What’s in a Name?

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Setting the Scene
The Problem
A Solution
Examples
Further Work
Summary

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Architectures

Architectures are a key part of Systems Engineering

They capture the

 fundament concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution (ISO42010)\(^1\)

Architecture Frameworks

Standards, such as ISO 42010, encourage the use of Architecture Frameworks (AFs)

An AF embodies the

*conventions, principles and practices for the description of architectures established within a specific domain of application and/or community of stakeholders* (ISO42010)¹

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Creating AFs

Techniques exist to help organisations create robust AFs, such as

Framework for Architecture Frameworks (FAF)¹, ²

The Open Group Architecture Framework (TOGAF)³

Key FAF Concepts

The FAF is based on agreeing:

a set of defined *concepts* (Ontology Elements, OEs)

the *relationships* between them (Ontology Relationships, ORs)

& collecting these together in an ...
Ontology

Collects together the concepts and relationships for a domain to help with

shared understanding & interoperability

Provides foundations for an AF, as the Ontology is

key to the definition of the Viewpoints in an AF

Viewpoints capture stakeholder perspectives and hence

how system model is visualised to meet their needs
Setting the Scene

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The Problem

Even when using the FAF, problems can arise due to:

the *term (name)* given to a concept

the *meaning* behind the concept
Four situations need to be considered

<table>
<thead>
<tr>
<th>Meaning</th>
<th>Term</th>
<th>Same Meaning</th>
<th>Different Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same</td>
<td>Same</td>
<td>Same term, same meaning (S1)</td>
<td>Same term, different meanings (S2)</td>
</tr>
<tr>
<td>Different</td>
<td>Different</td>
<td>Different terms, same meaning (S3)</td>
<td>Different terms, different meanings (S4)</td>
</tr>
</tbody>
</table>
Same term, same meaning (S1)

Two organisations working together in same domain both use

same term, ‘Function’

to represent same concept, ‘Logical Function’

This is not a problem per se

Organisations need to be proactive to ensure that the meanings are indeed identical
Same term, different meanings (S2)

Two organisations working together in different domains use term ‘Function’

One uses it to mean ‘Logical Function’

Other uses it to mean ‘HR Function’

Problem as they use the same term and may not be aware that they are using it differently
Different terms, same meaning (S3)

Two organisations working together in same domain use

different terms, ‘Function’ and ‘Logical Operation’

to represent same concept, ‘Logical Function’

Problem if they assume they use a common domain language but are unaware they use different terms for the same thing
Different terms, different meanings (S4)

Two organisations working together in different domains

One uses term ‘Logical Operation’ to represent concept of ‘Logical Function’

Other uses term ‘Function’ to mean ‘HR Function’

Least problematic situation

They need to be proactive to ensure that the meanings are indeed different
Domains & Contexts

Legend
- New concept
- Changed concept
- New relationship
- Changed relationship

Such as automotive, defence, HR

Such as a project, team, organisation;
A purposeful system, a system that is
... free to determine its own goals
needed to achieve an outcome

Splitting Ontology Element and Ontology Relationship

Legend
- New concept
- Changed concept
- New relationship
- Changed relationship

- «ontology element»
- Domain Ontology Element
  - FQN: String
- (DOE)
- Domain Ontology Relationship
  - 1..*
  - 1
  - is related to
- (OR)
- Ontology Relationship
  - FQN: String
- (COR)
- Context Ontology Relationship
  - 1..*
  - 1..*
  - /defines
- (COE)
- Context Ontology Element
  - 1..*
  - 1..*
  - /defines
- (DOR)
- Domain Ontology Relationship
  - 1..*
  - 1
  - /defines
  - 1

FQN
FQN is made up thus:
- For a DOE: <Domain.ID>::<DOE.Name>
- For a COE:
  - <Domain.ID>::<Context.ID>::<COE.Name>

(Of corresponding type E.G. Does are related via DORs etc.)
Subtyping Ontology

Legend
- New concept
- Changed concept
- New relationship
- Changed relationship

- **Ontology**
  - **Ontology Element**
    - **abstract**
    - **FQN**: String
- **Domain Ontology Element**
  - **DOE**: Domain Ontology
    - **ID**: String
    - **FQN**: String
  - **Context Ontology Element**
    - **COE**: Context Ontology
      - **ID**: String
      - **FQN**: String
- **Ontology Relationship**
  - **DOR**: Domain Ontology Relationship
  - **COR**: Context Ontology Relationship

- **FQN**
  - **For a DOE**: `<Domain.ID>::<DOE.Name>`
  - **For a COE**: `<Domain.ID>::<Context.ID>::<COE.Name>`

- **Legend**
  - 1 is related to
  - 1..* means same as
  - 0..* means same as
  - 1 defines
  - 1..* represents
  - 1 is created for
  - 1..* works in

- **OF corresponding type**
  - E.G. DOE is related via DORs etc.
AFs containing multiple Ontologies

There are three types of AF:

- **Generic**, aimed at a single Domain such as automotive (effectively a Domain AF)
- **Specific**, aimed at a specific Context such as a company or project (effectively a Context AF)
- **Combination**, at least one DAF and one CAF, with mappings between. For example, an AF containing an automotive DAF and 3 different CAFs from automotive companies that map to the DAF. NOTE that multiple DAFs COULD be included.
Viewpoint Changes

Two new Viewpoints added to FAF

- Domain & Context Viewpoint (DCVp)
- Ontology Mapping Viewpoint (OMVp)

Two existing Viewpoints modified to reflect changes

- Ontology Definition Viewpoint (ODVp)
- Viewpoint Definition Viewpoint (VDVp)
Domain & Context Viewpoint (DCVp)

{A DCV must show Domain Ontologies and Domains OR Context Ontologies and Contexts OR BOTH}

1..* is created for 1..*

{AND} 1..* works in 1..*

{AND} 1..* is created for
Ontology Mapping Viewpoint (OMVp)

An OMV must show COEs & DOEs AND/OR CORs & DORs

- `<ontology element>` Context
  - `<ontology element>` Context Ontology Element
    - `<ontology element>` Domain Ontology Element
      - `<ontology element>` Domain
        - `<ontology element>` Domain Ontology Relationship
          - `<ontology element>` Context Ontology Relationship
            - `<ontology element>` Context
Domain & Context View (DCV)

- **Auto Ontology**
  - ID = AUTO

- **HR Ontology**
  - ID = HR

- **AMPT Ontology**
  - ID = AMPT

- **BMPX Ontology**
  - ID = BMPX

- **SCL Ontology**
  - ID = SCL

- **Alpha Motors Powertrain Team**
  - ID = AMPT

- **Beta Motors Project X**
  - ID = BMPX

- **Special Consultants Ltd**
  - ID = SCL

- **Automotive**
  - ID = AUTO

- **HR**
  - ID = HR

- **Created for**: Alpha Motors Powertrain Team, Beta Motors Project X, Special Consultants Ltd

- **Works in**: Auto Ontology, HR Ontology
Ontology Mapping View (OMV)
Ontology Mapping View (OMV)

S4 - Different terms, different meanings

- «domain»: S/W Engineering
  ID = SWENG
- «domain»: Automotive
  ID = AUTO
- «domain»: HR
  ID = HR
- «context»: Special Consultants Ltd
  ID = SCL
- «context»: Alpha Motors Powertrain Team
  ID = AMPT
- «context»: Beta Motors Project X
  ID = BMPX

«defines»
«represents»
«same as»
«defines»
«defines»
«represents»

«domain ontology element»:
- Logical Function
  FQN = AUTO::Logical Function
- HR Function
  FQN = HR::HR Function
- AMPT::Function
  FQN = AUTO::AMPT::Function
- BMPX::Logical Operation
  FQN = AUTO::BMPX::Logical Operation
- SCL::Function
  FQN = HR::SCL::Function

«context ontology element»:
- Logical Operation
  FQN = AUTO::SCL::Logical Operation
- Function
  FQN = AUTO::AMPT::Function
  FQN = HR::SCL::Function
  FQN = HR::SCL::Function
  FQN = HR::SCL::Function

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Variant Modelling

Combine extensions discussed with concepts from Variant Modelling

Context Ontologies and their content are variants of a Domain Ontology
Complex mappings

Consider complex mappings

Single Context Ontology Elements (COE) or Relationships (COR) as a combination of multiple Domain Ontology Elements (DOEs) or Relationships (DORs)

Single DOEs or DORs mapping onto multiple COEs or CORs within a Context

Single COEs mapping onto a combination of DOEs and DORs
Coverage

Define metrics that quantify

how much of a Domain Ontology is covered by a Context Ontology

how much of a Context Ontology is the same as a Domain Ontology
Conflicts

Consider adding a “conflicts with” relationship

Likely to be needed if complex mappings are introduced, where two COEs (or CORs) share some commonality but also differ in other parts of their mapping
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Changes discussed force those developing or using AFs to consider & differentiate between

the underlying concepts & relationships
(Domain Ontology Elements & Relationships)

and

the names used for those concepts & relationships
(Context Ontology Elements & Relationships)
Benefits

Capturing domain/context meanings in system model helps those:

working in *different* domains & contexts to ensure that terms thought of as having same or different meaning actually do

working together in *same* domain to ensure that they can translate between themselves

thereby:

avoiding naming conflicts (e.g. when merging models)

enhancing collaboration

reducing the risk of costly misunderstandings

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