The Scarecrow MBSE Embassy presents...

Variant Modelling

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Hello from Jon & Simon!
Protocol and resources

• Please mute microphones
• Raise any questions via chat
  – We will get to you
• Resources available off line
  – Slides with hand-drawn notes
  – Video
  – Access to Scarecrow’s KnoB
  – Access to the MBSE Embassy YouTube channel
Overview

I. Introduction
   – Context
II. Problems
   – Lots of approaches, duplication, non-triviality
III. A Solution
   – Requirements, overview, concepts, example
IV. Summary & Questions
I : Introduction
1. Context – Three-plus-two Packages

Compliance
  + Standard
  + Process Set
  + Framework
  + Ontology
  + Viewpoint

Approach
  + System
  + Model
  + View

Visualisation
  + Notation
  + Diagram

Implementation
  + Tool

Diagram:
- Standard implements 1..* 1..*
- Framework describes how to use 1..* 1..*
- Approach complies with 1..* 1..*
- System visualises 1..* 1..*
- Model is consistent with 1..* 1..*
- View defines template for 1..* 1..*
- Diagram is based on 1..* 1..*
- Tool is defined 1..* 1..*

Key:
- + used here
- Defined
- Implemented
2. Context – Evolution

Stage 1: Document-based
Stage 2: Document-centric
Stage 3: Model-enhanced
Stage 4: Model-centric
Stage 5: Model-based
II : Problems
1. Which approach to use?

• Lots of approaches out there
• Feature Oriented Domain Analysis (FODA)
  – Old (1990)
• Common Variability Language (CVL)
  – Intended to be an OMG standard; no longer
• Orthogonal Variability Model (OVM)
  – Implemented in some tools
• VAriant MOdeling method for SysML (VAMOS)
  – Tim Weilkiens
• SysML 2.0
  – Not yet released
2. Common Problems

• Duplication of effort
  – Model the System
  – Model the variants separately
  – Map variant model to System model

• Non-standard notion
  – FODA, CVL, OVM

• Somewhat unclear definition
  – VAMOS

• Not supported by all tools
3. Variant modelling is non-trivial

• SCL tried and failed twice
  – Tried to adopt existing approaches to way we work
  – This is an example of the Tool leading the Process

• Often organisations want to apply it in wrong place
  – In MBSE, walk (and jog) before run
  – VM is running
Attempt in the correct stage

Stage 1: Document-based
Stage 2: Document-centric
Stage 3: Model-enhanced
Stage 4: Model-centric
Stage 5: Model-based
III : A Solution
1. Requirements

- Must use our existing notation (SysML)
- Must use our standard approach (Ontology & Framework)
- Must not require duplication of effort
  - Variation aspects must be able to be added to existing System model, not modelled separately
- Must support some level of automation, e.g.
  - Automatic checking of conformance to approach
  - Extracting an actual variant, as a new model, (semi-) automatically from the variation-annotated model

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2. Overview of the Scarecrow Approach

• Approach assumes:
  – You have a model of your System
  – You are using a Framework with an Ontology and defined Viewpoints (defined using the Framework for Architecture Frameworks – FAF)
  – You want to annotate your model with Variant Modelling information

• Approach defines a number of key concepts
• These now discussed and examples given
3. Key Concepts & Examples

• Variation Points
  – What allowed to vary, in terms of Ontology & Model Elements

• Variation Elements
  – The options available to vary a specific Model Variation Point

• Variant Configurations
  – The possible configurations that can be made from regular Model Elements and Variation Elements

• Variant Configuration Instances
  – Example instances of Variant Configurations
Key Concepts & Examples (cont.)

• Viewpoint Sets
  – Used in definition of Variants (see below)
  – Define all the types of Viewpoint that a given Model Element can appear on; deterministic, based on Framework

• Variants, View Sets and View References
  – Used when want to extract a Variant Configuration from a model
  – A Variant shows what actual Views (instances of Viewpoints) contain the model information for a given Variation Element and its constituent elements
  – These Views are represented as View References that are collected into View Sets
Variation Points

Subsystem Ports & Part Ports can NOT be varied

Steam Beam Engine and Building are Systems that vary

Only Systems, Subsystems & Parts can be varied

Subsystems & Parts can NOT be varied

Steam Beam Engine and Building are Systems that vary

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Abstract, must have defined Variation Elements

Boiler must be EITHER a Coal-fired Boiler OR a Gas-fired Boiler

Fuel Source must be EITHER Coal OR Gas

If Coal-fired Boiler chosen, then Fuel Source MUST be Coal
Variation Elements can have structure defined

Must have a Building but not specific about the actual Variation Element, hence use a Model Variation Point

Single Beam System MUST have Gas-fired Boiler Subsystem
Variant Configurations

Two concrete Variant Configurations defined. Both are made up of a Single Beam through the abstract Variant Configuration, Single Beam System Set-up.

Single Beam System Set-up #1 requires that the Single Beam is in a Shed.

Single Beam System Set-up #2 requires that the Single Beam is in a Museum.

An (abstract) Model Variation Point MUST be replaced by a (concrete) Variation Element within a Variant Configuration.
There are two instances of Single Beam System Set-up #1, one in Swansea and one in Wolverhampton.

Both of these will be in Sheds (as per **Variant Configuration** Single Beam System Set-up #1)

There is a single instance of Single Beam System Set-up #2, in Crofton.

This will be in a Museum (as per **Variant Configuration** Single Beam System Set-up #2)
We know System can appear on these Viewpoints (from our AF), so…

System has an associated Ontology Variation Point, so MUST have…

…we know which Viewpoints appear in the Viewpoint Set
Every Variation Element MUST have an associated Variant.

Variant contains View Sets that specify relevant Views for all Model Elements in the Variation Element.

The Views in a View Set are represented by View References (omitted for some of the View Sets here for clarity).

Single Beam is made up of another Variation Element Gas-fired Boiler. This will be configured by the Variant Gas-fired Boiler, but from p.o.v. of Single Beam the «uses» shows that its Variant does not specify the View Sets (& hence View References) for Gas-fired Boiler.
IV : Summary & Questions
Summary

• Variant modelling is hard
• Must tackle it in the correct stage of your MBSE evolution
  – Not too early
• Many flavours exist; need to choose for yourself, but be aware of:
  – Duplication
  – Non-standard notation
  – Unclear definition
• Scarecrow have a solution that:
  – Uses SysML
  – Annotates your existing model
  – Is not tool-specific
  – Can support automation
Questions?
Further reading
Further information

Resources available offline

- Slides with hand-drawn notes
- Video
- Access to Scarecrow’s KnoB
- Access to the MBSE Embassy YouTube channel

Don’t forget SysML-anary

- Every Friday morning
- Follow us on LinkedIn
Coming soon...

Training courses:
- 9th: Introduction to SysML
- 16th: Introduction to MBSE

Free events every Thursday:
- 1000 – 1045 – a free talk and presentation
- 1100 – 1145 – the Model-Based Social Event

Bespoke courses and services also available
- Visit www.scarecrowconsultants.co.uk for more details