Australian Government
Department of Defence
Science and Technology

An MBSE Methodology to Support Early Stage Australian Naval Vessel Acquisition Projects

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Outline

- Background

- Research Issue

- Focus of Presentation

- Proposed MBSE methodology

- Hydrographic Survey Capability Example Implementation

- Conclusions

Background – Australian Naval Vessel Acquisition

First Principles Review

The ADOD '…must deliver a significant capability modernisation program against a backdrop of strategic uncertainty including, but not limited to: rapid technological change; budget uncertainty; substantial economic growth in our region; and increasing demand for military responses…'

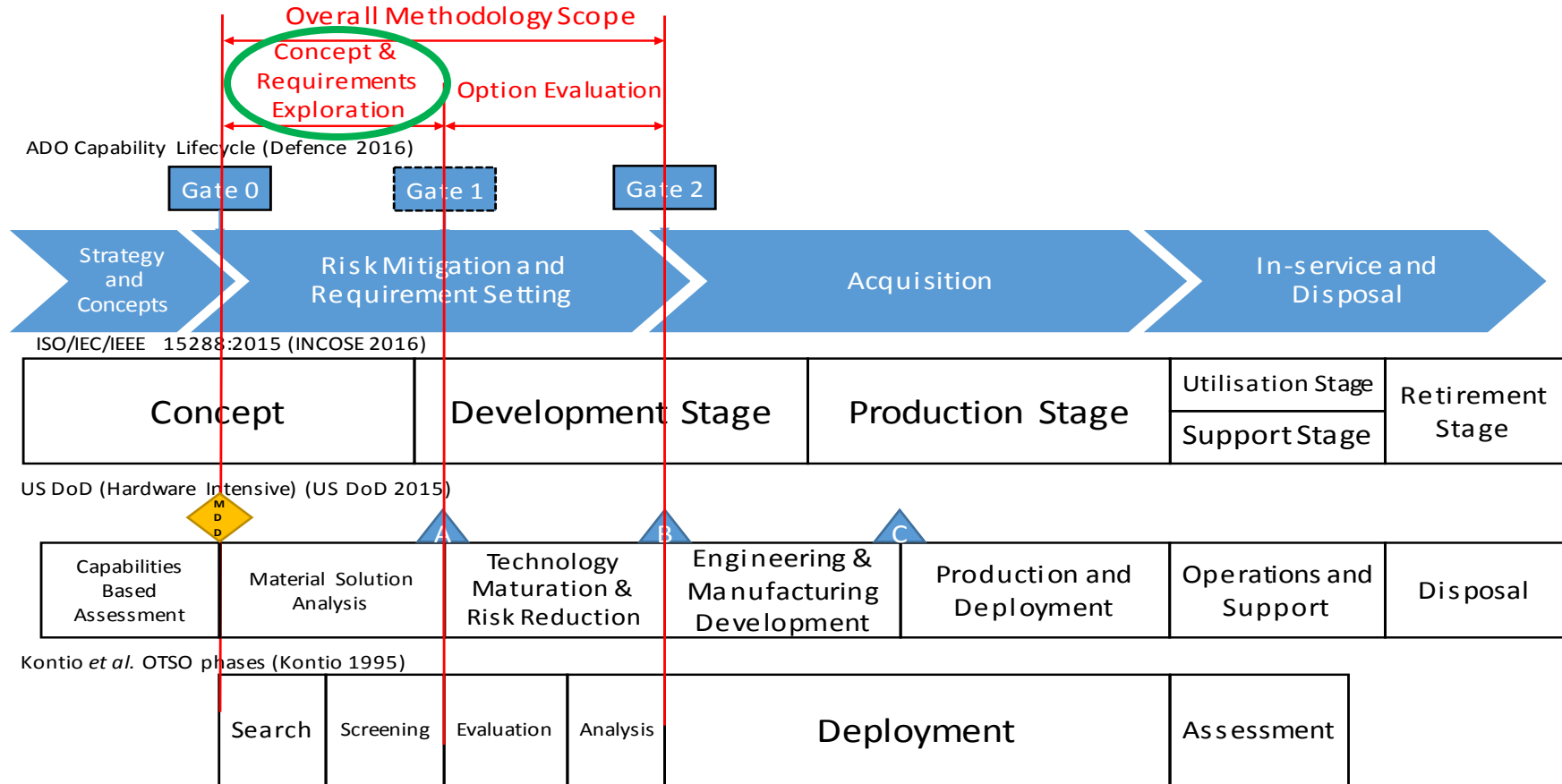→ Reduced guidance with increased oversight

Naval Shipbuilding Plan
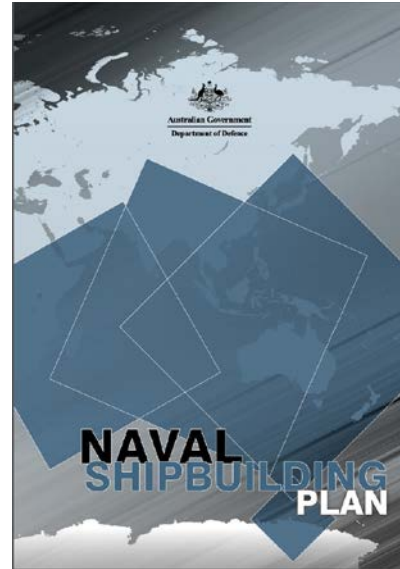
'Selecting a mature design at the start of the build and limiting the amount of changes once production starts; Limiting the amount of unique Australian design changes.'

→ Off-the-Shelf (OTS) approach changes nature of acquisitions to 'middle-out'

Research Issue

In the early stages of Australian Defence Organisation Off-the-Shelf naval vessel capability acquisition projects, support for traceable, defensible requirement development activities is currently lacking.

The OTS constraint also changes the nature of the acquisition's Systems Engineering approach.

Blanchard and Blyler (2016)

Research Focus for this Presentation

Proposed MBSE Off-the-Shelf Concept and Requirements Exploration Methodology

Feedback and revisit if required

Stakeholder Engagement

Process	Establish Operational Scenarios, Functions and KPPs	Build and Explore a Design Space for KPPs Based on Suitable Hullforms (Design Space Exploration)	Build and Interrogate a Database of Existing Vessel Designs (Market Survey)	Use Knowledge of preferred designs and marketplace to develop RFT requirements
Methods	• Top-down decomposition • CONOPS analysis • User/SME workshops • Use a library	• Executable Parametric and Surrogate models • Naval Architecture tools • Design of Experiments • Sensitivity analyses	• Analyse online vessel data repositories • Analyse parent navy vessel data • Multi-Criteria Decision Making	• Requirements driven • Capability option driven
Outputs	• Operational and support mission activities and KPPs	• Relationships between vessel design characteristics and mission performance	• Ranking of existing vessel designs for acquisition needs • Any capability risks	• RFT requirements

ADO Risk Mitigation and Requirement Setting

Gate 0 ← Concept and Requirements Exploration → Gate 1
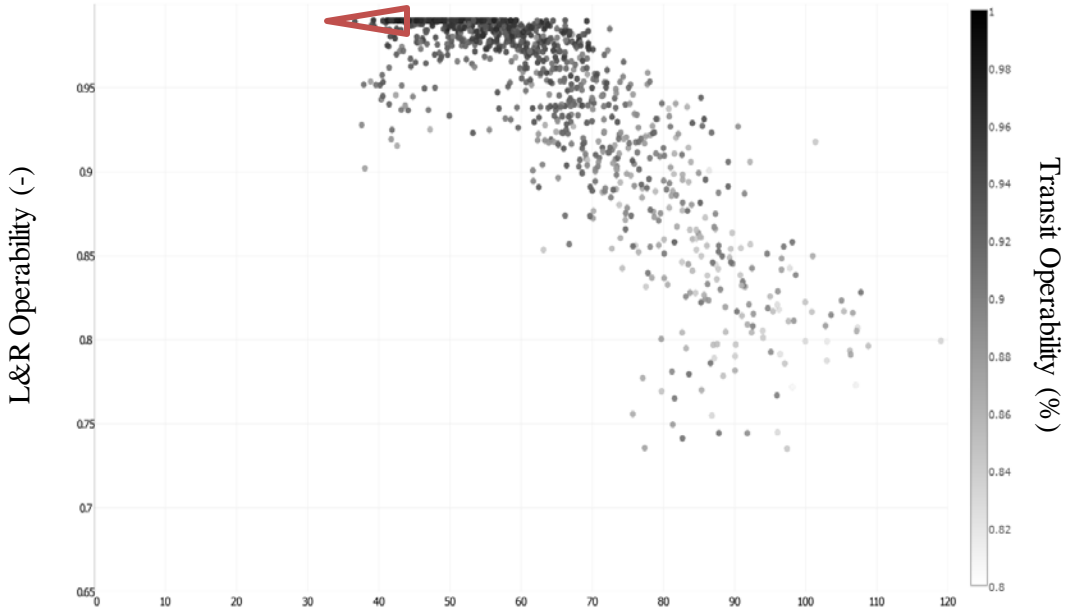
Establish Operational Scenarios, Functions and KPPs

Build and Explore a Design Space for KPPs Based on Suitable Hullforms
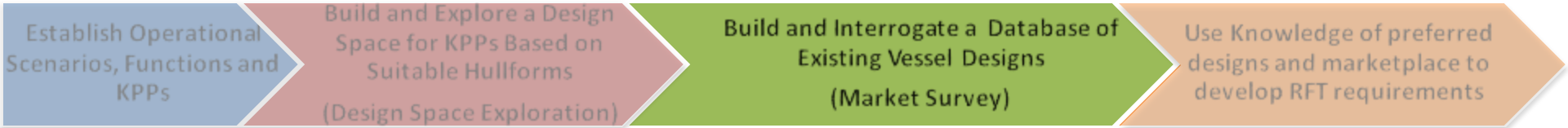
(Design Space Exploration)

Build and Interrogate a Database of Existing Vessel Designs

(Market Survey)

Use Knowledge of preferred designs and marketplace to develop RFT requirements

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Use Knowledge of preferred designs and marketplace to develop RFT requirements

Total Resistance/Displacement @ 14 knots (kN/tonne)

Generated Design	Length Overall (m)	L/B	B/T	Displacement (tonnes)
775	95	4.12	3.34	9135
337	94.2	4.26	3.47	7871
786	95	4.09	3.97	7850
796	95	4.48	3.50	7301
334	94.2	4.36	3.59	7018
785	95	4.26	3.86	7055
135	93.4	4.12	3.95	7252
482	87.7	4.05	3.56	6443
317	90.2	4.16	3.70	7155

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| Rank	Displacement (tonnes)	Length (m)	Beam (m)	Length/Beam	Speed (knots)	Range (nm)	Crew
1	6421	89.9	19.1	4.71	15	12000	33
2	2889	87	14.6	5.96	15	12000	31
3	3477	85.7	15	5.71	14	11000	58
4	3455	83.5	16	5.21	15	11300	22
5	2991	85	14.1	6.03	14	10060	23
6	3024	72.5	15.24	4.76	12	10500	20
7	2164	76.8	12.8	6.00	14.5	10000	24
8	2205	71.2	15.2	4.68	14	18000	61
9	2382	67.5	15.3	4.41	16.5	22000	22
10	2298	68.3	13.1	5.21	11	19000	49

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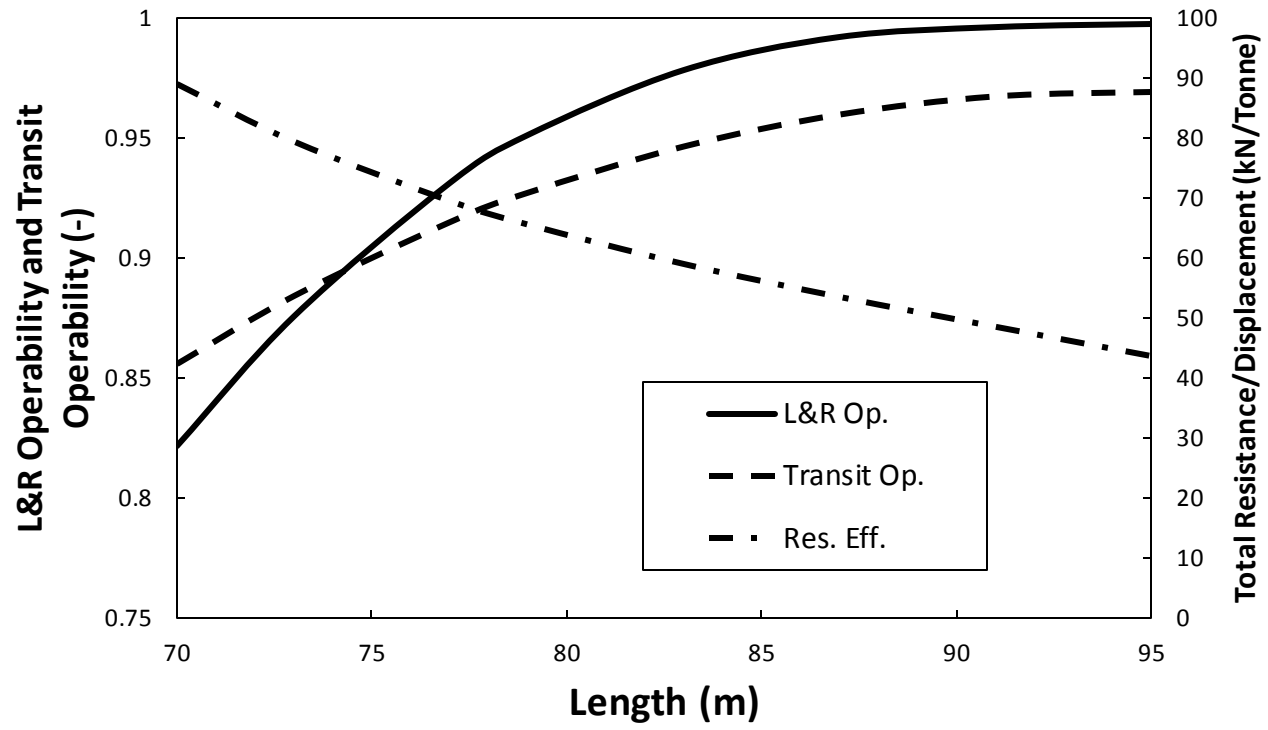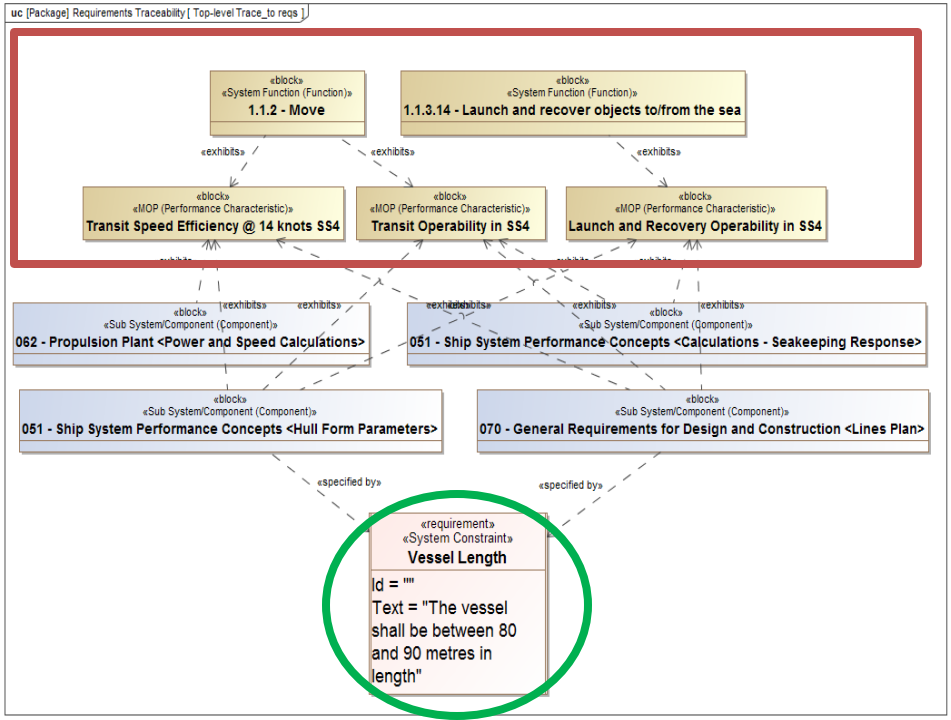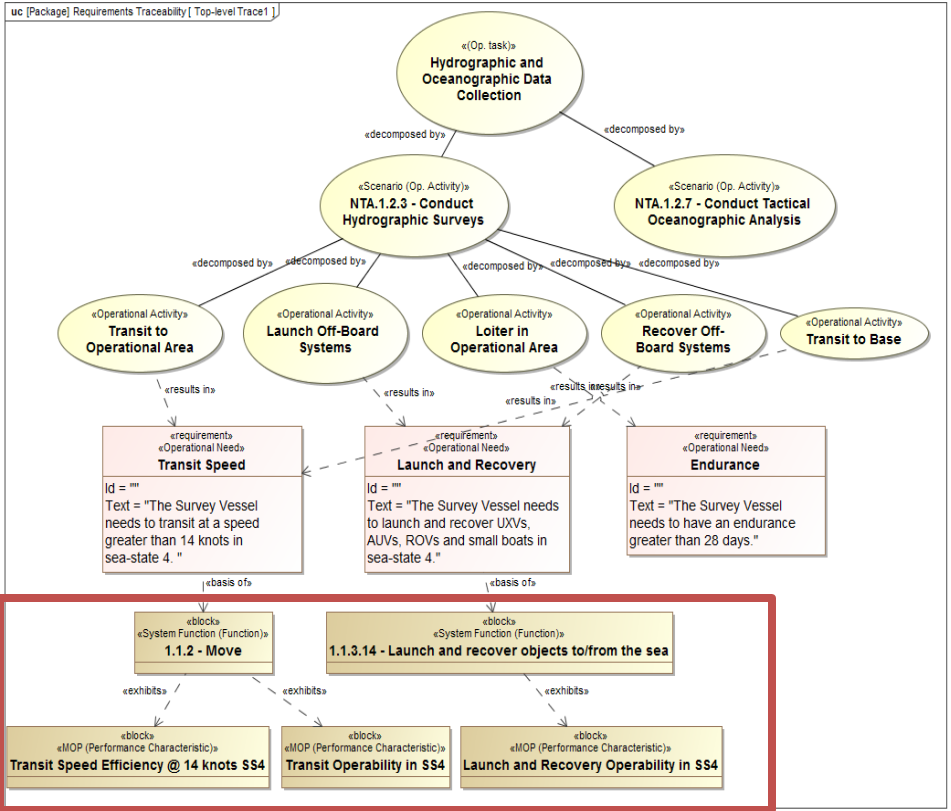
Conclusions

- OTS approach changes the nature of naval vessel acquisitions.
- Proposed an MBSE methodology to support these acquisitions.
- The focus was on the Concept and Requirements Exploration part of the methodology, which includes an explicit market survey.
- The methodology supports defensible decision making through evidence-based analysis and traceability to the strategic capability needs.