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Effective System Architecture Description using a Presentational Data Schema

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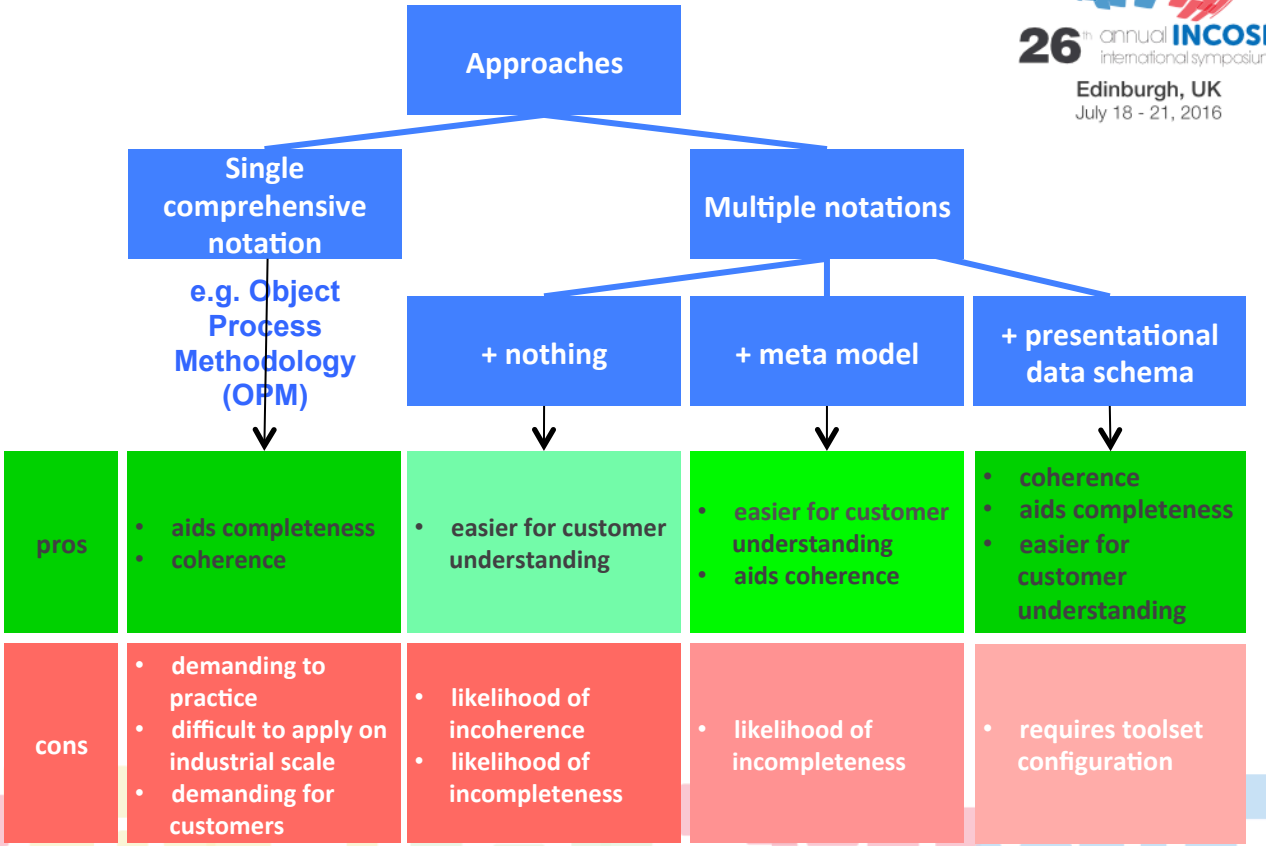
What the paper is about

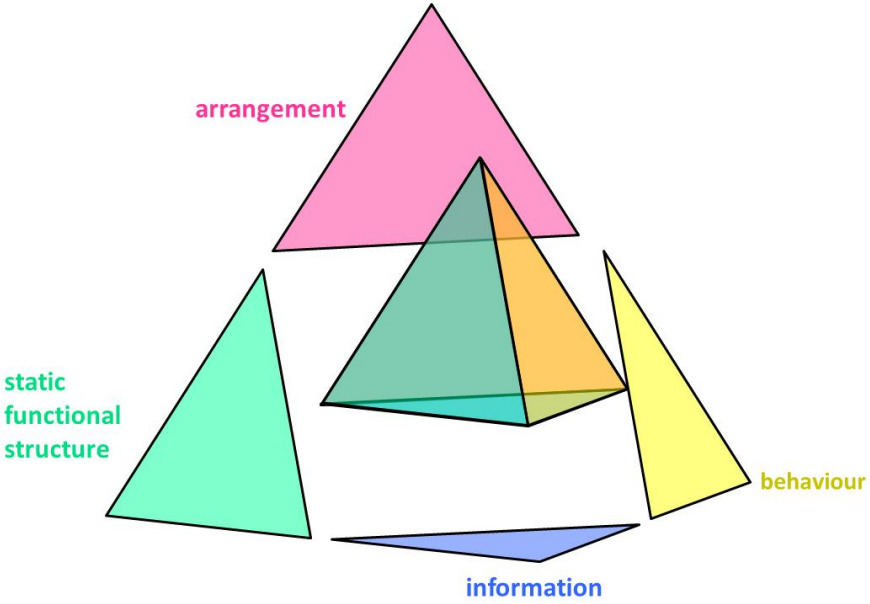
- Architecture description including population
- It identifies some different approaches
- … and reviews them
- It introduces an approach using a presentational data schema
- … which has been employed ‘in anger’ on industrial scale projects
- … and which the authors believe provides customer and practitioner benefit



The paper is not about

- A review of Architecture Description Languages and other potentially suitable systems notations
- A treatise on systems architecting
- A ‘how to’ guide on devising and applying a presentational data schema

What constitutes an architecture description?

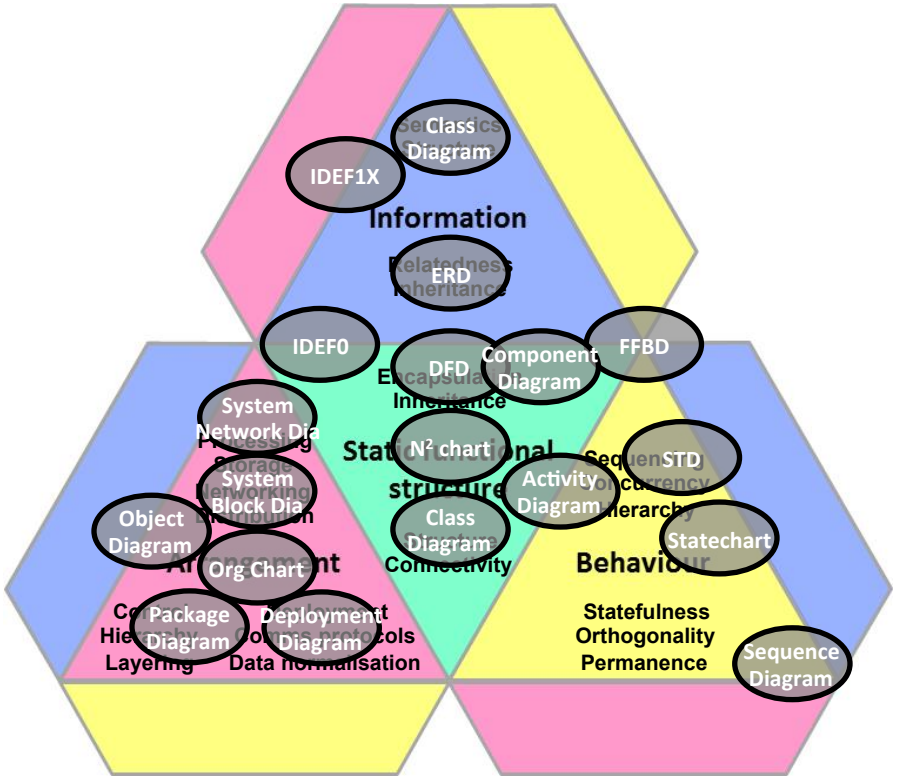


'Tetrahedral model':

- 4 functional aspects
- May be composed of multiple viewpoints
- … but relationships between, and coverage of, viewpoints are rarely addressed
- May be augmented or annotated with non-functional considerations e.g.
  - safety
  - security
  - performance
  - availability

A viewpoint is a 'work product establishing the conventions for the construction, interpretation and use of architecture views to frame specific system concerns', BS ISO/IEC/IEEE 42010:2011

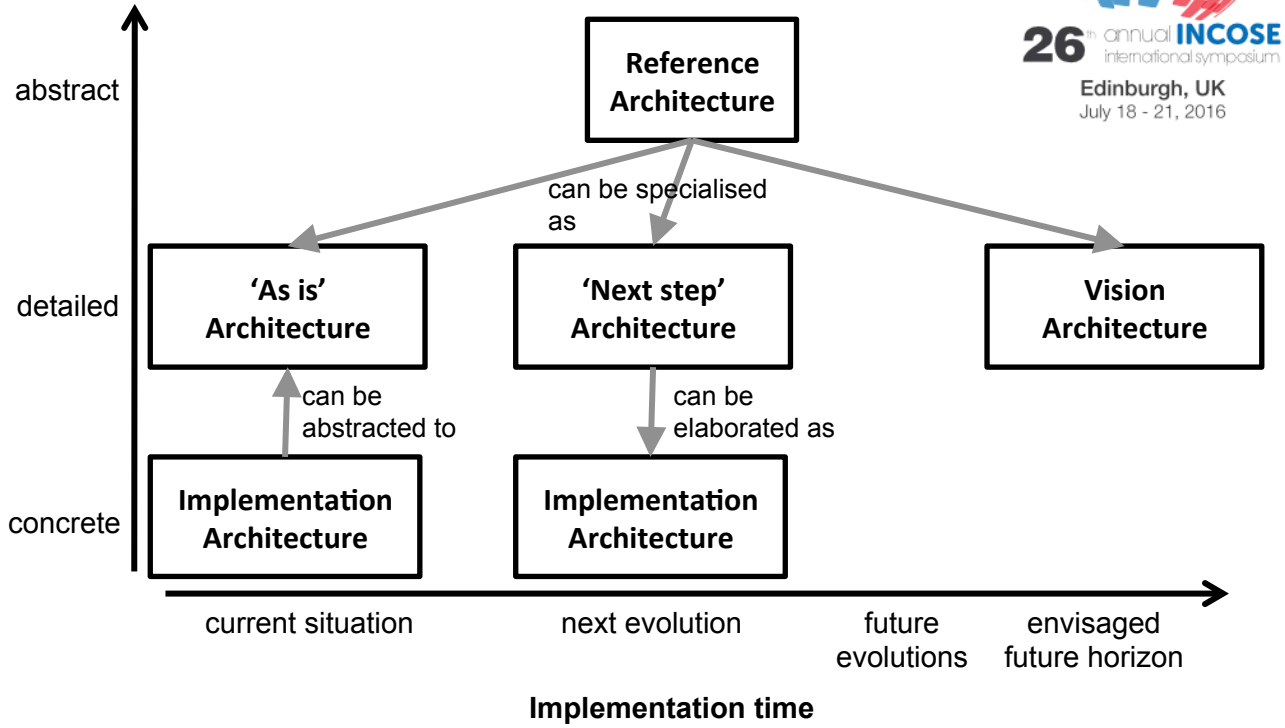
Populating an architecture description with views



- Net of tetrahedron model
- Populated with issues
- Overlaid with some standard notational (diagrammatic) forms
- Traditional approach to architecture description is to use various such forms
- … with incoherence and incompleteness being reduced if a meta model is employed

Some different levels of architectural abstraction and uses over time

- Architectures may be used employed at different levels of abstraction and concerning different time periods
- A Reference Architecture may be used to maximise coherence of an architecture evolution over time
- Implementation architectures may be employed to reverse architect an existing system or forward architect a new system



Comparison of 2 different graphical notations used for architecture description

- Architectures may focus on decomposition by aspect or by detail
- Bringing coherence to different aspects is difficult
- OPM focusses on bringing coherence between aspects
- Unified Modelling Language separates aspects and supports decomposition by detail

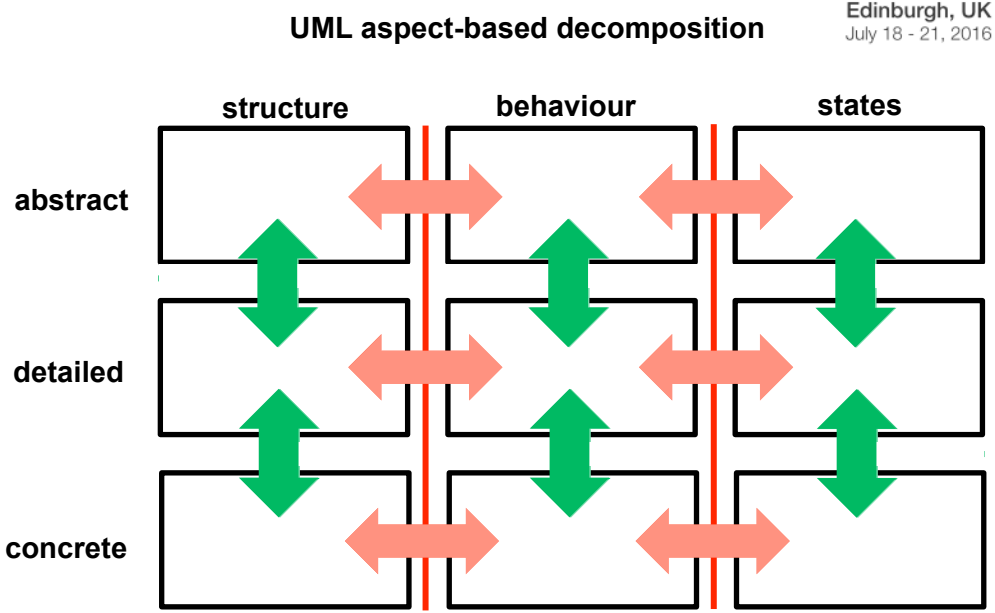


Figure from Dov Dori's book 'Object Process Methodology' reproduced without permission

An example of OPM

- **System Model** exhibits **Completeness** and **Clarity**
  - **Completeness** of **System Model** can be **partial** or **full**
  - **Clarity** of **System Model** can be **low** or **high**
- **Modeller** handles **Complexity Managing**
- **Complexity Managing** consists of **Zooming-in and Zooming-out**, Unfolding and Folding, **State Expressing & Suppressing**, and **View Creating**
- **Complexity Managing** changes **Clarity** from **low** to **high** and **Completeness** from **partial** to **full**

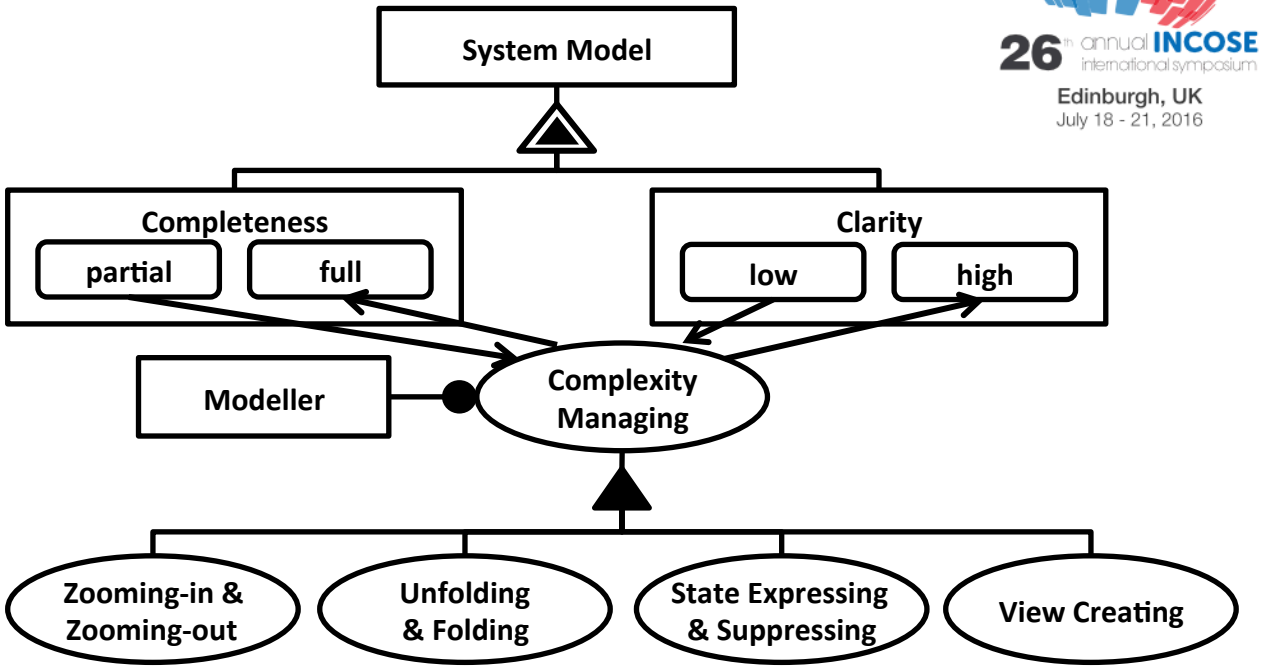
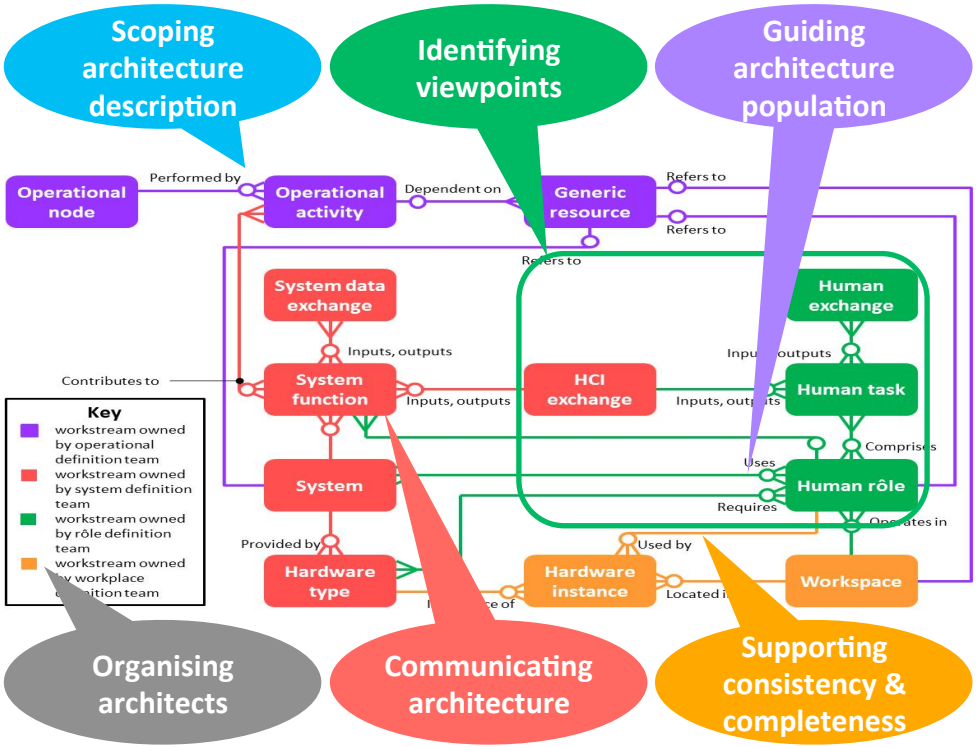


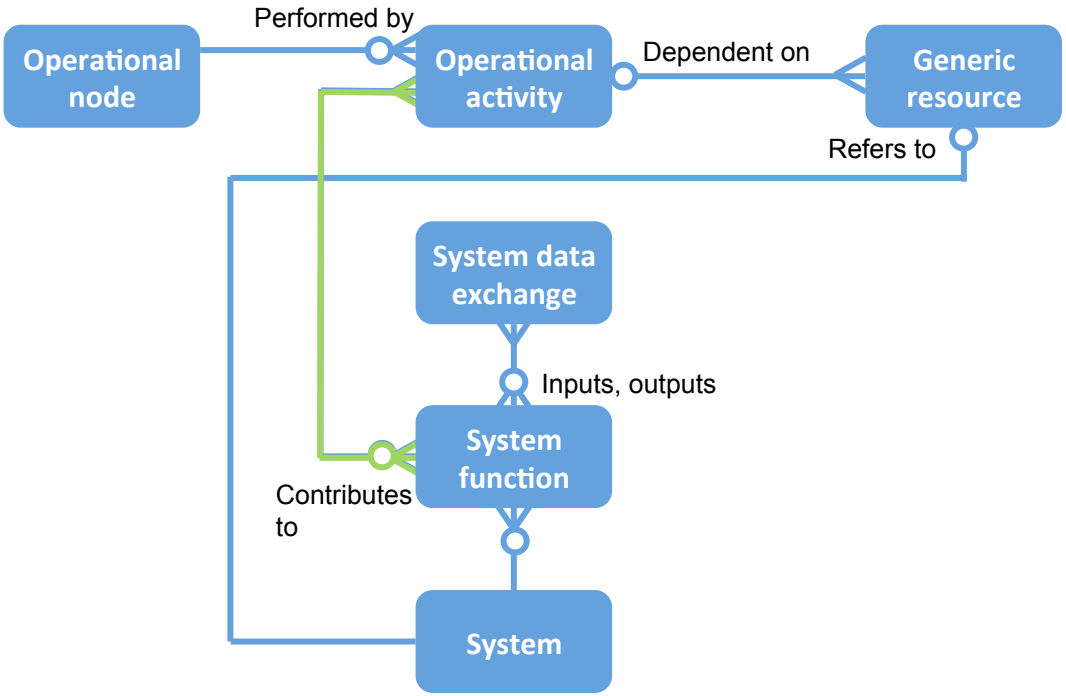
Figure from Dov Doris's 'Model-Based Systems Engineering with OPM and SysML' reproduced without permission

An alternative approach using a presentational data schema



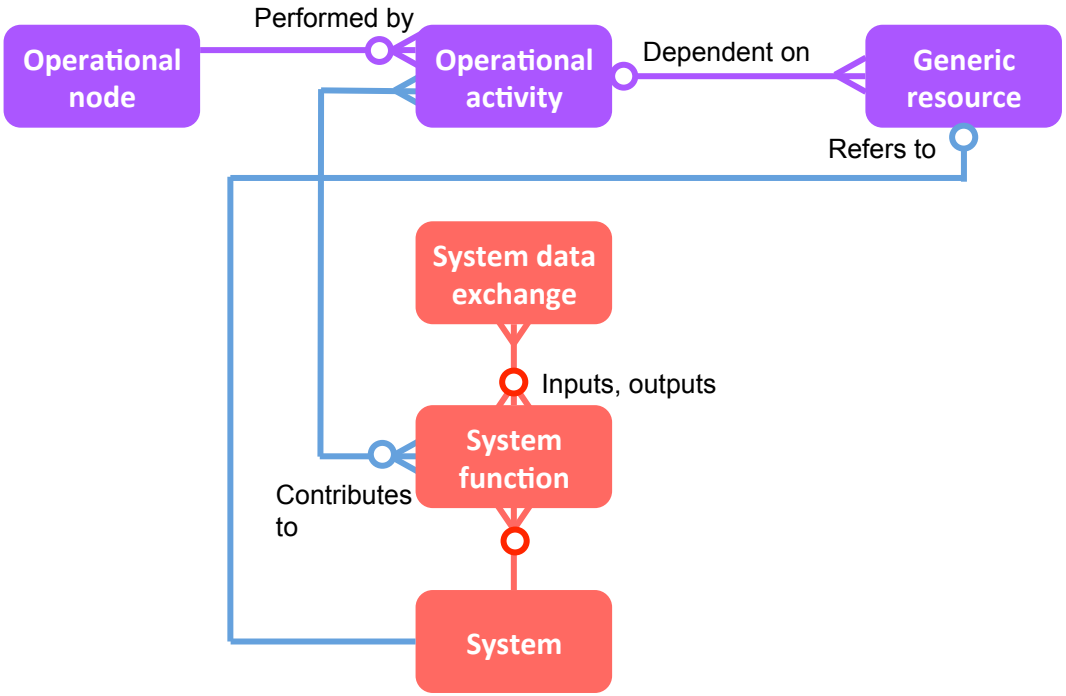
- Authors advocate a novel approach employing a presentational data schema
- It addresses several issues such as:
  - capturing what needs to be architected, how it should be described, and (by inference) what doesn't need to be architected
  - understanding what viewpoints and diagramming styles can be employed to capture an architecture
  - assisting system architects in populating a system architecture
  - deriving tool-enforceable consistency and completeness checks
  - communicating architecture, its elements and relationships to stakeholders
  - organising architecting work amongst a team and between different specialists

Using the presentational schema to organise the architecting process



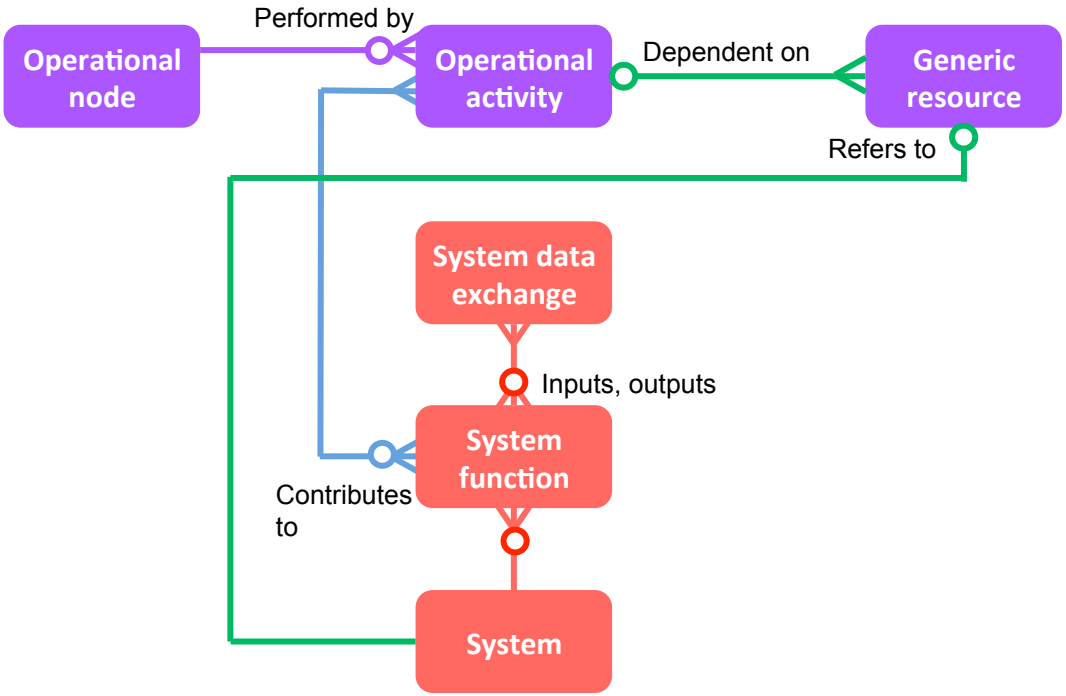
- One of the products we are Interested in is the SV-05: the mapping of Operational Activities and System Functions
- This mapping is shown in green

Using the presentational schema to organise the architecting process



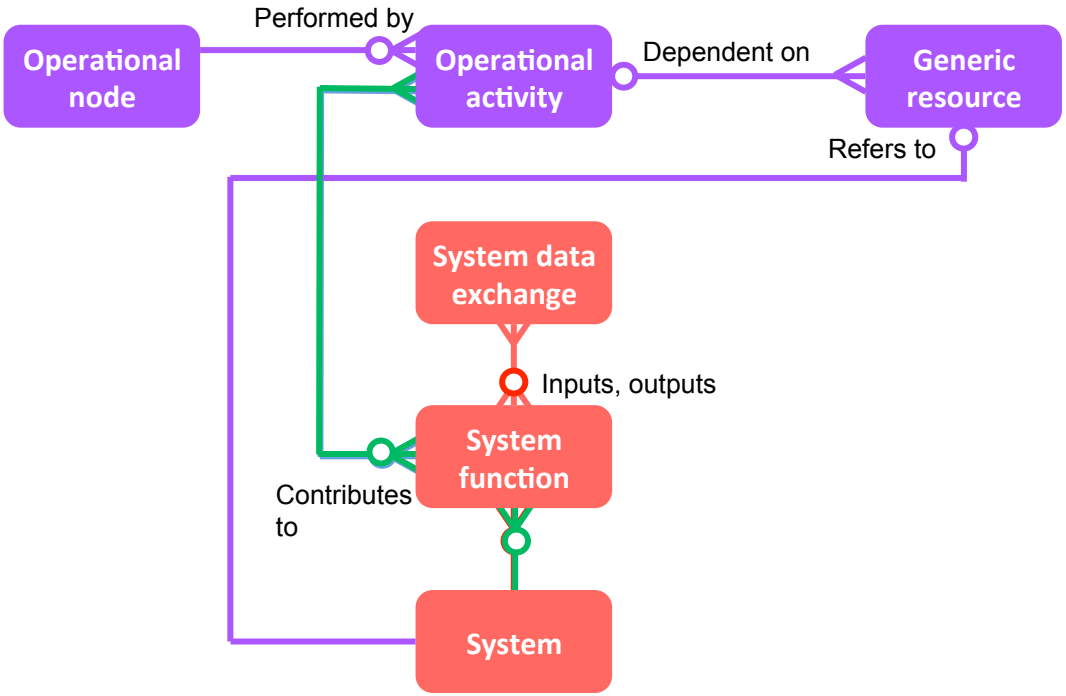
- This provides some clarity by highlighting the fact that two domains of expertise are involved
- But we still have the problem of spanning what could be a large conceptual gap

Using the presentational schema to organise the architecting process



- The first step is for the Operational Analysts to 'tag' each Operational Activity with the System(s) believed to be involved in the Operational Activity, as shown in green

Using the presentational schema to organise the architecting process



- If the tagging is accepted, the focus moves to the set of System Functions performed by each System, as shown in green

Presentational data schemas are part of the ‘toolset’ of systems architects

- Architecture descriptions may be used for system design and other systems engineering purposes
- They are enabled by an armoury of architecting tools
- Presentational data schemas are a key and complementary tool