Space System Ontology

esa

GorillaIT

Experts in fact based modelling & Model driven development

Agenda

- Vision & objective
- Approach
- What is Arcadia & Capella
- Results
- Findings
- What’s next
- Questions

Vision

To capture all knowledge related to a Space System in a global conceptual data model in such a way that semantic interoperability is possible.

The global model provides the capability:

- to capture the needs of each community (each actor, each stakeholder) involved in the Space System life-cycle;
- to integrate all needs, resulting in a fully consistent global conceptual schema;
- to subset from that global conceptual model, the so-called “local” conceptual views that represent the views of the “global” conceptual model of relevance to each community.

Starting point

The European Space Business is working on model-based system engineering to enhance the way a spacecraft is developed and to provide standard means to exchange information through all customer/supplier relations.

ESA is assessing the semantics of several model-based approaches, such as Capella, in order to produce the Space System semantics commonly accepted by the European Space business.

Objective of our project

To provide the skeleton of the global conceptual data model on which each domain specific conceptual model could be attached to.

The European Space Business is working on model-based system engineering to enhance the way a spacecraft is developed and to provide standard means to exchange information through all customer/supplier relations.

Approach

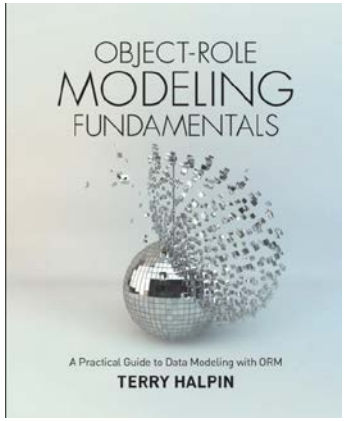
The approach is to fully and adequately reverse-engineer the meta-model of Capella.

Use the existing model based approach

Analyse meta model: purpose & meaning

Provide skeleton of global conceptual model

ARCADIA

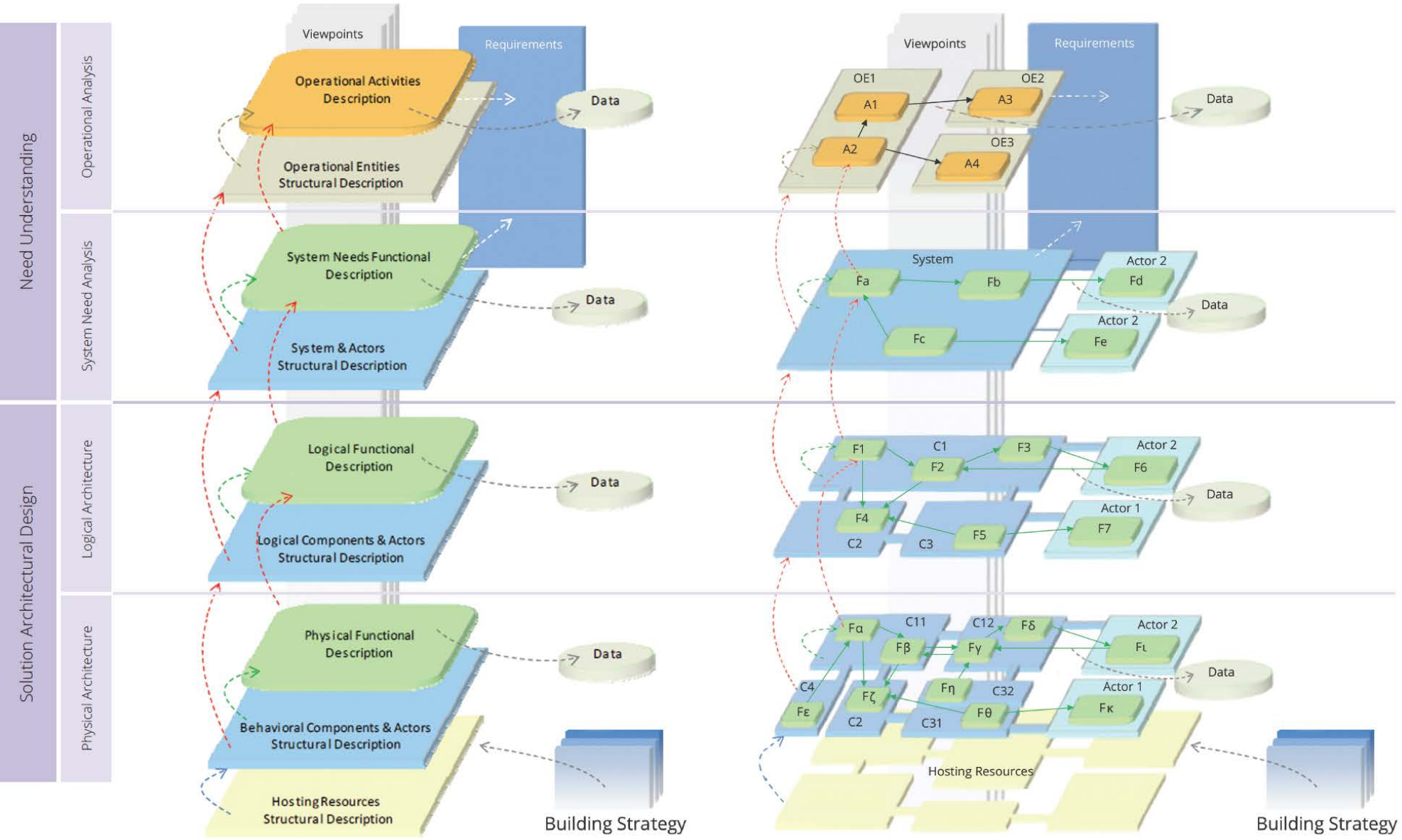


What is Arcadia

ARCADIA is a tooled method devoted to systems & architecture engineering. It describes the detailed reasoning to understand the real customer need, define and share the product architecture among all engineering stakeholders, early validate its design and justify it, ease and master Integration, Validation, Verification, Qualification (IVVQ).

Five major steps structure the engineering activities, each one dealing with specific engineering issues:

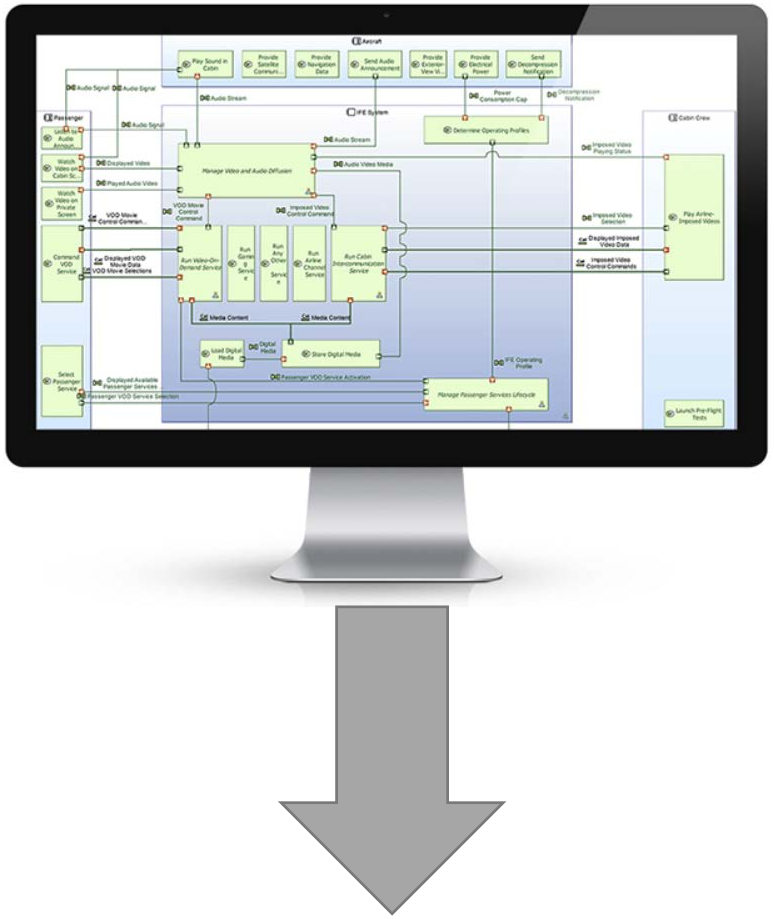
Model-based System and Architecture Engineering with the Arcadia Method

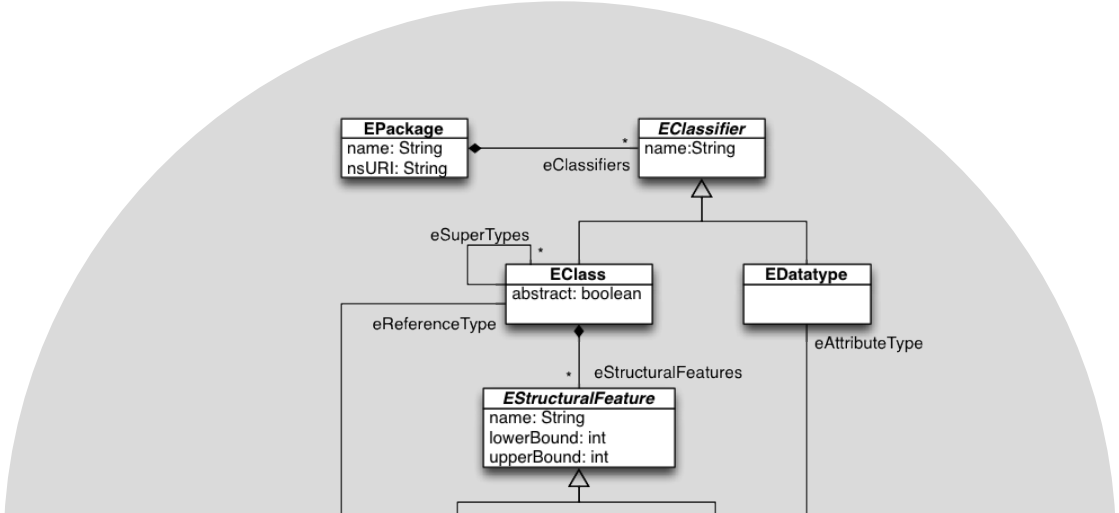


Capella, the tool

Capella provides methodological guidance, intuitive model editing, and viewing capabilities for Systems, Software and Hardware Architects

Capella relies on Arcadia a field-proven model-based methodology that covers each engineering phase





Meta-model described in Ecore

The core Eclipse Modeling Framework (EMF**) includes a meta model (Ecore) for describing models and runtime support for the models** including change notification, persistence support with default XMI serialization, and a very efficient reflective API for manipulating EMF objects generically.

High level approach

Use an existing model based approach → Analyse purpose & meaning → Provide skeleton of global conceptual model

What did we do

Get existing knowledge

- Starting from the Arcadia method
- Using the meta model from the tool Capella
- Converting Ecore to ORM

Analysing

- Map concepts meta-model to the theory
- Analyse tool
- Consult experts

Modeling

- Model knowledge
- Remove non semantic concepts
- Add semantics
- Add constraints

Results

Primary deliverables

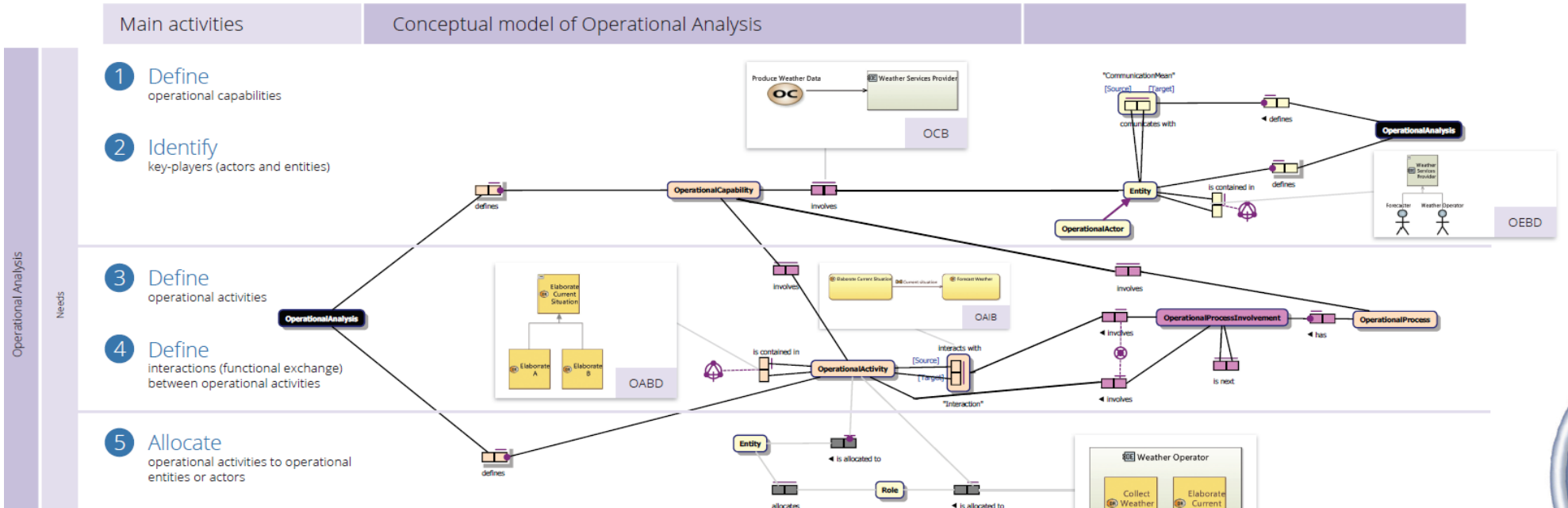
A skeleton of the global conceptual data model

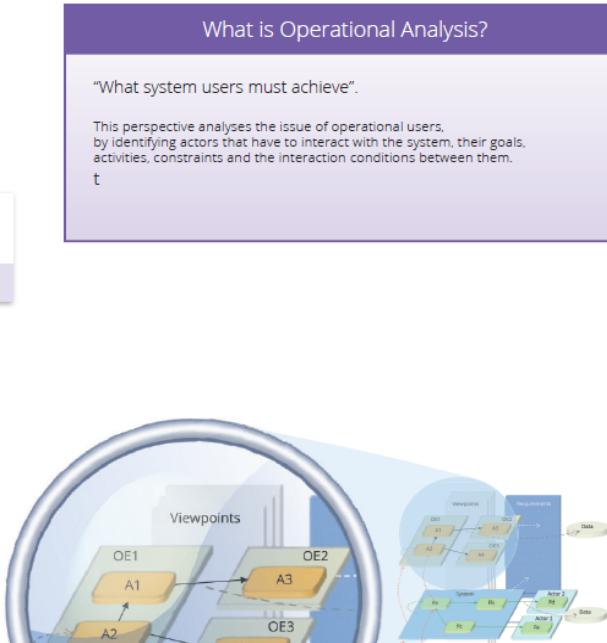
Secondary deliverables

- Posters to teach
- Book to share

Automatation

- Automatic reporting Ecore
- Automatic report coverage Ecore/ORM
- Methods to parse Ecore constraints



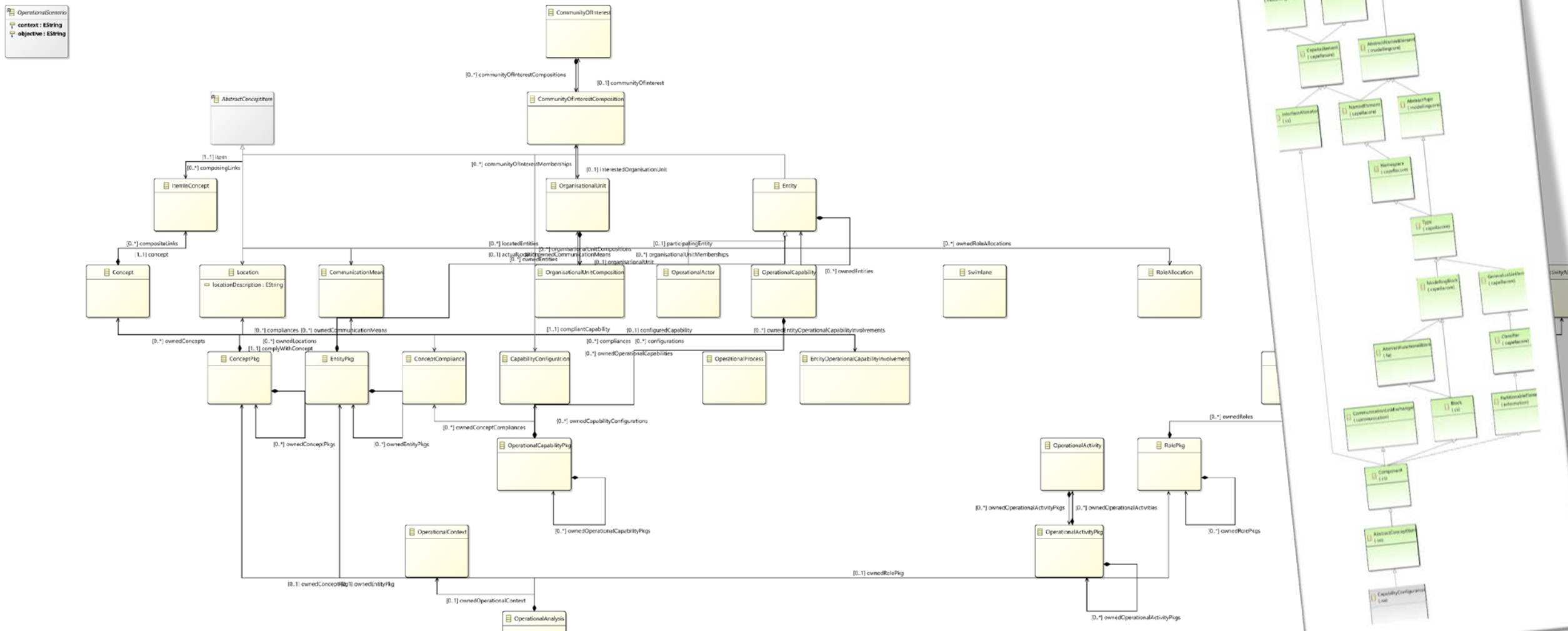


Findings

- Explaining and teaching the model is easier when connecting to real life examples
- Automation leads to more efficiency

→ Some examples

Finding:model in Ecore is designed towards technical implementation



Finding: ORM can model & verbalize complex constraints

Conceptual

For each FunctionalChainInvolvement, **exactly one of the following holds:**
that FunctionalChainInvolvement involves **some** FunctionalExchange;
that FunctionalChainInvolvement involves **some** Function.

Technical

MDCHK_FunctionalChainInvolvement_Involved_1

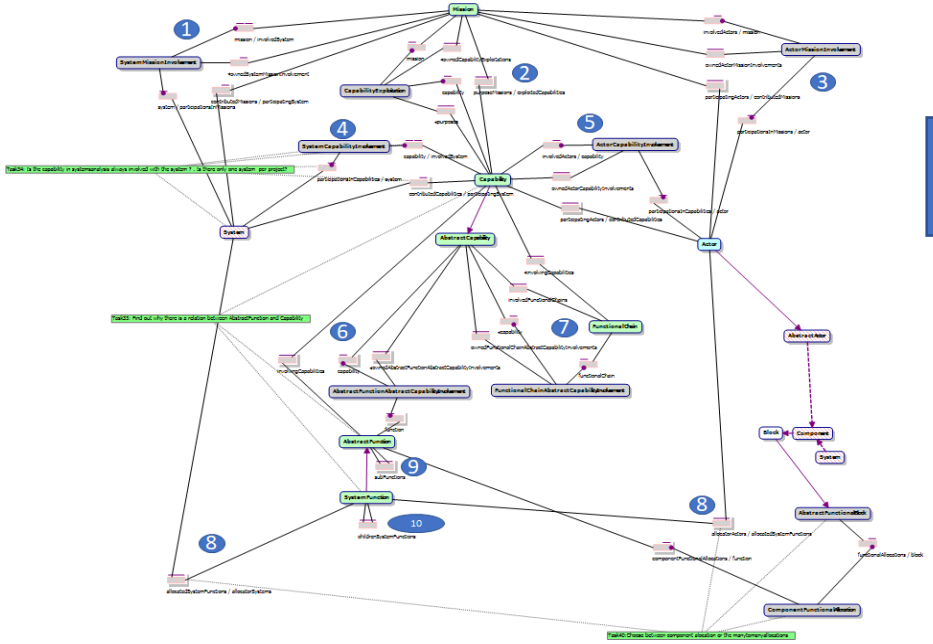
This rule checks that a Functional Chain Involvement only involves an Abstract Function or Functional Exchange

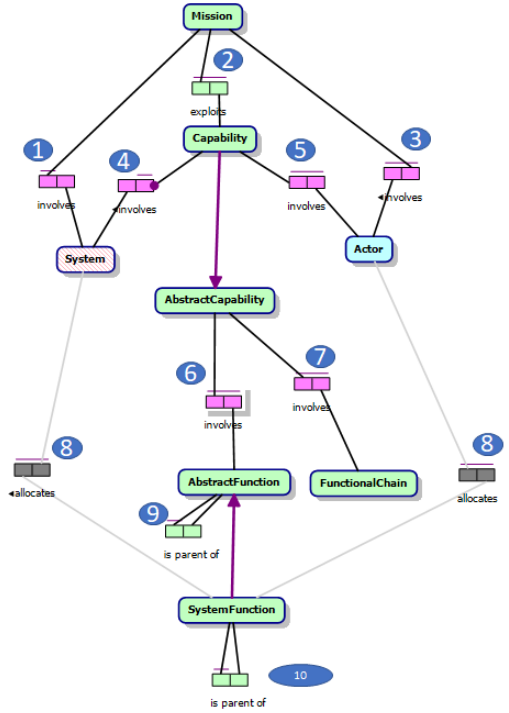
```
package
org.polarsys.capella.core.data.fa.validation.functionalChainInvolvemen
t;

import org.eclipse.core.runtime.IStatus;
import org.eclipse.emf.ecore.EObject;
…

public class MDCHK_FunctionalChainInvolvement_Involved_1 extends
AbstractValidationRule {
  /**
   * @see
org.eclipse.emf.validation.AbstractModelConstraint#validate(org.eclips
e.emf.validation.IValidationContext)
   */
  @Override
  public IStatus validate(IValidationContext ctx) {
    if (EMFEventType.NULL.equals(ctx.getEventType())) {
      EObject eObj = ctx.getTarget();
      if (eObj instanceof FunctionalChainInvolvement) {
        InvolvedElement involved = ((FunctionalChainInvolvement)
eObj).getInvolved();
```

Finding:50% reduction of facts

Original: **850 facts**

New model: **412**





What's next?

High level approach

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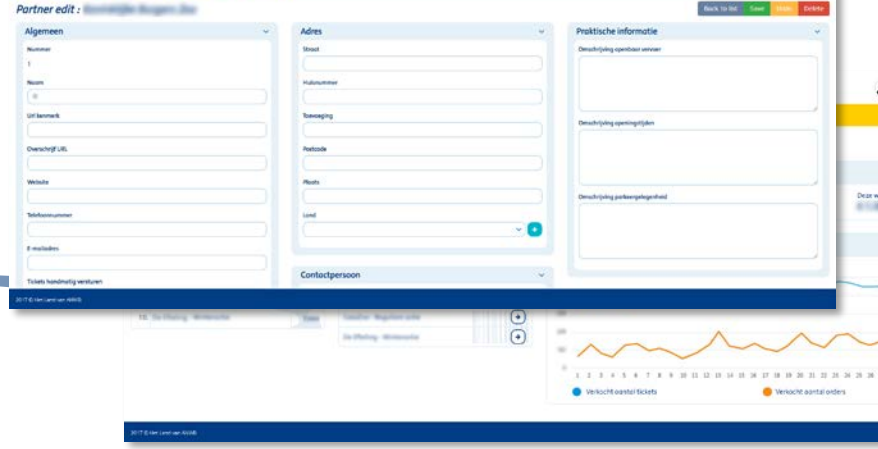
Validate the model by populating

- Real examples
- Application with editors
- Database to hold information

Shared vision on MDD



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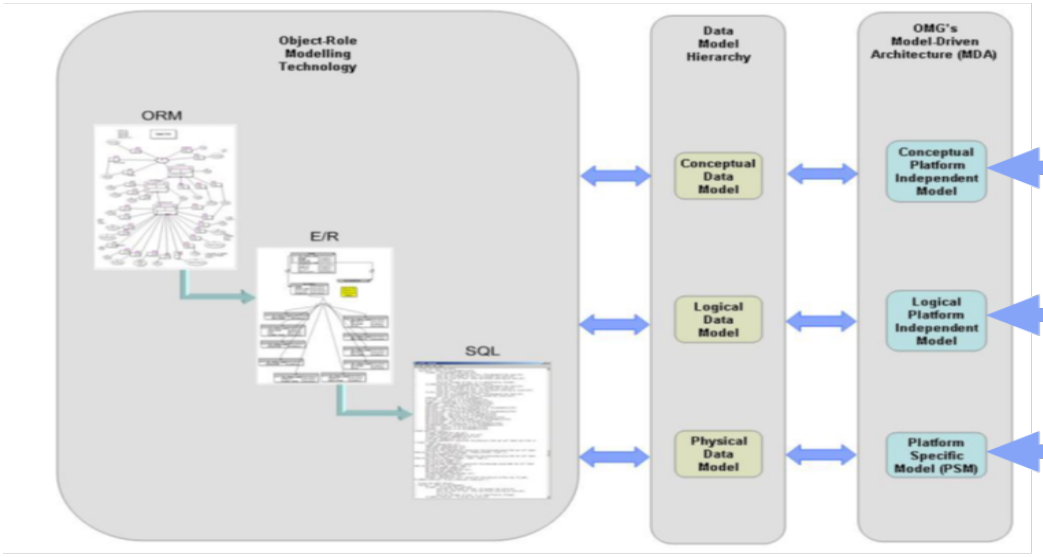

Reference : ECSS-E-TM-10-23A
Figure 6 - Mapping of data models to different technologies

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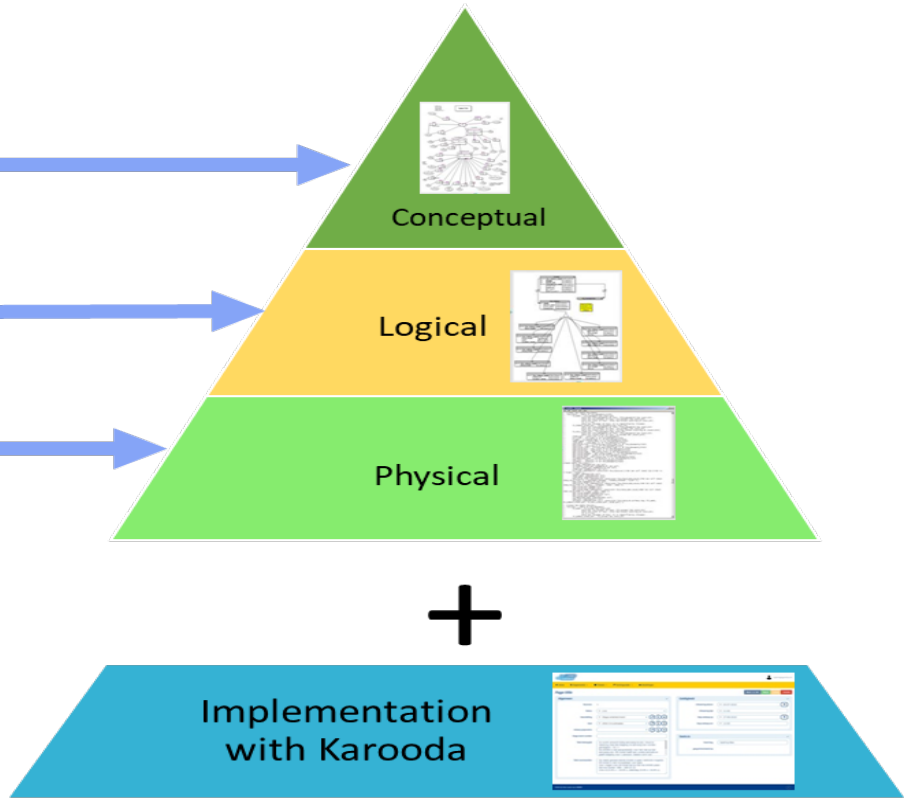


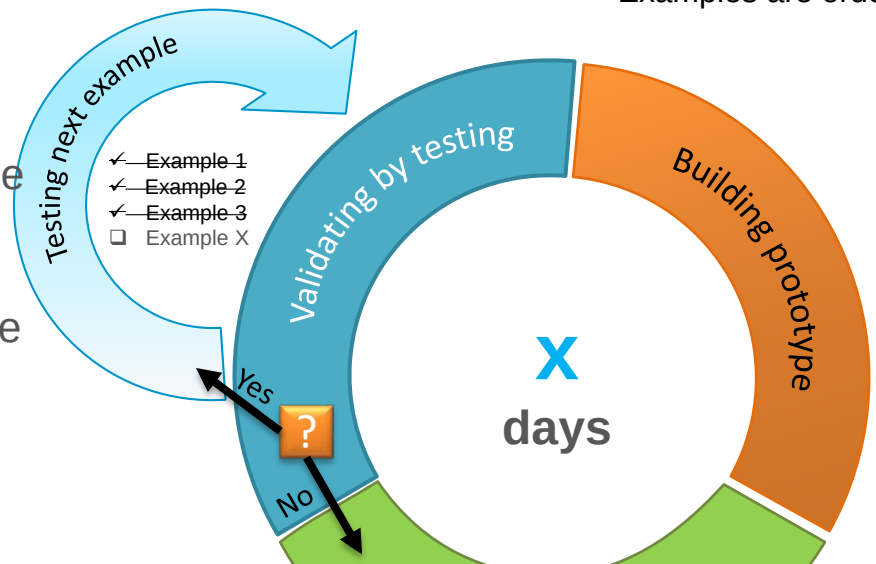
The approach

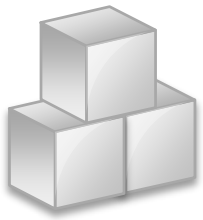
The general concepts of a iteration

Given a backlog of concepts & semantics of the knowledge to be captured AND a list of examples (testcase models) we keep iterating until all examples can be stored in the global model.

Examples to test in current iteration

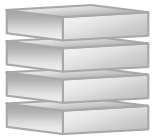
Examples are ordered by complexity





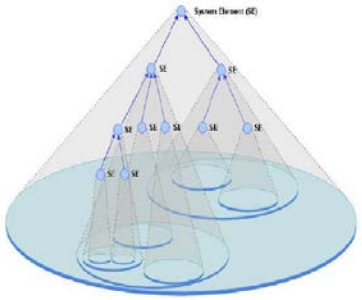
Semantic Backlog

List of concepts & semantics of the knowledge to be captured



Concepts & semantics

to be captured in current iteration



Global model

Other possible next steps

- Import Capella into database
- Generate documentation
- Transform & Export to other ontology standards
- Transform & Import from other ontology standards

Object Role Modeling

- We are contributing to NORMA
- We can automatically transform ORM
- Collaborate
- Community

Questions

Kaiton Buitendijk

Kaiton.Buitendijk@GorillaIT.nl

https://www.linkedin.com/in/kaitonbuitendijk/

GorillaIT
Masters in software development

Gérald GARCIA

https://www.linkedin.com/in/garciagerald/

ThalesAlenia Space
a Thales / Leonardo company