26th annual INCOSE international symposium
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MB-PLE to Plan and Track Submarine Configurations

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Overview

- Introduction
- Product Line and Variant Modelling
- Modelling Submarine Variants
- Conclusions

INTRODUCTION

Submarine Configuration Management

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- Submarine class life measured in decades
- Full information set “build to”/ allocated baseline at class or batch level
- No two submarines “as built” / product baselines are ever the same
- Only agreed changes managed at individual submarine level

Modelling technology

- Opportunities to improve arise from advancements in hardware performance, software tools and standards
- Model Based Engineering (MBE) and Model Based Systems Engineering (MBSE) enables earlier trade-off and impact studies to be undertaken
- MBSE coupled with Product Line Engineering (PLE) and Orthogonal Variability Modelling (OVM) supports enhanced configuration management at the individual submarine level

The Australian context

- Defence White Paper 2016
  - Rolling programme for submarine design and build
  - Continuous programme for shipbuilding
- Future Submarine
  - 12 Regionally Superior Submarines
  - Class operationally active 2030s to 2070s
  - Evolution of Collins Combat Management System and Weapons
  - Modern design and construction techniques

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Product Line and Variant Modelling

Variant Modeling

- Variant Diagram
- Variation on all Diagrams
- Simple Notation

Variation Point

Variant

Variability Dependency

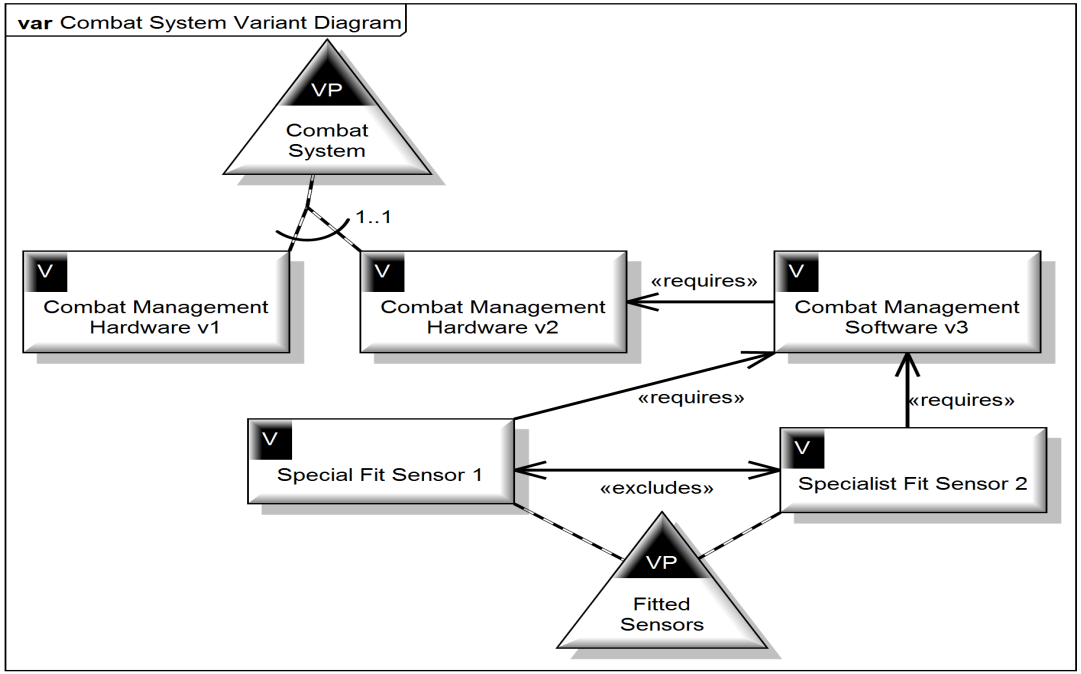
Mandatory/Optional

Requires Dependency

Excludes Dependency

Artifact Dependency

Alternate Choice

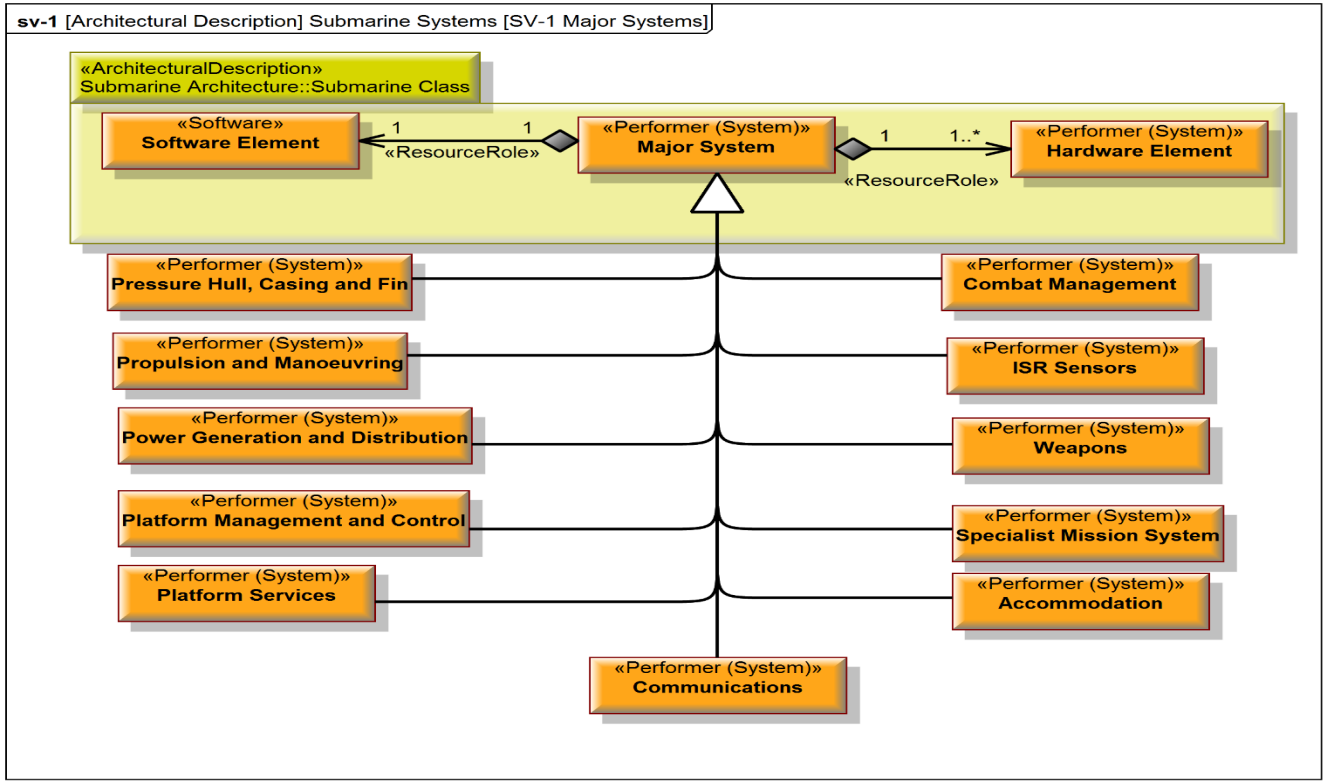


- OVM

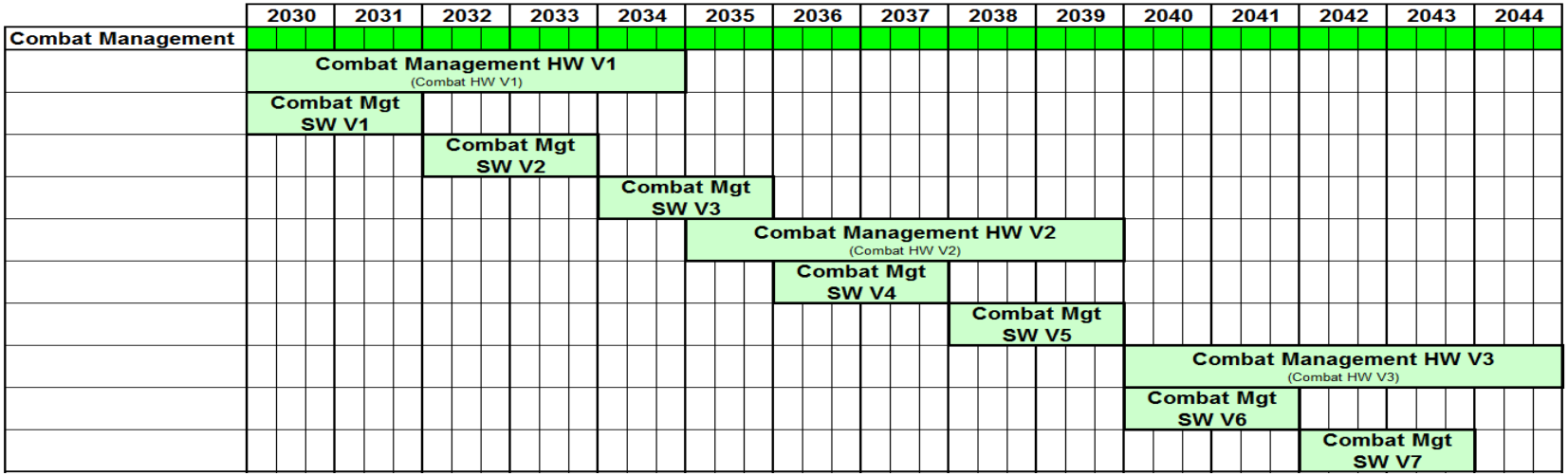
PALUNO, The Ruhr Institute of Software Technology
Software Product Line Engineering (Pohl et al - Springer 2005)

MODELLING SUBMARINE VARIANTS

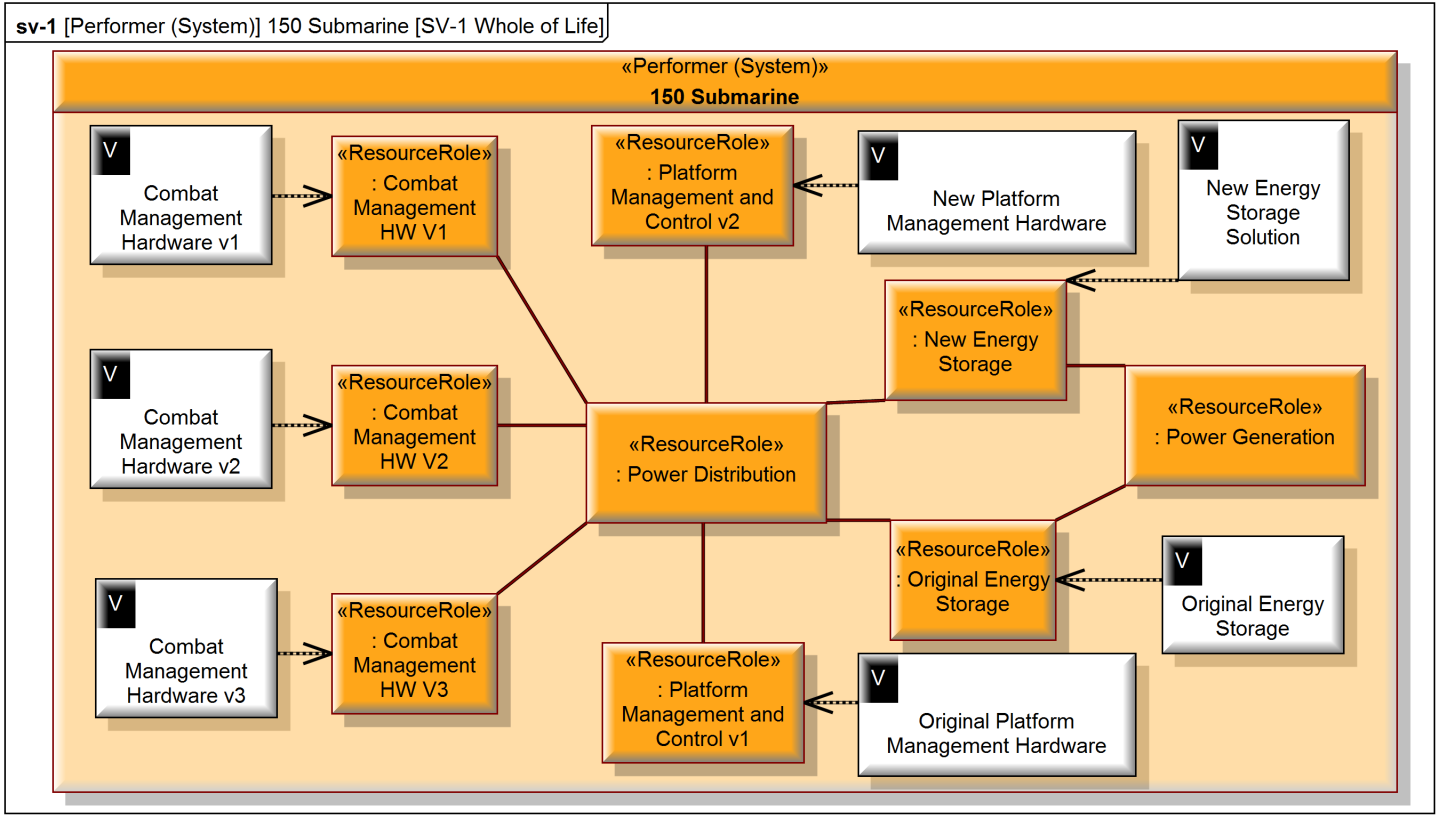
Simplified System Breakdown



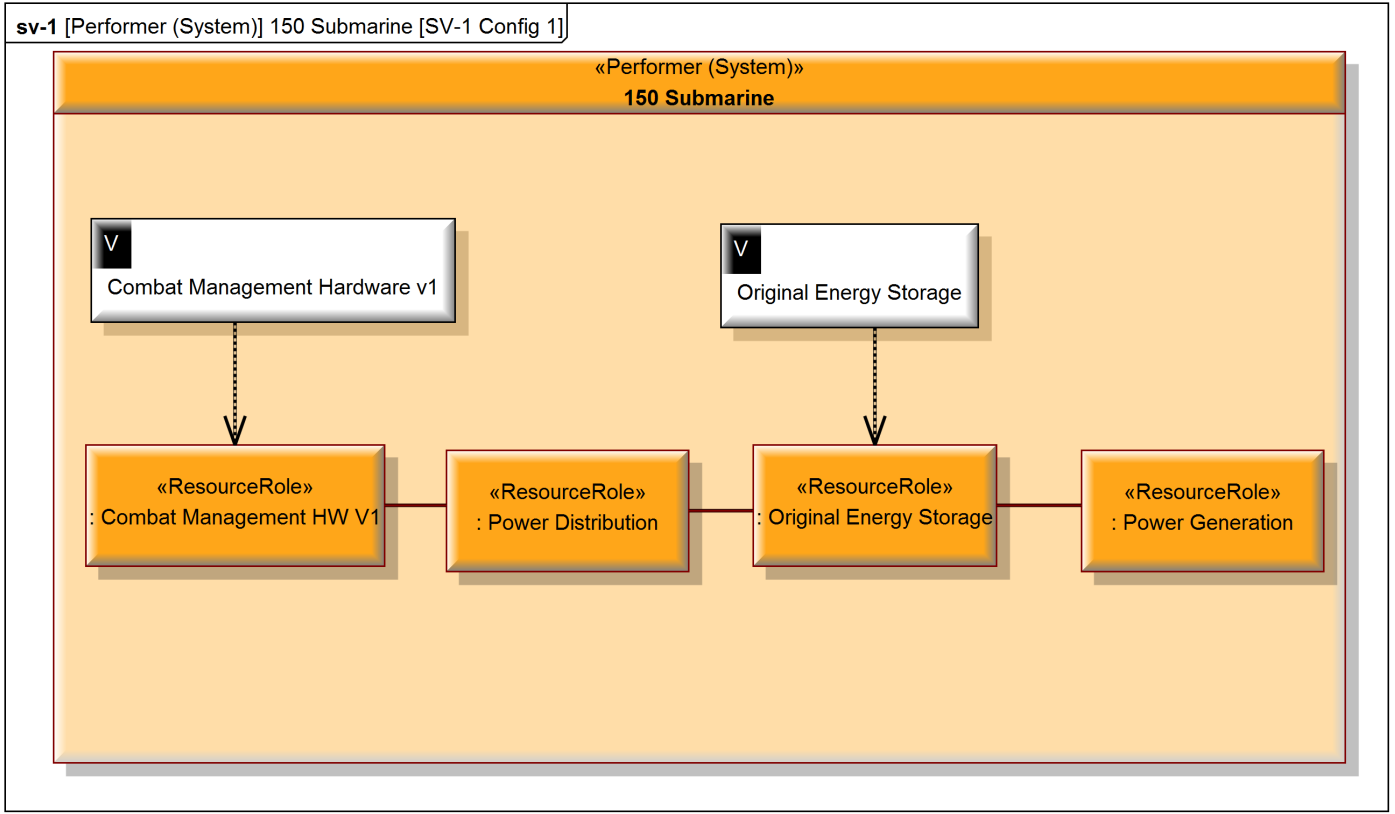
Major System Evolution



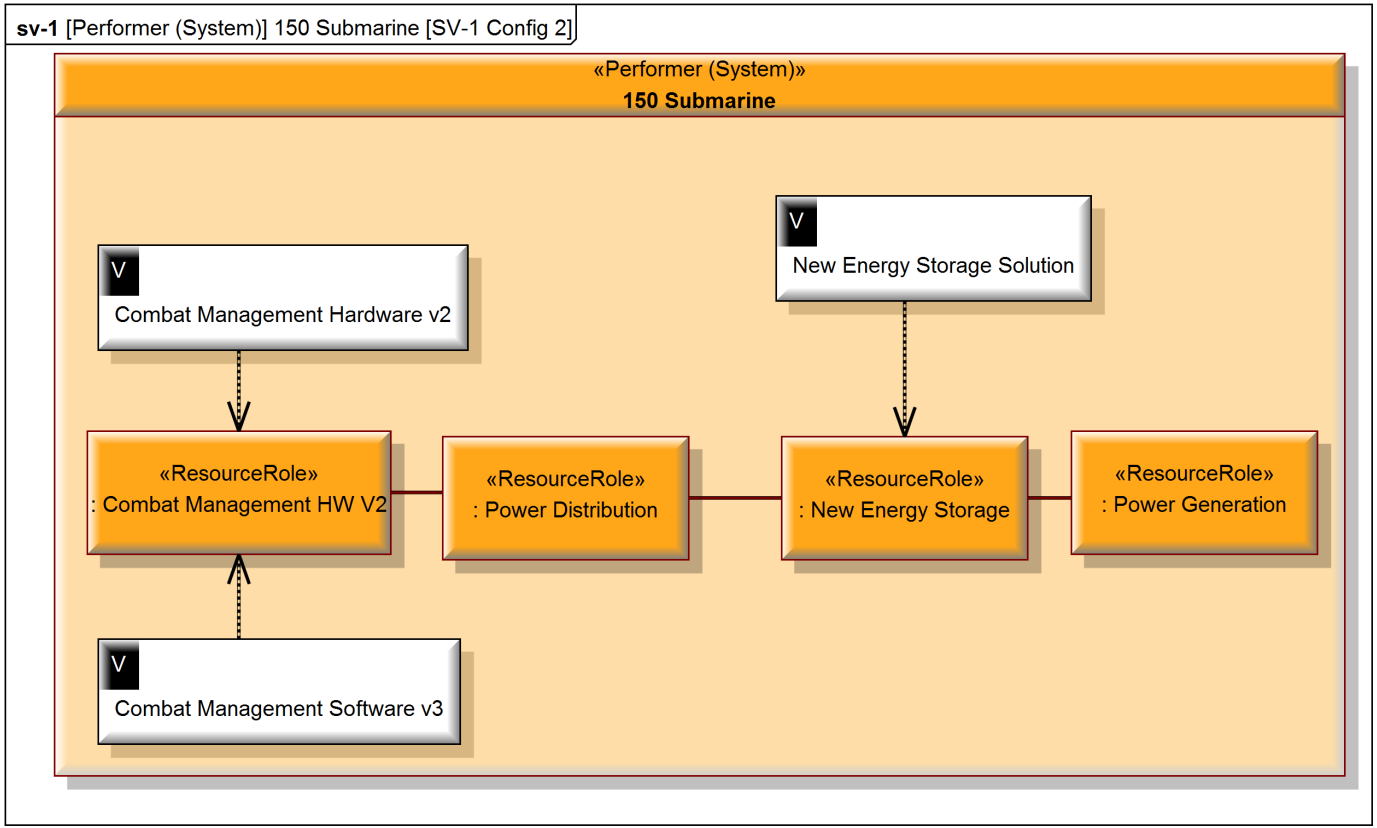
The 150% model



The 150% Model (V1 Viewpoint)

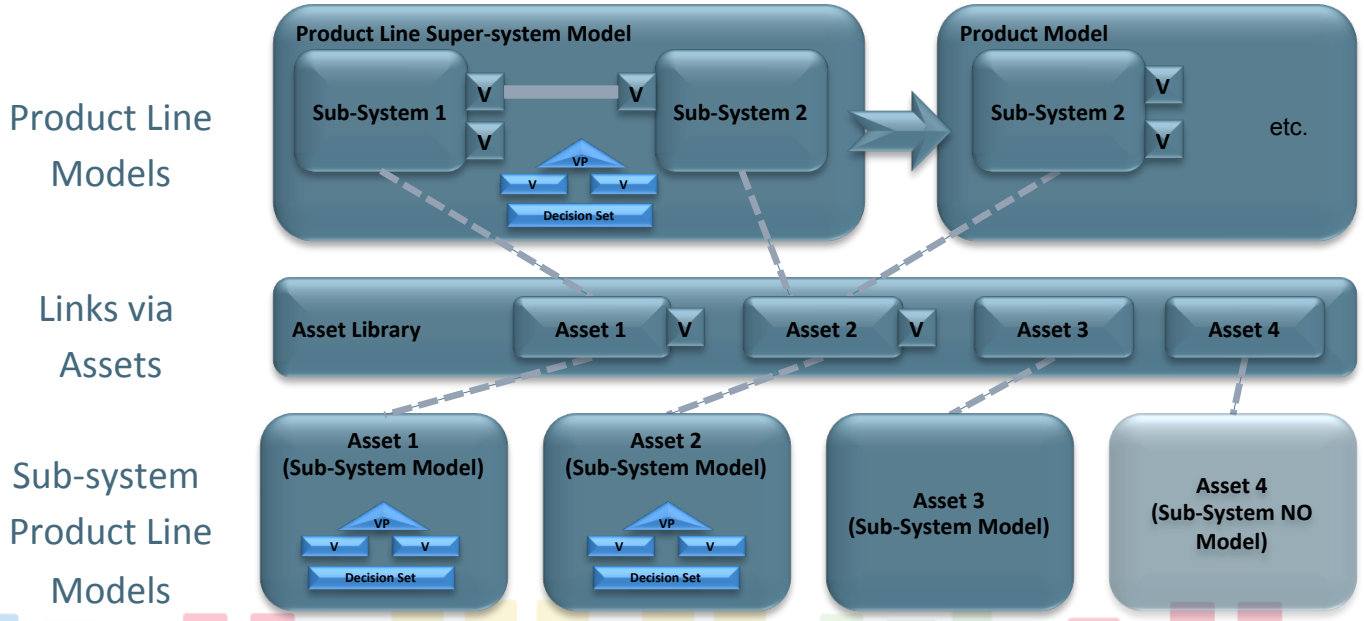


The 150% Model (V2 Viewpoint)



MB-PLE: Asset Management

- Integrated MBSE, Modular Design & Variability Modeling = Model-based Product Line Engineering
  - Uses the OMG Reusable Asset Specification (RAS)



Variability Modelling During Design And Build

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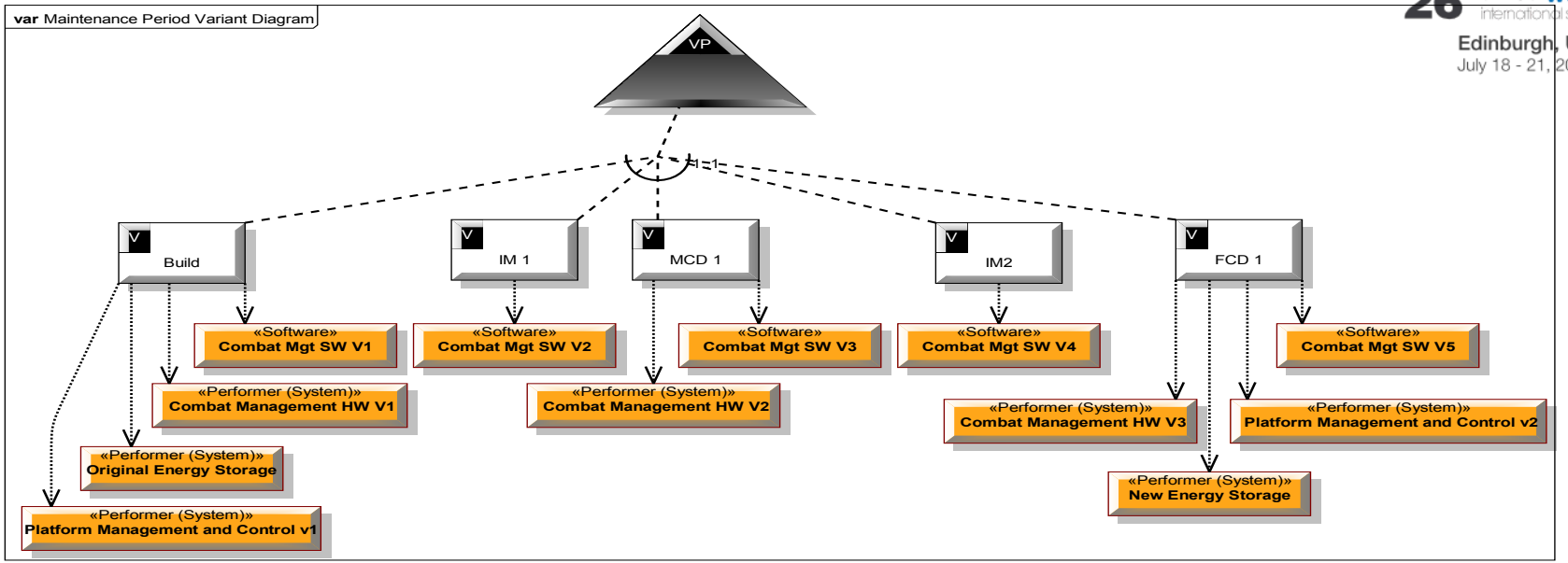
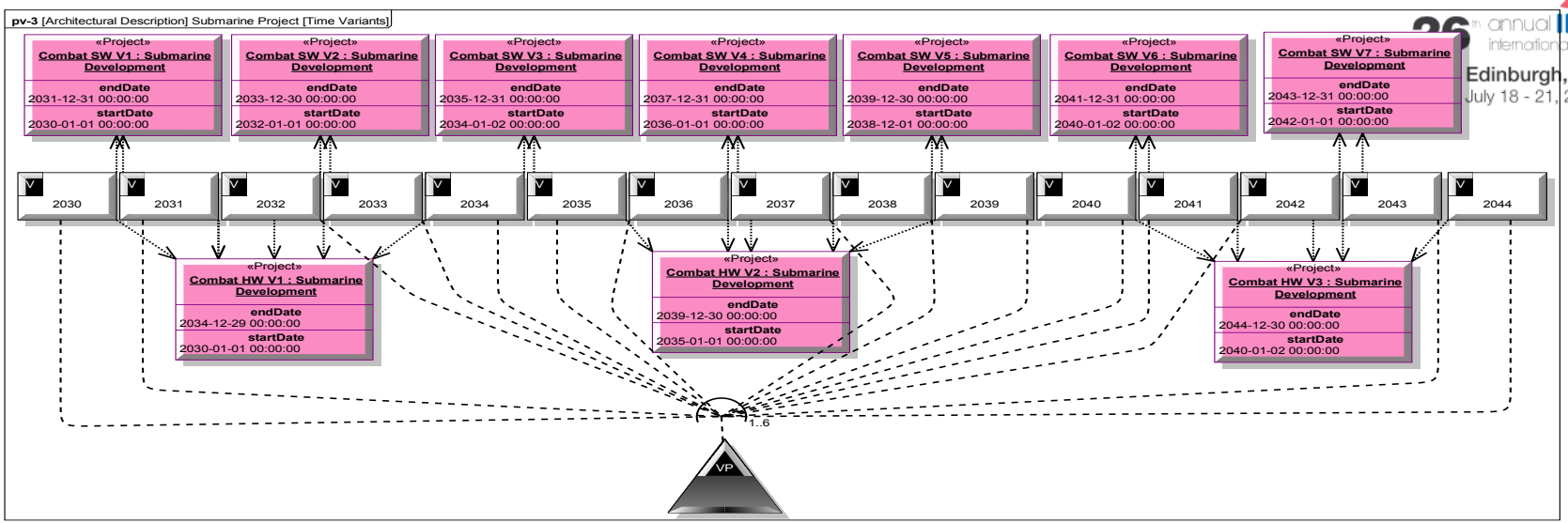
- Supporting trade studies
- Planning updates and technology insertions during maintenance
- Planning technology refresh periods

Planning of Updates



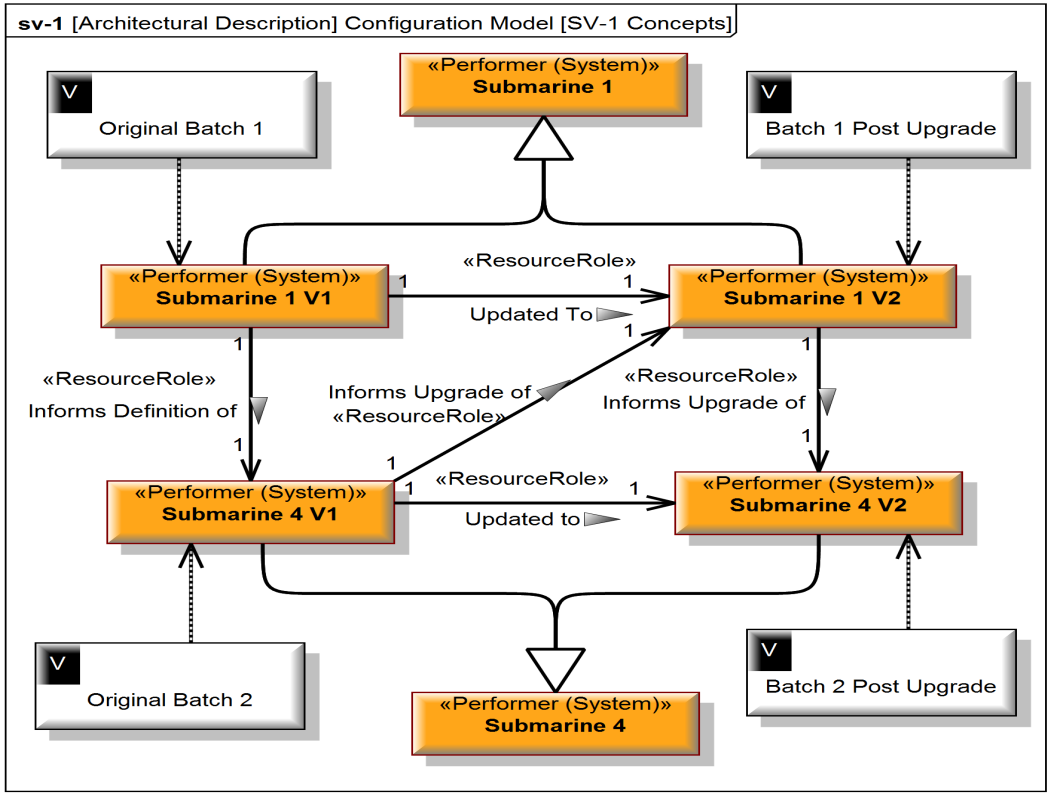
Scheduling of Updates



Variability Modelling During Operation And Maintenance

- Re-planning updates and technology insertions during maintenance
- Re-planning as reliability data becomes available
- Planning unforeseen technology insertions

Tracing Submarine Variants



Conclusions

- MBSE / MB-PLE supports early understanding of submarine evolution options
- MBSE / MB-PLE provides enhancements in managing submarine variants over time
- MBSE / MB-PLE supports and documents engineering decisions
- MBSE / MB-PLE can be applied to multiple domains

Questions

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