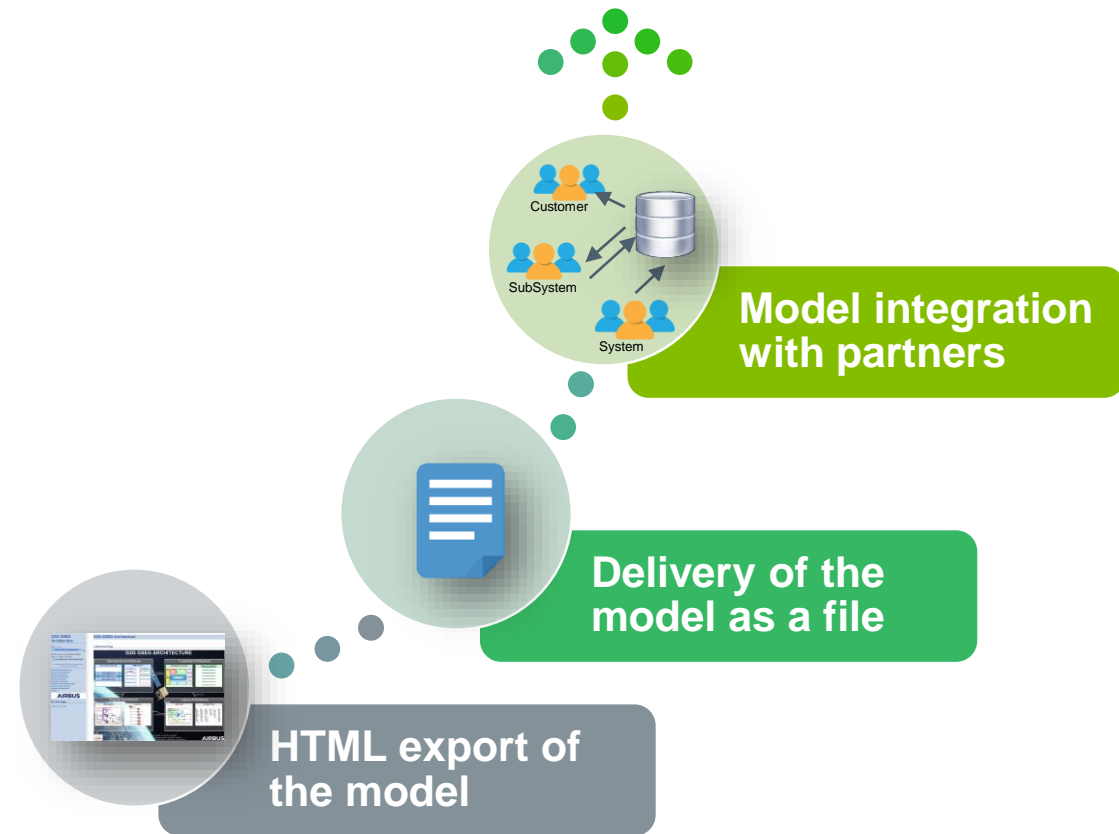DEFENCE AND SPACE

Ontological Approaches for Scaled MBSE Deployment

ESA MBSE2022

Lucie Laborde, Ground Systems MBSE Support and Improvement
November 2022

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From MBSE to model-centric engineering

Model integration with partners

Delivery of the model as a file

HTML export of the model

- At ADS, we are focusing on deploying MBSE to achieve model exchanges (internally and externally)

- The prerequisite is to extend and normalize MBSE

- Model exchange requires an alignement of modelling frameworks between partners (issue today)

- The Space System Ontology will enable interoperability at semantic level and remain tool-independent
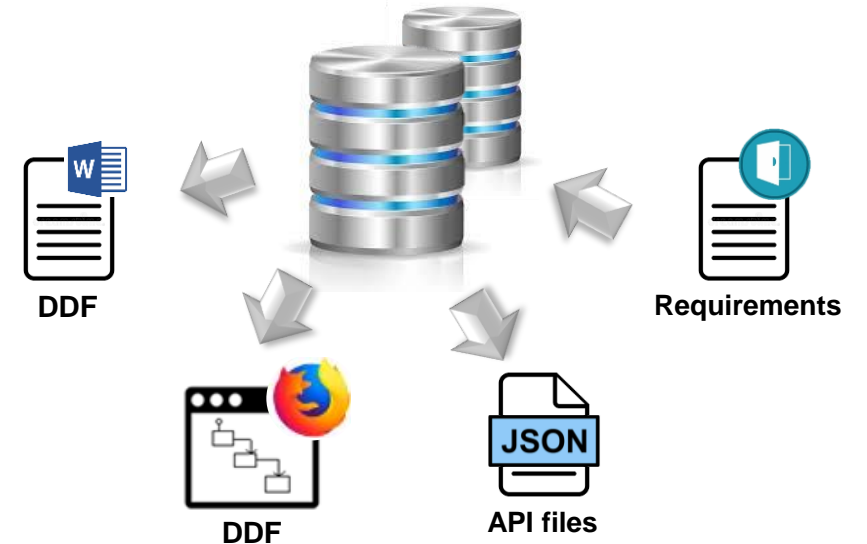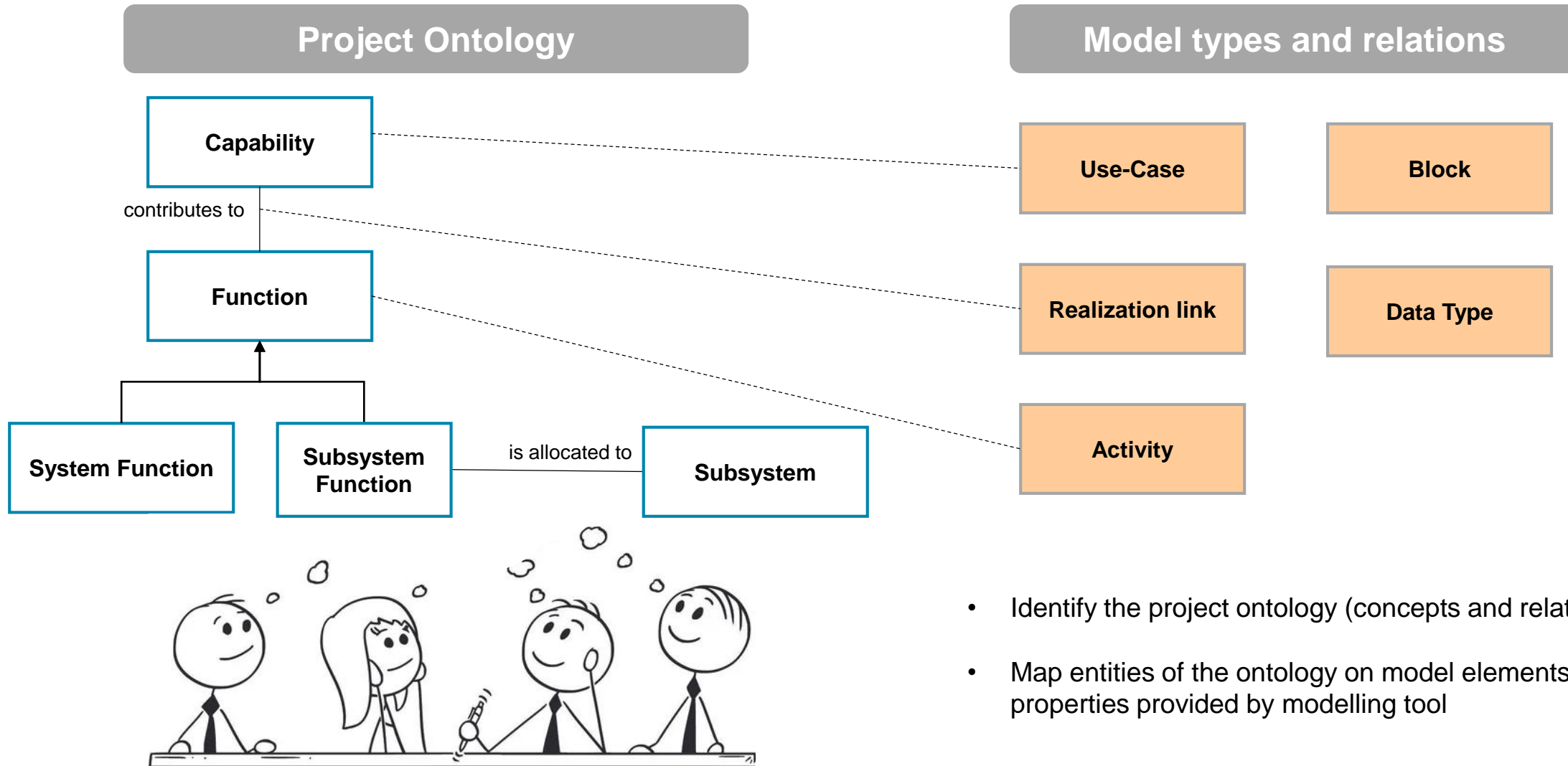
Overall Semantic Modelling
OSMoSE
For Space System Engineering

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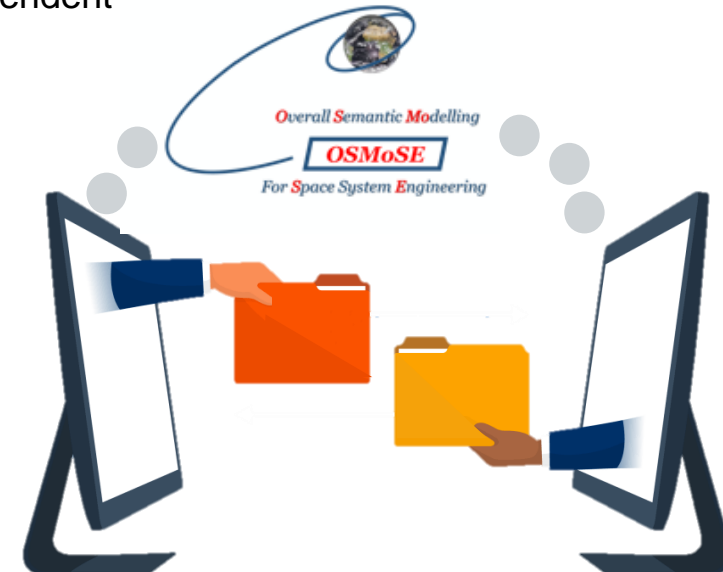
MBSE on Navigation Ground projects

EGNOS

- ~75 user accounts
- 300+ diagrams
- 100+ Analysis reports
- 4 models synchronized (System and subsystems)

DDF

DDF

ICD

Interface import

OPS & Maintenance Procedures

GALILEO
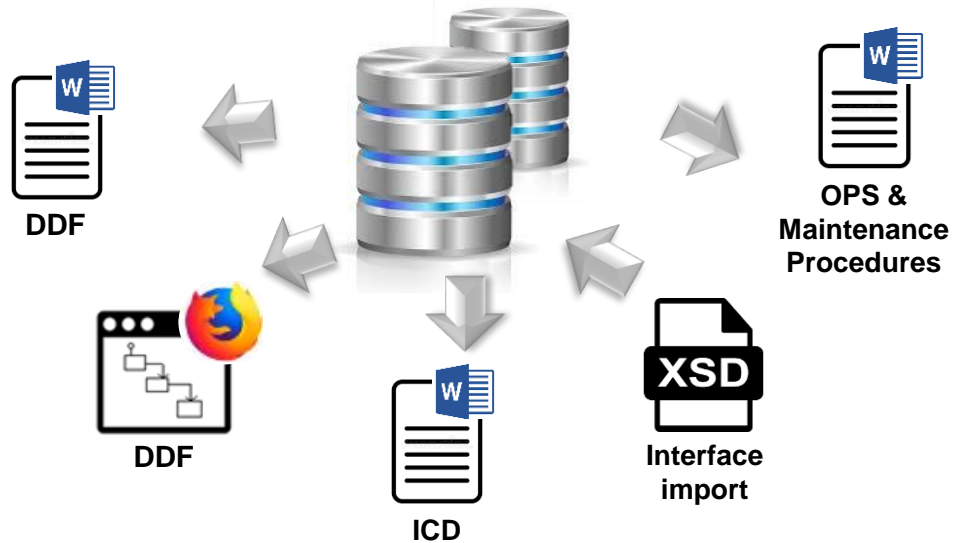
- ~35 user accounts
- 4000+ requirements imported and traced in the model
- 400+ diagrams
- 30+ Analysis reports
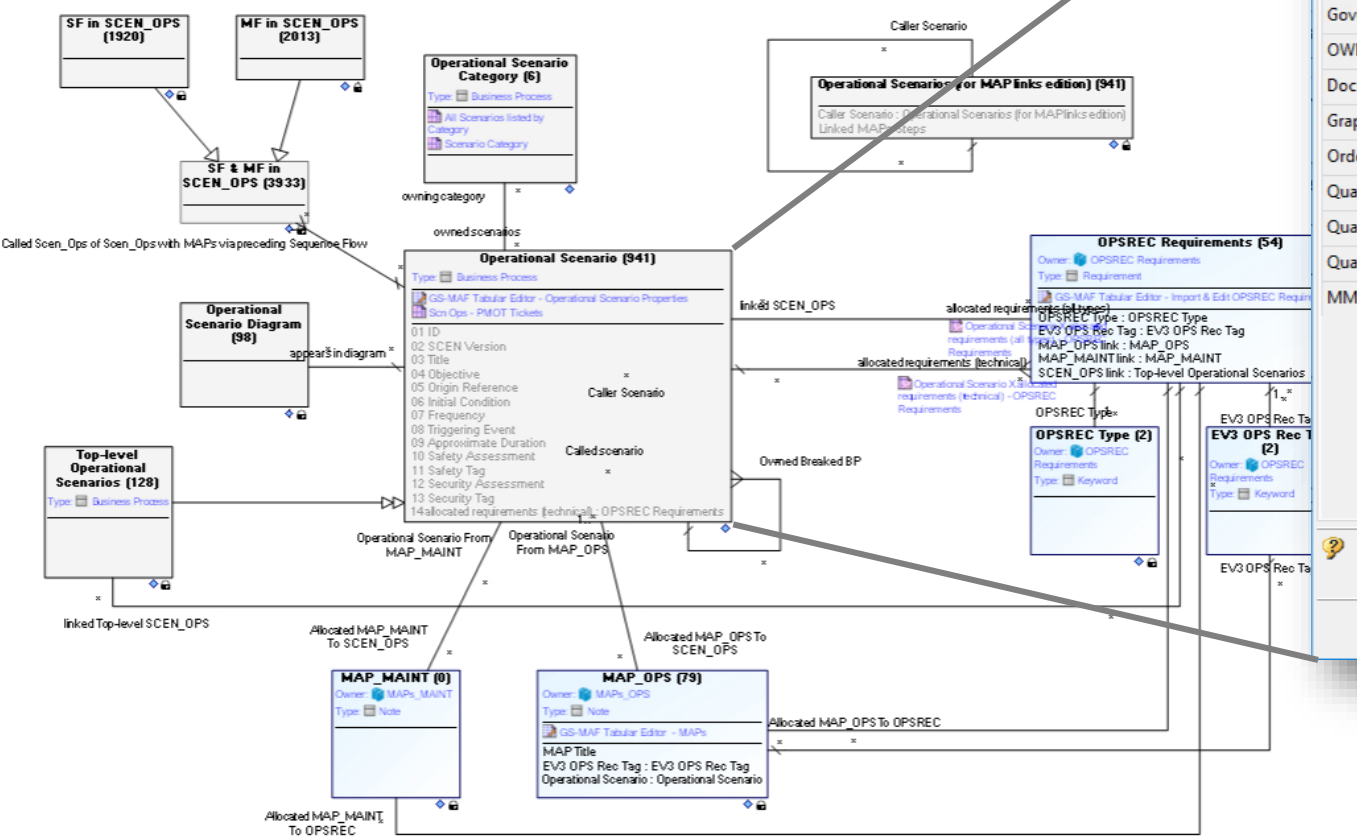- 2 models synchronized (Classified and Unclassified)

DDF

DDF

API files

Requirements

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How to define a project ontology

Project Ontology

Model types and relations

Capability

contributes to

Function

System Function | Subsystem Function

is allocated to

Subsystem

Use-Case

Block

Realization link

Data Type

Activity

- Identify the project ontology (concepts and relations)

- Map entities of the ontology on model elements and properties provided by modelling tool
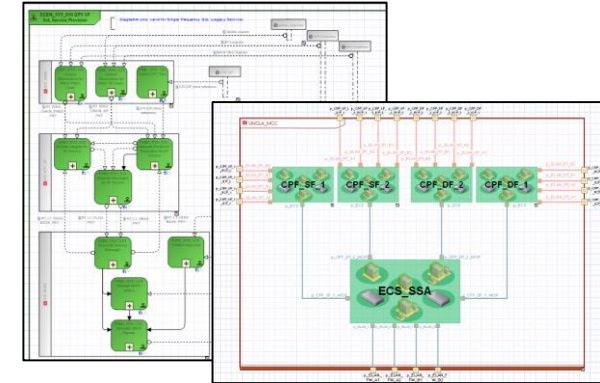
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Implementation of the project ontology

Extract of EGNOS V3 ontology implementation

The project ontology as shared "language"

- The result is a consistent and homogenous model

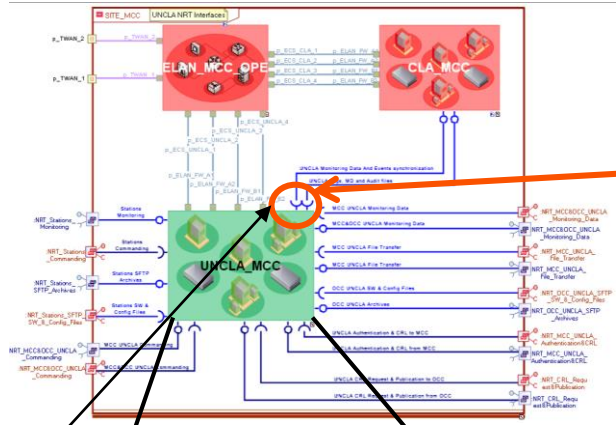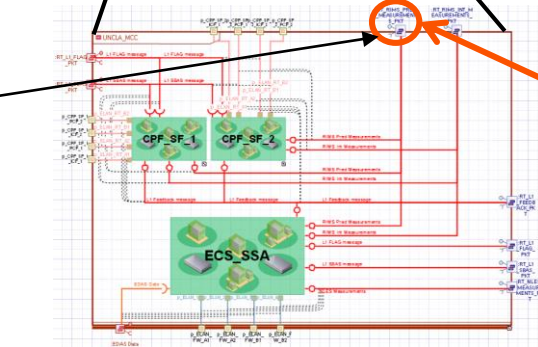- Facilitates MBSE adoption using domain-specific terms

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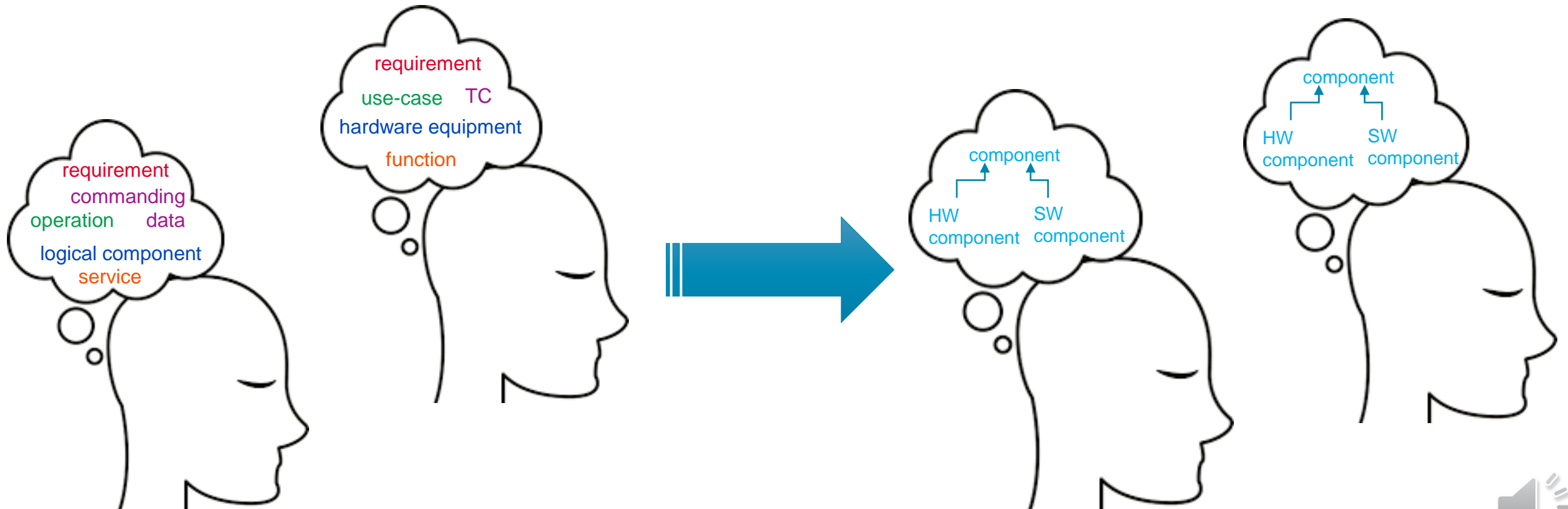
The ontology helps modelling complex aspects

- A single model element can simultaneously belong to several ontology concepts depending on the perspective

- Creating these "smart" datasets on top of the modelling tool really facilitates the work of architects in their modelling process.

Model

Project Ontology

Interface

Internal interface

External interface

belongs to   belongs to

Component

At System level the interface is INTERNAL

At Sub-system level the interface is EXTERNAL

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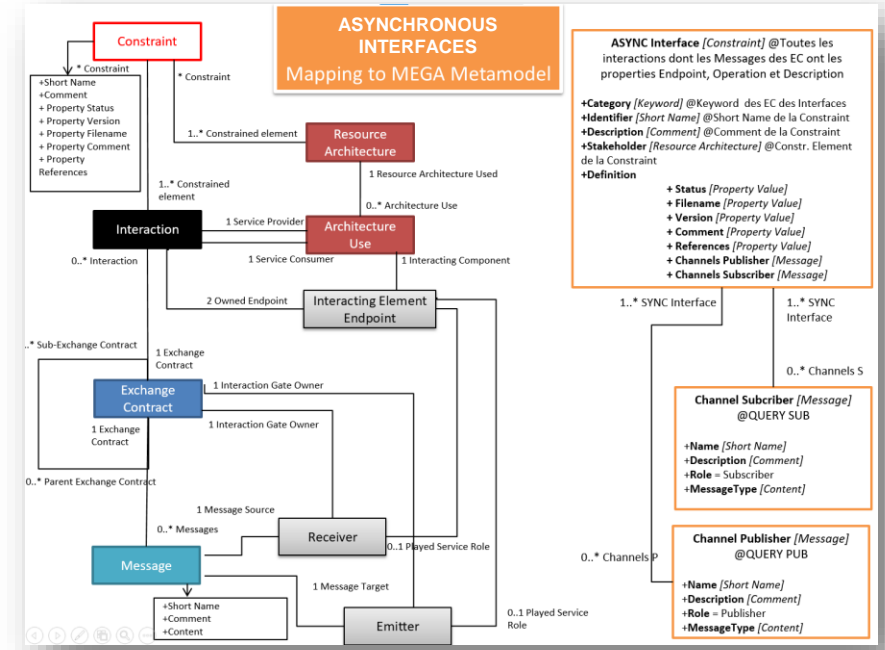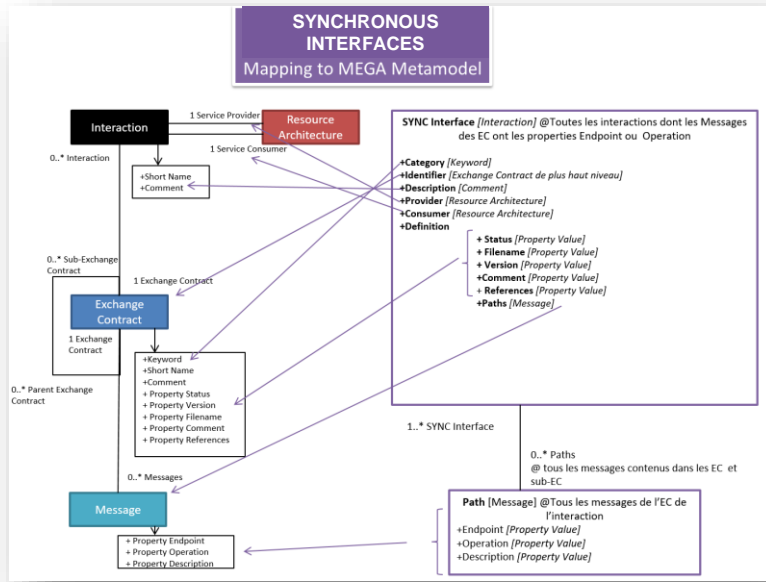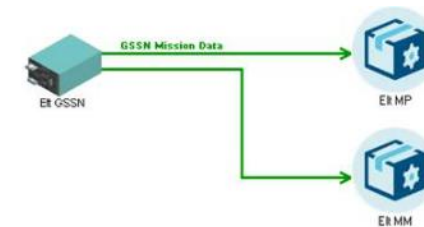
The ontology helps modelling complex aspects

Here, the ontology facilitates the defintion and production of standardized interfaces (OpenAPI and AsyncAPI)
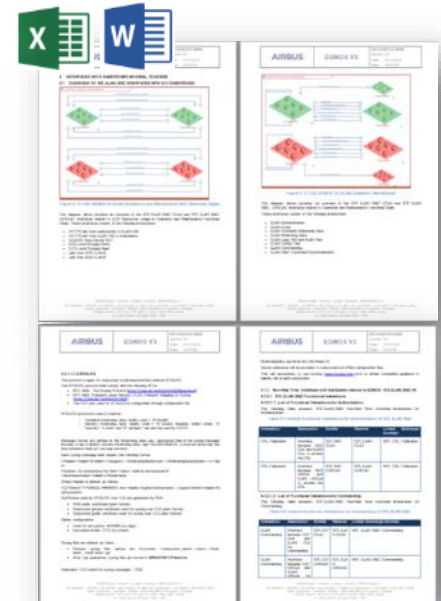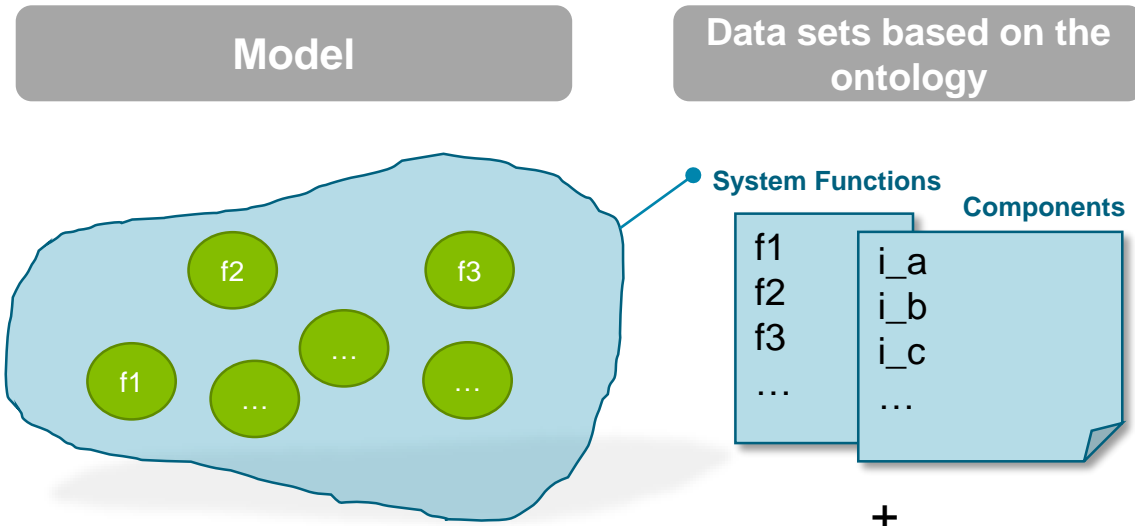
The ontology as enabler for model exploitation

Model

Data sets based on the ontology

System Functions

Components

- Reuse of element sets for document generators (when implemented)

- Bridges the gap between modelling and software development

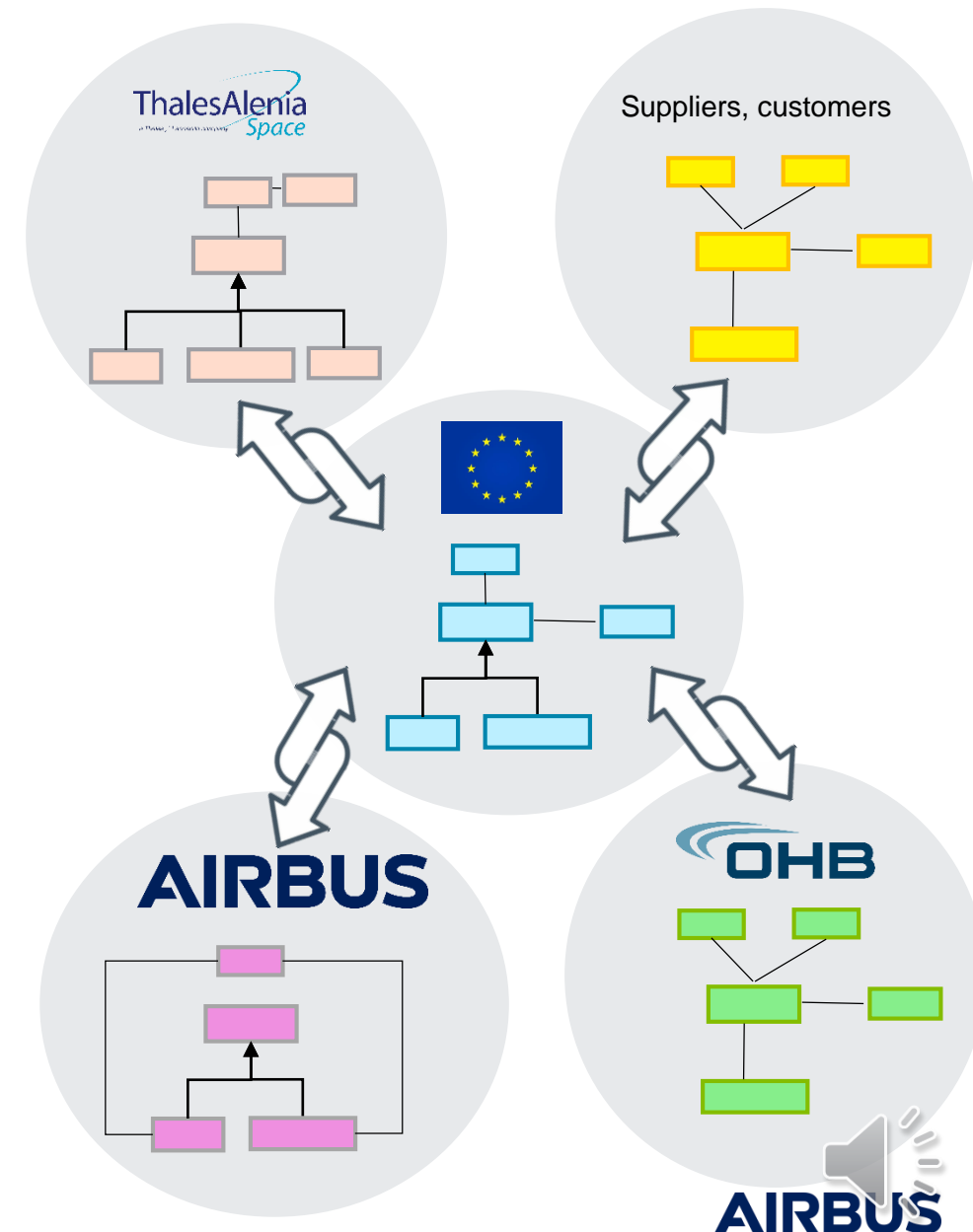- Improves the quality, the reliability and the time to produce documents and reports.

Document structure

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Conclusion

- Ontologies combined with MBSE capture engineering concepts contained in the model when sometimes language elements can be limited in terms of semantics.

- The use of a project-specific ontology has been key to establish model-based system engineering on large scale projects like EGNOS V3 and G2G GSEG.

- Many model enablers like interface definition exporters, document generators, analysis reports are based on the project ontology.

- By being tool-independent, ontologies offer a great opportunity to capitalize knowledge about architectures and system definitions over time.

- They provide resilience towards tool changes.

- Soon, when sharing a common Space Systems Ontology, it will be possible to exchange models between European Space community.

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Thank you

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