**From engineering models to knowledge graph: delivering new insights into models**

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1. **Introduction**

The ECSS-E-TM-10-25A Technical Memorandum facilitates the common data definitions and exchange of concurrent engineering studies outputs such as engineering models. These models hold essential information on the mission’s early design options, yet they are uneasy to visualize, query, or compare. This paper proposes to enhance the data linkage, reusability, and interpretability of engineering models by merging them into a knowledge graph. Knowledge graphs allow to organize data with different levels of depth and complexity. Furthermore, by augmenting the graph with a reasoner and inference engine, new insights into the model can be devised. This study will demonstrate how a knowledge graph populated with engineering models can facilitate information retrieval and reuse at the early stages of space mission design.

1. **Methodology**

The schema layer, structure, of the graph is based on the ECSS-E-TM-25A UML model and implemented with the Grakn software [1]. Concepts from the UML model (e.g., class, attributes, relationships) are mapped into Graql ones (e.g., entities, attributes, roles). Once the structure of the knowledge graph is defined, the graph can be automatically populated with engineering models [2]. The proposed approach is tested on a set of models from similar missions. Once the graph is populated, it is possible to compare models and swiftly traverse the graph, correlating the information contained in different model sources. The graph automatically highlights bridges in-between models, a comparison otherwise done manually in a tedious process. It will be also be shown how adding semantic on the graph can further enhance its query and inference capabilities. Natural Language Processing enhancements build upon the work done in the frame of the Design Engineering Assistant project, an expert system for the early stages of space mission design [3].

1. **Conclusion**

Integrating knowledge graph into the process of space mission design has the tremendous potential to improve data visualization, interpretability, and querying. This study demonstrates how one product of concurrent engineering sessions, several engineering models based on the ECSS-E-TM-10-25A standard, could be migrated into a knowledge graph, delivering new insights into accumulated knowledge.

1. **References**

[1] Grakn Labs webpage, <https://grakn.ai/>

[2] A. Berquand: Building a Space Mission Design Knowledge Graph with Grakn?, Grakn Cosmos, February 2020, <https://www.youtube.com/watch?v=S2pB_Twi0QQ>.

[3] A. Berquand, Y. Moshfeghi, A. Riccardi: Space mission design ontology: extraction of domain-specific entities and concepts similarity analysis, Proceedings of the AIAA Scitech 2020 Forum, Orlando, USA, January 2020.