (presenting various aspects of a sub-system) and integrate them into a global model. Domain-specific ontologies for each sub-system are created considering the domain experts knowledge and space domain references.

The proposed approach is presented by means of an under-development example from the thermal control engineering discipline. The modelling tool is NORMA ORM (Object-Role Modelling) which is considered by OSMoSE as “the best technical solution to develop the Space System Ontology”[2].

Based on this approach, each item from the spacecraft will be modelled from the System Of Interest (SOI) perspective and external systems perspective. Such an approach can contribute

[1] Terraillon, J. (2022) ‘Digital transformation in the European Space Industry’, in Embedded Real Time Systems (ERTS), Jun 2022, TOULOUSE, France.

[2] https://mb4se.esa.int/OSMOSE_Space%20System%20Ontology.html

to the digital continuity in space systems by proposing a framework for domain knowledge modelling which can be easily integrated into the OSMoSE high-level ontology.

2. Modelling approach and proposed thermal engineering model

This paper proposes a framework to create domain-specific ontologies for space systems that are compatible with OSMoSE. In doing so, domain-specific ontologies for each sub-system will be created. The viewpoint of the engineering domain that is the focus of the ontology is considered as the System Of Interest (SOI) and all other related systems are named External Systems. In this paper, the thermal control system is the SOI and related systems such as structure, power, etc. are the External Systems that are interacting with our SOI and the other way around. This approach let us to detect all important information for each discipline as well as interfaces between disciplines.

In order to present this approach, the concept of Perspective is adopted. In this paper, the Perspective is the presentation of the system and its items from the view of different engineering disciplines. The SOI has requirements towards external systems. To show these requirements, two kinds of perspectives are considered as SOI Perspective and External System Perspective (Figure 1).

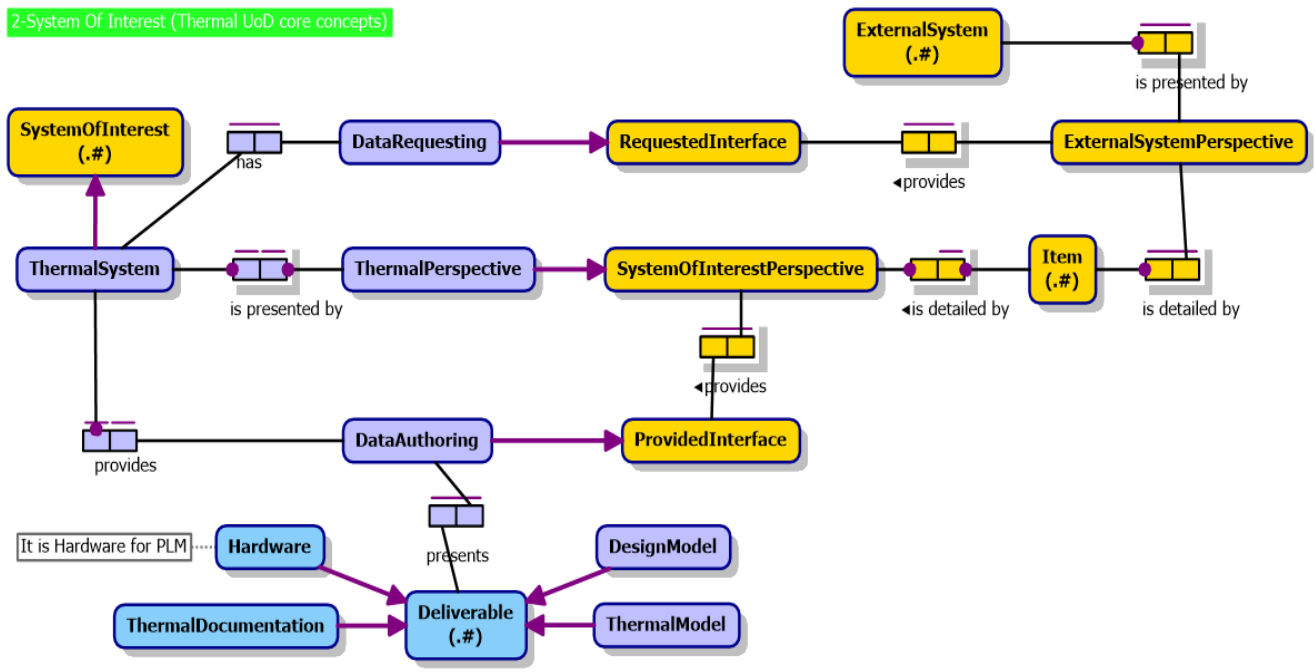

Figure 1: The general view linking the Thermal ontology to the other (sub-)system(s) ontology

3. Discussion and future work

The presentation will introduce the approach used for the thermal engineering discipline, explaining how the initial definition of the thermal process model helped to the identification of the fact types and object types of the ORM ontology, further validated by the domain expert.
Depending on the progress of the related activities, it will address the relationship between the ontology and the exchange format that could be used in the thermal discipline, for example in the STEP family.
Intentions for future work concentrate on extending the domain ontologies to cover different engineering domains and on including additional detailed features from the engineering process semantics. Full implementation and testing of this proposal for the whole space disciplines is in progress.