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

- 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
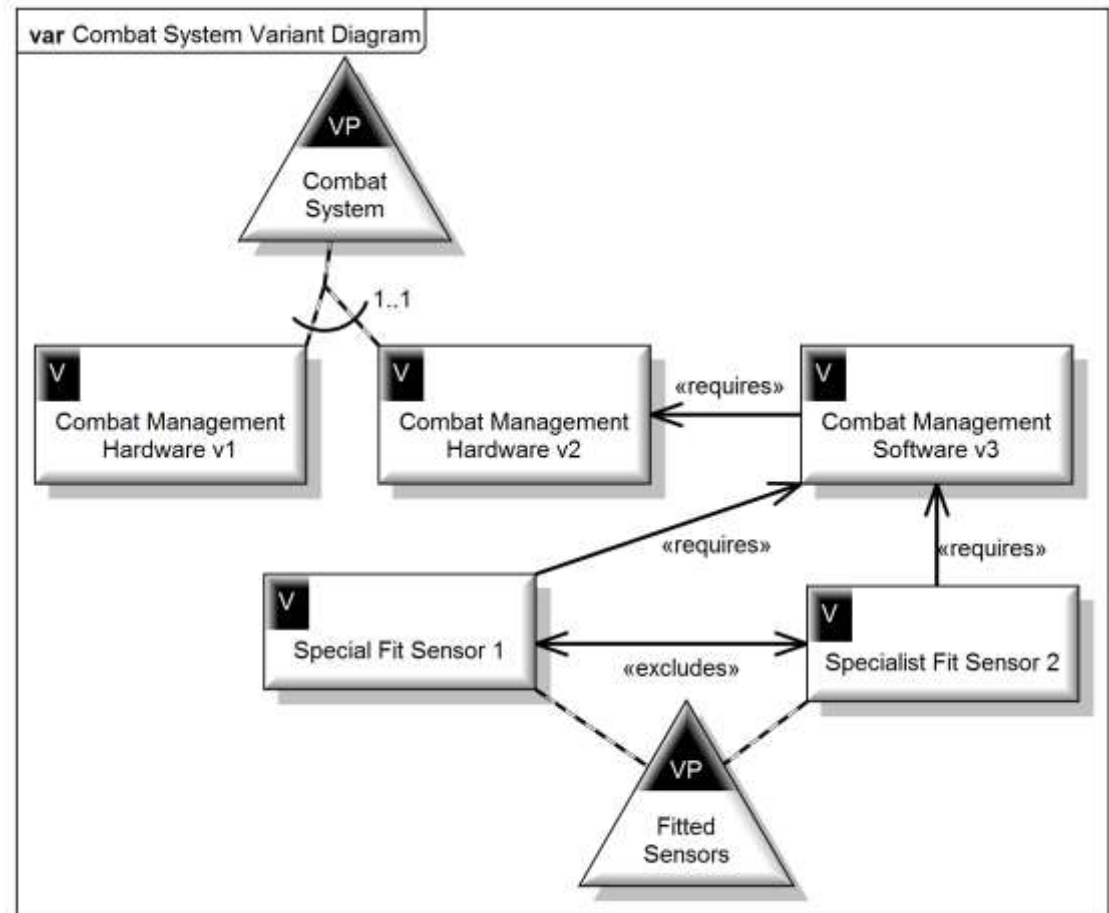
PRODUCT LINE AND VARIANT MODELLING

Variant Modeling

- Variant Diagram
- Variation on all Diagrams
- Simple Notation

  △ Variation Point

  □ Variant

  ▲ Variability Dependency

  ▲ Mandatory/Optional

  ▲→ Requires Dependency

  ▲↔ Excludes Dependency
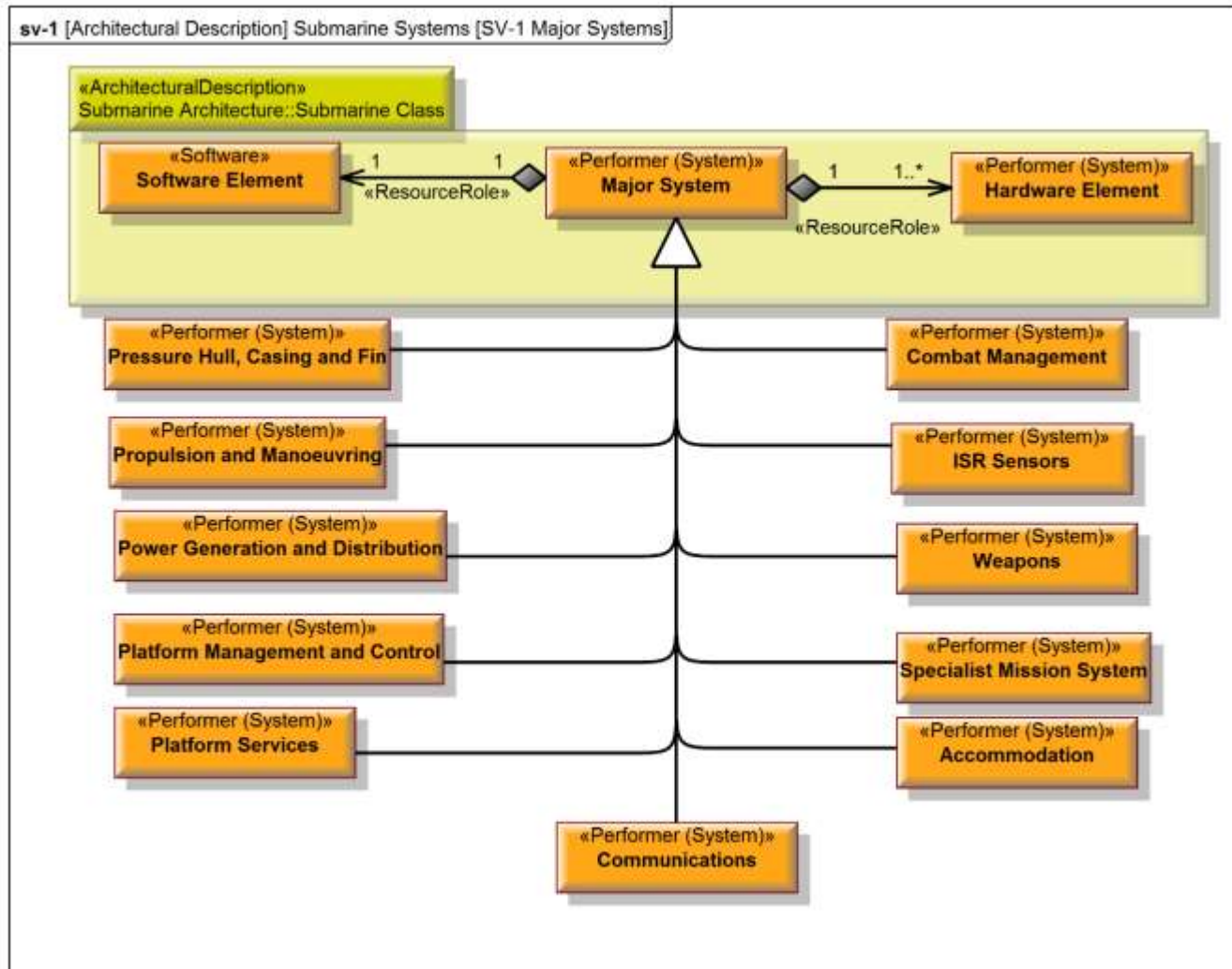
  ▲⋯→ Artifact Dependency

  ⛢ Alternate Choice

- OVM

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

var Combat System Variant Diagram

VP Combat System

1..1

V Combat Management Hardware v1

V Combat Management Hardware v2

V Combat Management Software v3

«requires»

«requires»

«requires»

V Special Fit Sensor 1

V Specialist Fit Sensor 2

«excludes»

VP Fitted Sensors

MODELLING SUBMARINE VARIANTS

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Simplified System Breakdown

Major System Evolution
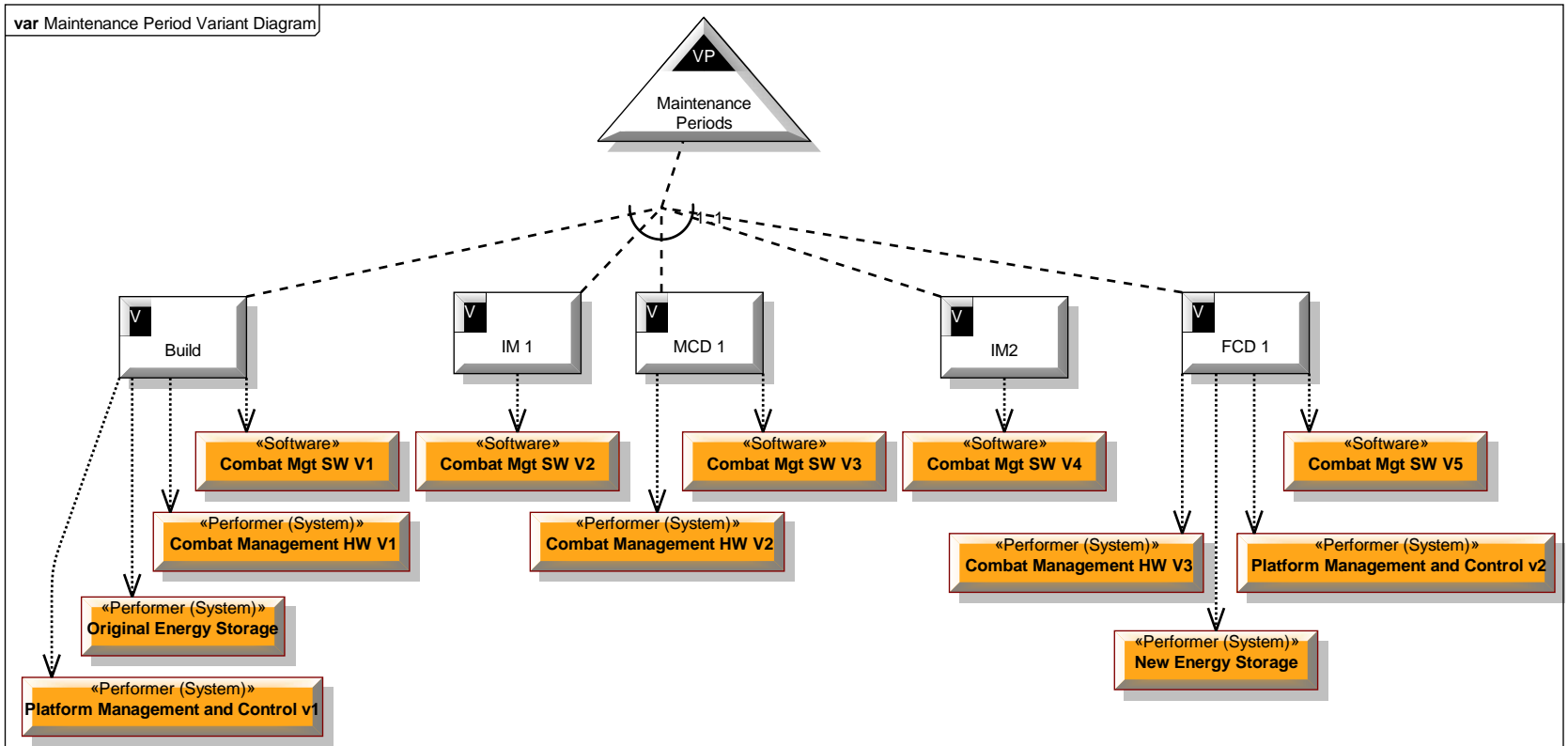
The 150% model

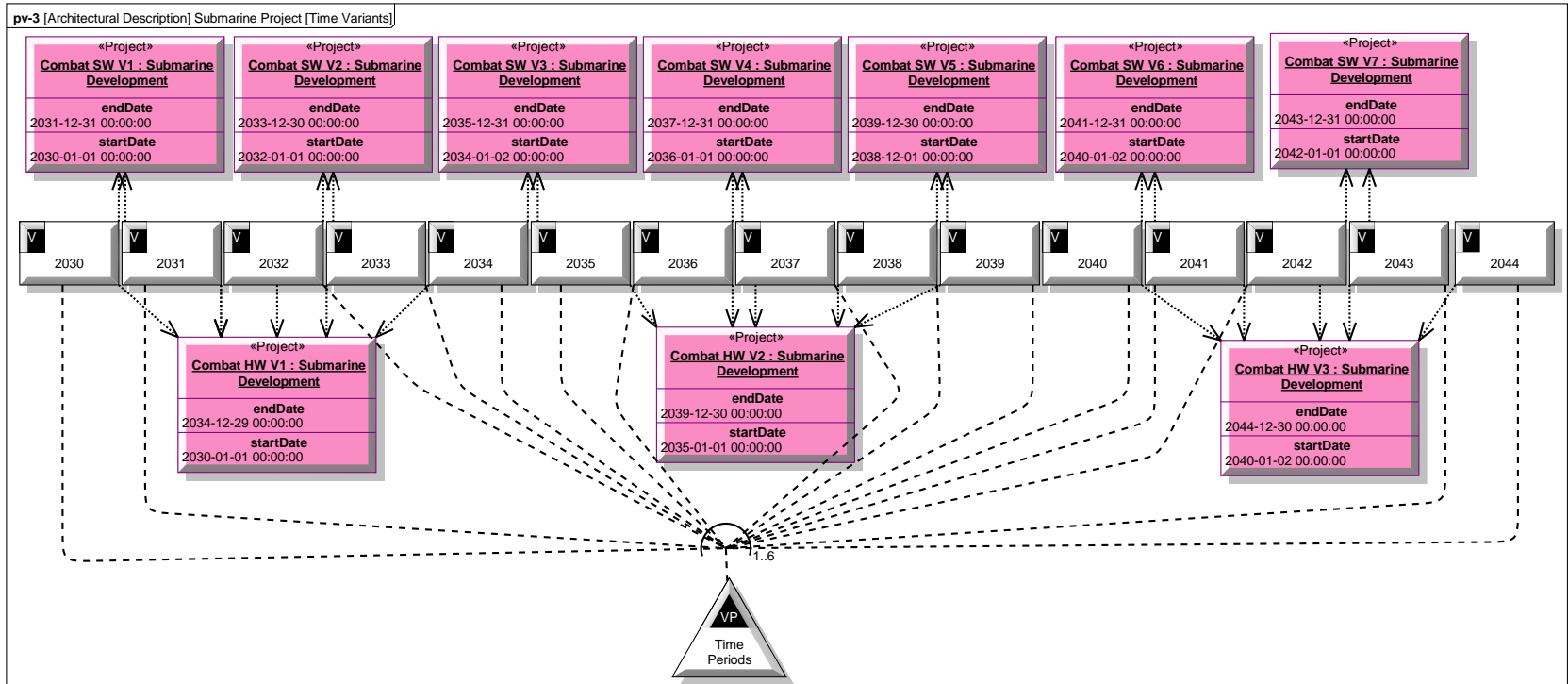MB-PLE to Plan and Track Submarine Configurations

Variability modelling during design and build

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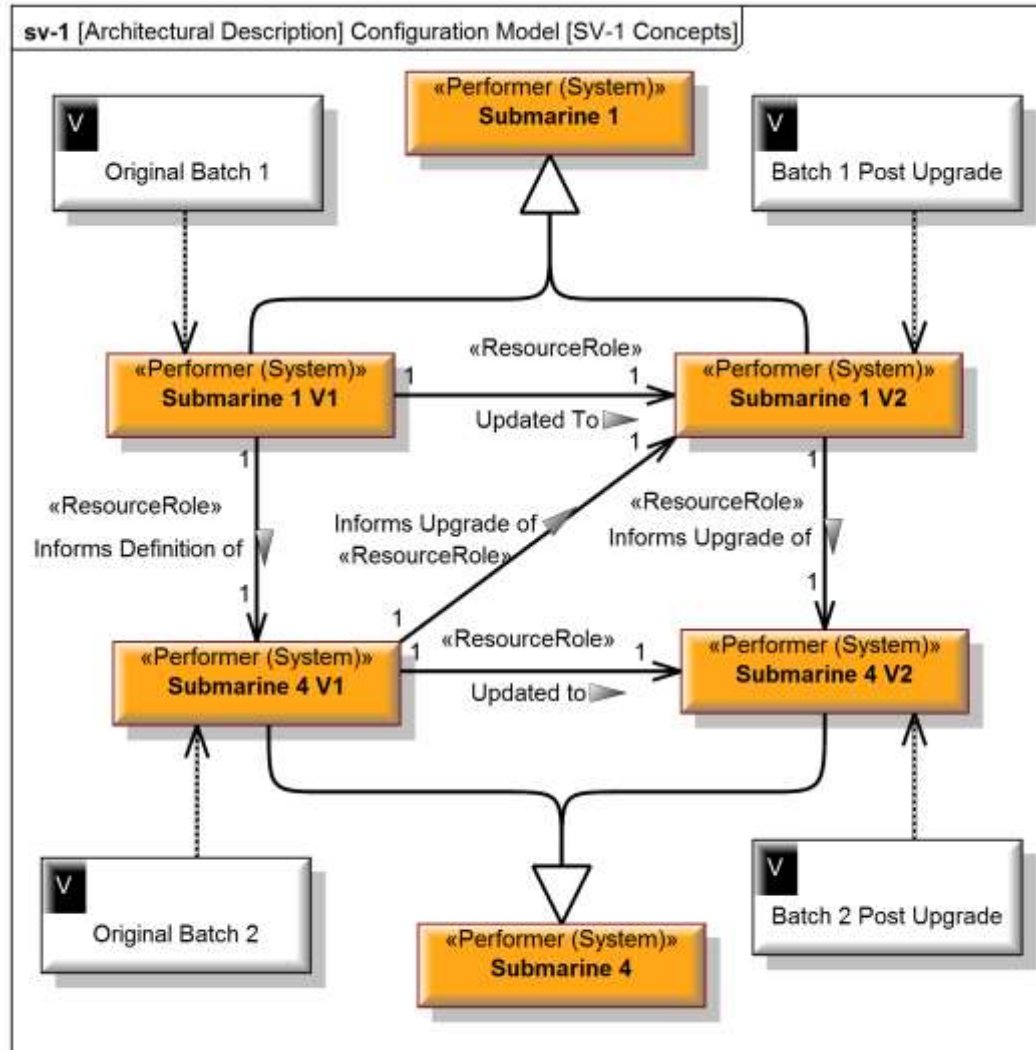
Planning of updates

Scheduling of updates

SHOAL

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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