

IMPARO: Impact of Anomalies and non-conformances on future Requirement formulations

Nowadays, data is spread through different systems, being very complex share information across them. In this context, data is understood as Project data, such as specifications/documents of requirements and anomaly discovery from Space Mission ESA development. Having this, the main goal is to exploit lesson learn to improve future Space Mission, that is, it is wanted to reuse the information generated in previous projects.

This goal itself is a challenge due to the excessive number of documents (unstructured data), redundancy/duplicity of terms, unconnected data, and lack of standardization (ambiguity).

On the other hand Artificial Intelligence is installed in our daily routines. Every day we consume this technology in a way that is fully transparent for the citizens, making our lives more comfortable. Namely, AI has been successfully applied to Natural Language Processing to help machines to understand how human-being express their thoughts.

Therefore, the idea behind this project is to demonstrate that AI brings benefit to Space Mission ESA, in somehow future project can learn from the past.

To this end, firstly and ontology based Knowledge Graph has been built. The ontology gathers the main concepts that are needed to create a vocabulary for the Missions, for example, the relationship between anomalies and test have been modeled in the following way: anomaly discovered by test (with the associated constraints). Secondly, to extract the concepts from documents (project data), Named Entity Recognition and Topic discovery models have been used as input for the Knowledge Graph. Last but not least, a Web User Interface has been used to facilitate the population of this KG (for administrator purposes) and to request information from it in a friendly way (final users). All these cross-related technologies and features have been collected in a single solution: IMPARO.

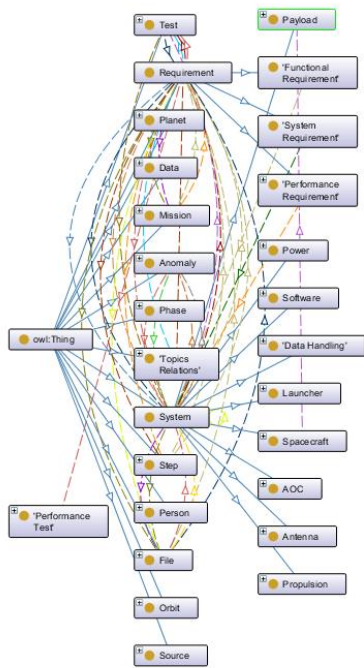


Figure 1. Simplified graph of the ontology

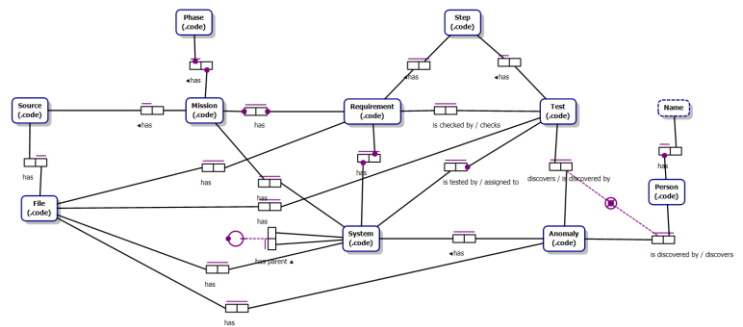


Figure 2. Global Data Model

With IMPARO solution, the CDF (Concurrent Design Facility) Missions and System engineers can compare a new mission to be launched with previous ones in order to prevent anomalies (for example) and improve the specification in a particular system.

They can interact with the constructed Knowledge Graph asking questions as follows:

- What requirements were applied?
- What anomalies were detected?
- What tests were used to detect the anomalies?

We can summarize the main aspects related to CDF Missions and System engineer use cases as follows:

- Improve the exploitation and visibility of lessons learned for the definition and specification of future projects.
- Improve the ability to respond to identified failures and not to repeat them.
- Enable the efficient capture of expert knowledge (operators, engineers, etc.).
- Reduce project risks and costs by mitigating production delays and anomalies caused by inefficient or non-existent requirements.
- Improve the reuse of information, for example in similar missions and sharing components could reuse requirements and historically identified lessons learned.
- Find information more quickly.
- Enable the extraction of value from unstructured information (texts with anomalies, project documents, etc.).

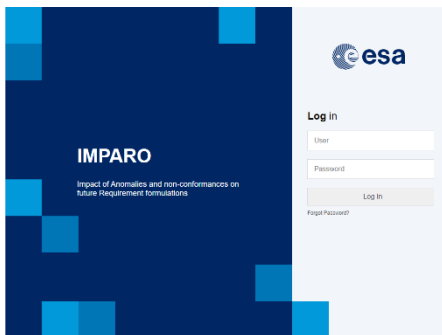


Figure 3. IMPARO Login

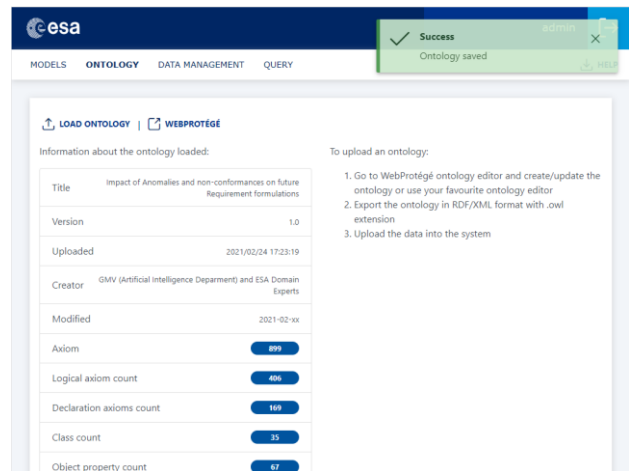


Figure 4. IMPARO Ontology Management

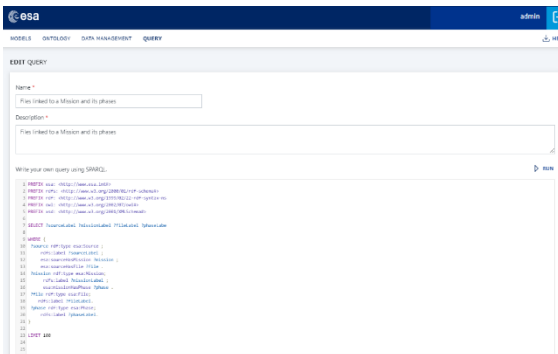


Figure 5. IMPARO Query execution

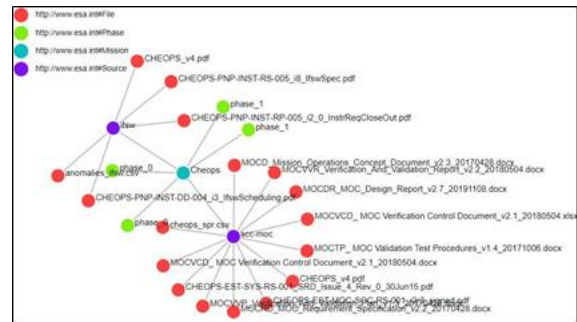


Figure 6. IMPARO Query results