

The Use of Models Across the Contractual Boundary: Past, Present and Future

Dr Quoc Do
Frazer-Nash Consultancy

Prof Stephen Cook,
University of South Australia

Terje Fossnes, ESEP
Norwegian Defence Logistics Organisation (NDLO)
Naval Systems Project Division – Submarines,
Norway

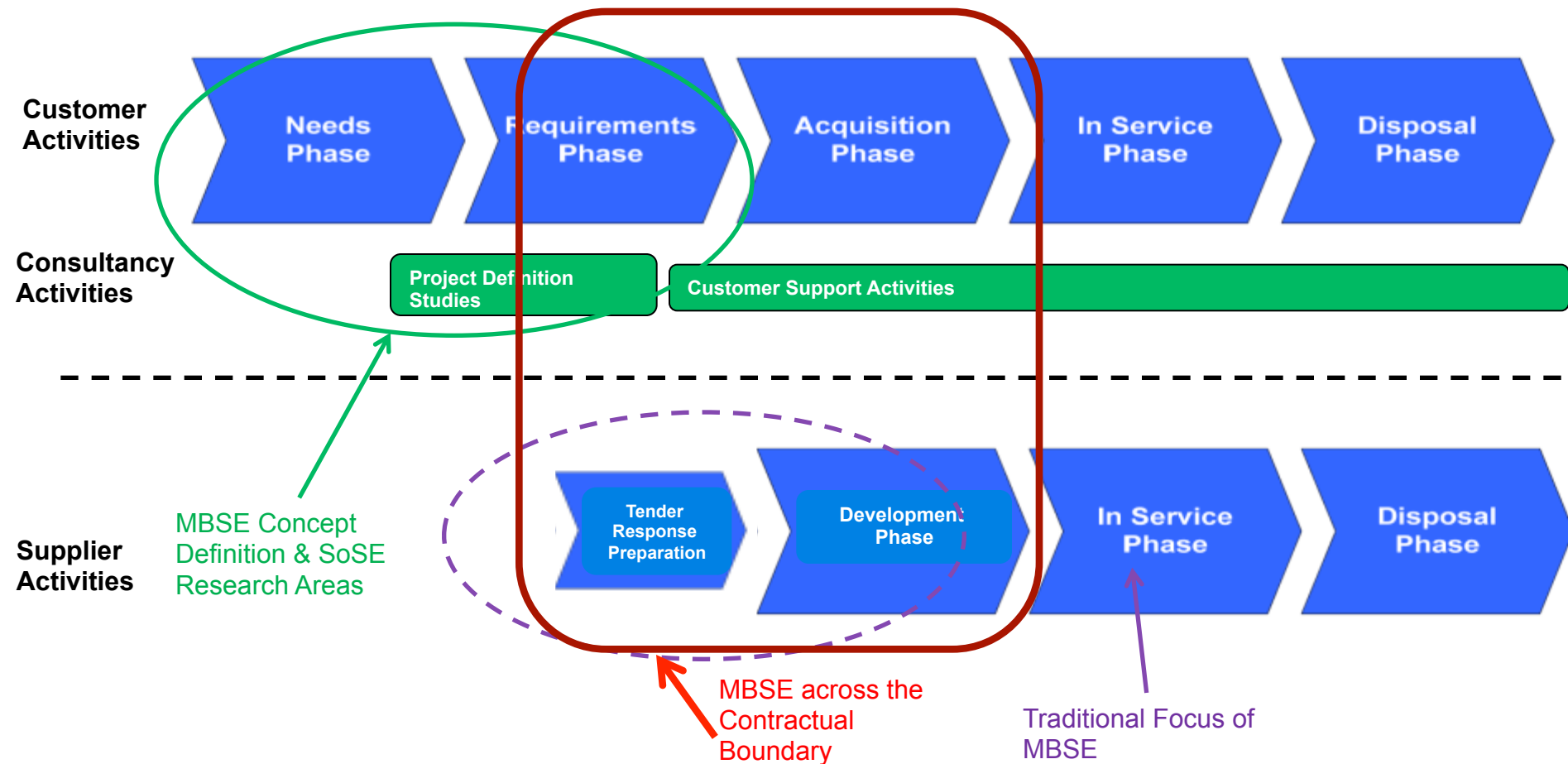
Cecilia Haskins, ESEP
Department of Production and Quality Engineering
Norwegian University of Science and Technology

Contents

1. Introduction to Model-Centric Acquisition:
 - Defence acquisition context (Australia)
 - Model exchange framework and requirement
2. Literature Review on Model-Centric Acquisition
3. Model-Centric Acquisition Case Studies:
 - Norwegian Frigates Acquisition
 - UniSA Model-Centric Acquisition Study
4. Discussion and Analysis of Outcomes
5. Summary

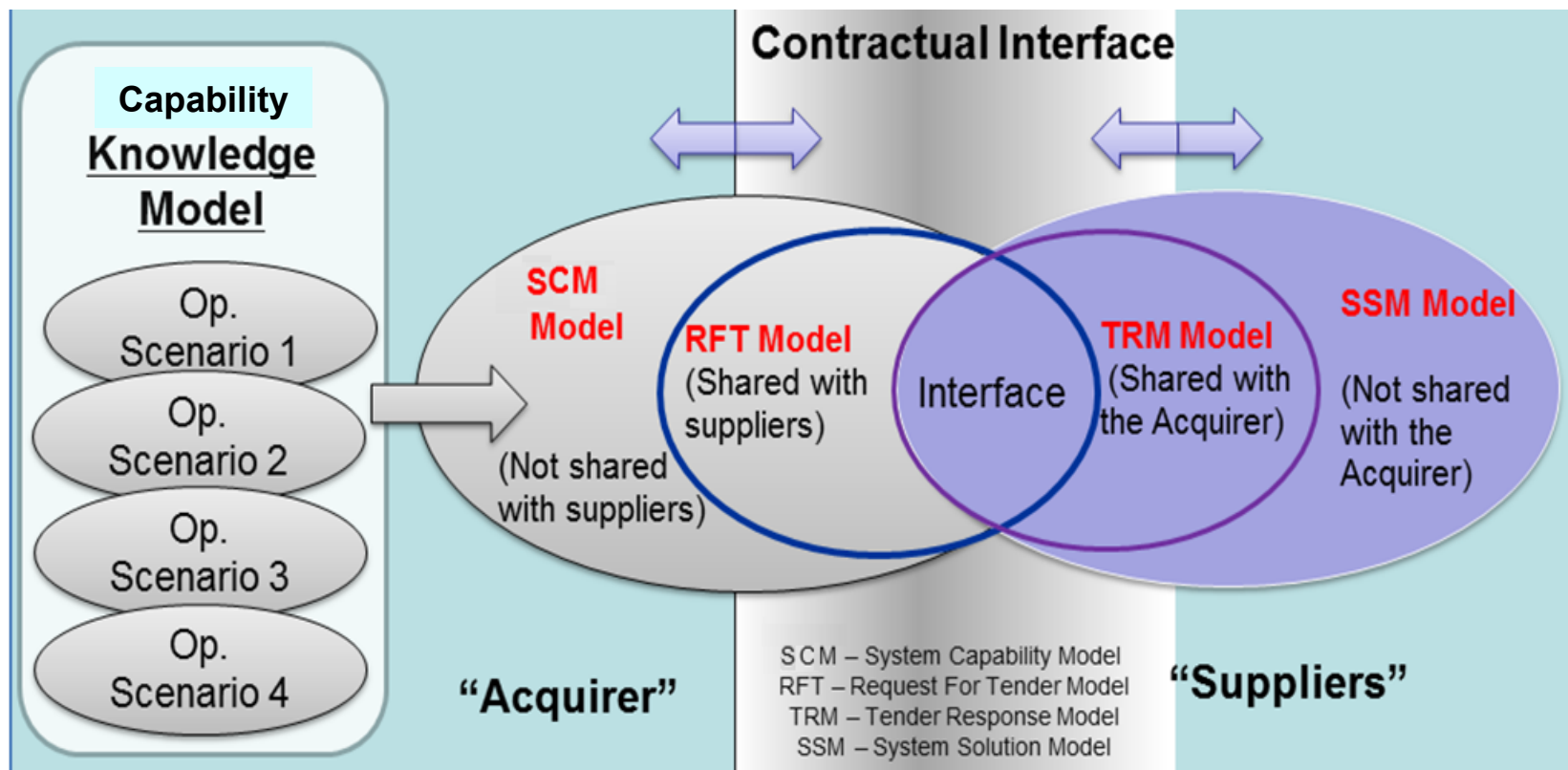
Introduction to Model-Centric Acquisition

Model-Centric Acquisition Context
Example – Australian Capability Acquisition Lifecycle



Introduction to Model-Centric Acquisition

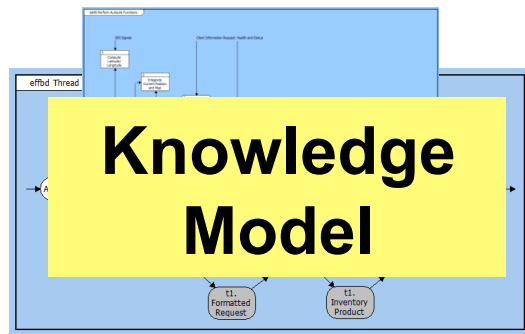
Model Exchange Needs



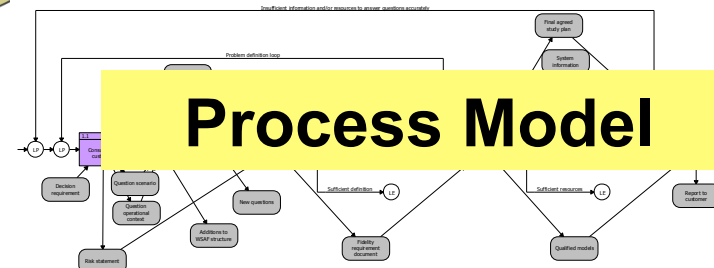
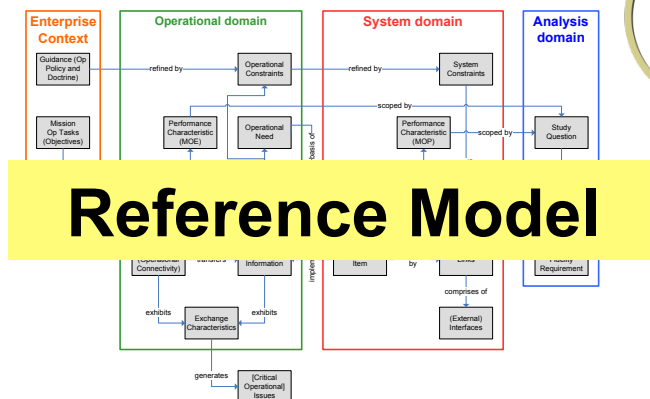
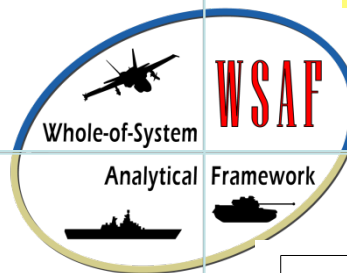
Literature on Model-Centric Acquisition

DSTO WSAF Approach

- Whole-of-System Analytical Framework (WSAF) was developed by Defence Technology Organisation based on CORE DoDAF Schema in 2010.



Portal and Scripts

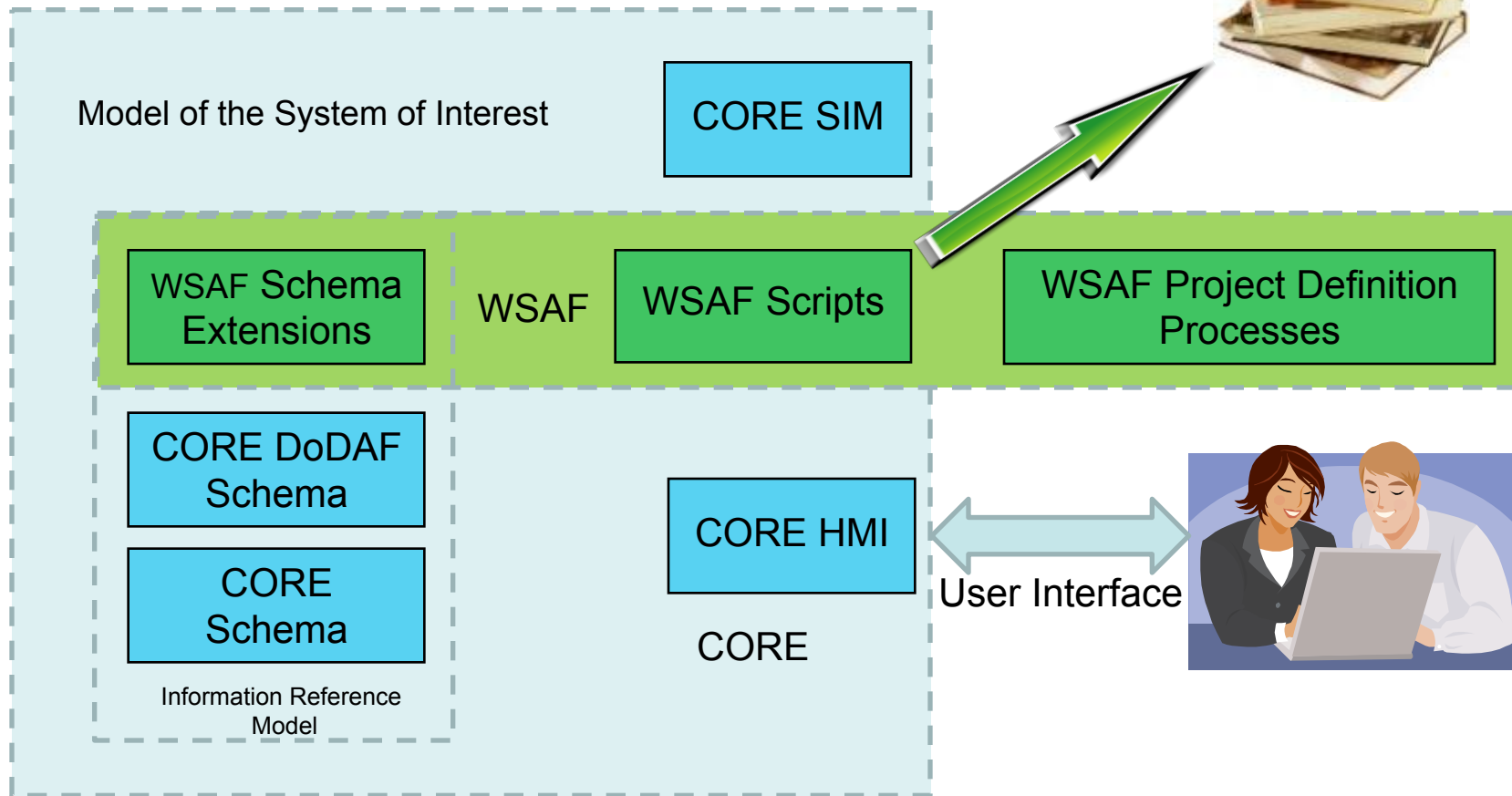


(Adapted from Robinson, 2010)

Literature on Model-Centric Acquisition

DSTO WSAF Approach

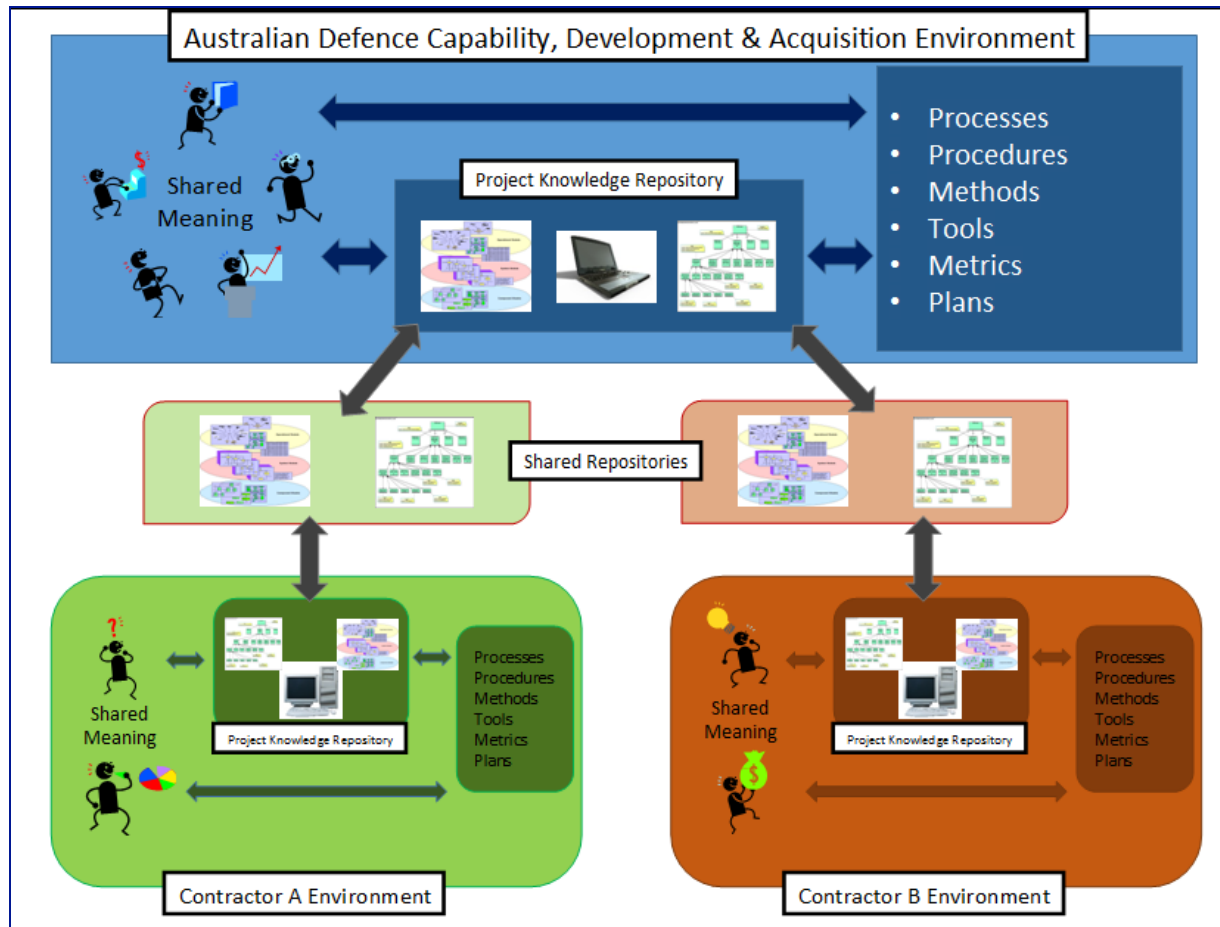
A Model of a Solution in WSAF



Literature on Model-Centric Acquisition

DSIC's Research 2011

Model Exchange Needs



Model Exchange Needs

Key Aspects of Information and Model Exchange Questions	Project Findings
What classes of information in the Acquirer's RFT model should NOT be provided to the Suppliers?	<ul style="list-style-type: none"> Costing information, internal management information Sensitive information (particularly prior to contract)
What classes of information in the Acquirer's RFT model should be disclosed to the Suppliers?	<ul style="list-style-type: none"> Functional model (enables iterative approach between government and industry) Issue of how approvals of model will take place vs a document-based approach Rationale for performance figures and essential/desirable etc. Standards: <ul style="list-style-type: none"> 1) How to specify which details are relevant and testing against these? 2) If conversion of Standards into model is sensible or useful Support concept, test and evaluation information
What classes of information in the Supplier's Tender Response Model (TRM) should be disclosed to the Acquirer?	<ul style="list-style-type: none"> System behaviour and measures of performance Assumptions, rationales, applicable standards Test plans and test cases Technical forecast and resulting risks, technical integrity risk Support system model Anything as specified by acquirer – when it makes sense to be in a model The TRM should describe the system solution at an appropriate level of abstraction to avoid IP issues.
What classes of information in the Supplier's TRM should NOT provide to the Acquirer?	<ul style="list-style-type: none"> Lower-level detail risk and cost; and IP related information not to undermine their position during the tender evaluation process.
What interfacing issues have been identified between the models?	<ul style="list-style-type: none"> Need for a metamodel that can underpin SCM, RFT, SSM, TRM Feasibility of model-centric tender evaluation by the acquirer Inherent impediments to achieving the long term goal (i.e. Legal framework and IP issues) Current interfacing standards are insufficient and these need to evolve and mature for model-centric acquisition before they can be adopted and/or mandated.

Case Studies

Norwegian Frigates Acquisition

Pre-contract and Contract Award

- Navy's SE experience 10 years; RDD-100
- Multiple SSS for RFO; + SOW and ILS req
- Security Clauses
- RDD-100 desire
- Navy & Yard + 1 major subcontractor

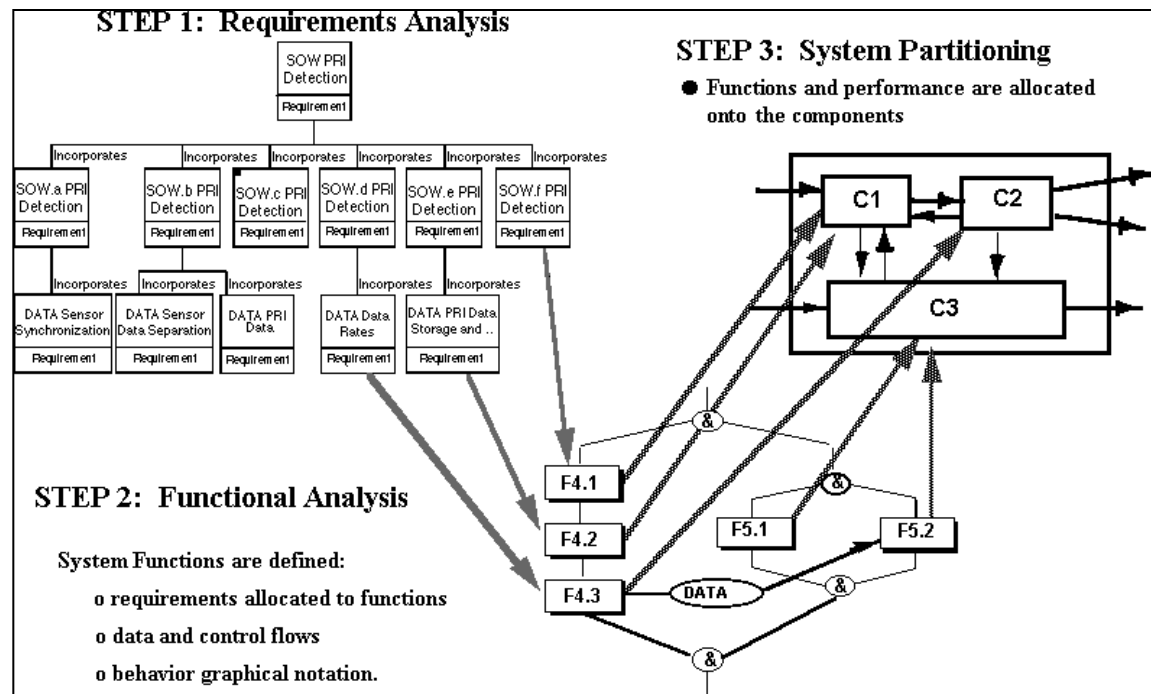


Norwegian Frigates Acquisition

During Contract – MBSE Content

- RDD-100 contractual baseline grew over time to real MBSE content:

- Requirements
- Functions
- Components
- Q,V&V ≠ ships
- CI (18.000)
- ++ other entities with traceability



Norwegian Frigates Acquisition

During Contract – MBSE Data Exchange

- Encrypted telecom N ↔ E model exch.
 - Change Packages
 - USA → E updates
 - Also: sync.mtgs for CM (ECP to CCB)
-
- Commercial in Confidence;
 - classified attributes kept separately.
 - Entire model available to all 3 parties.
 - IP-rights to own produced information.
 - Navy ownership to RDD-100 future model use.



Norwegian Frigates Acquisition

Post Contract Reflections

- Ascent Logic Corporation – developer and vendor of RDD-100 is out of business
 - Model must be converted to new SE tool



- Navy satisfied with RDD-100 and modelling effort
 - High demand for qualified resources
 - Training need, and Champion user
- Cultural differences N and E

UniSA Model-Centric Acquisition Study

Research Questions

- Qn.1 - What MBSE practices are needed to integrate
 - Acquirer system [definition](#) models &
 - Supplier system [solution](#) models?
- Sub-questions
 - What are the challenges?
 - What practices are needed for tendering activities?
 - What practices are needed to manage
 - Requirements-driven change?
 - Implementation-driven change?

UniSA Model-Centric Acquisition Study

Research Questions

- Qn.2 - How can we use MBSE tools to support the design process (as opposed to design capture) in the supplier organisation?
- Interested in:
 - Design synthesis of multiple candidate solutions
 - Trade-off analysis
 - Performance estimation

UniSA Model-Centric Acquisition Study

Research Questions

- Qn.3 - How do we represent and manage the information that needs to traverse the contractual boundary?
 - Nature of the schema
 - Partitioning of models
 - Configuration management across the boundary

UniSA Model-Centric Acquisition Study

Overall Approach

- Investigation approach:
 - Learn-by-doing
 - Identify challenges to be addressed
 - Trial solutions using a case study
 - MBSE practices
 - Innovative tool use
 - Bounding the problem

UniSA Model-Centric Acquisition Study

The Learn-by-Doing\Scenario

- **Acquirer:**

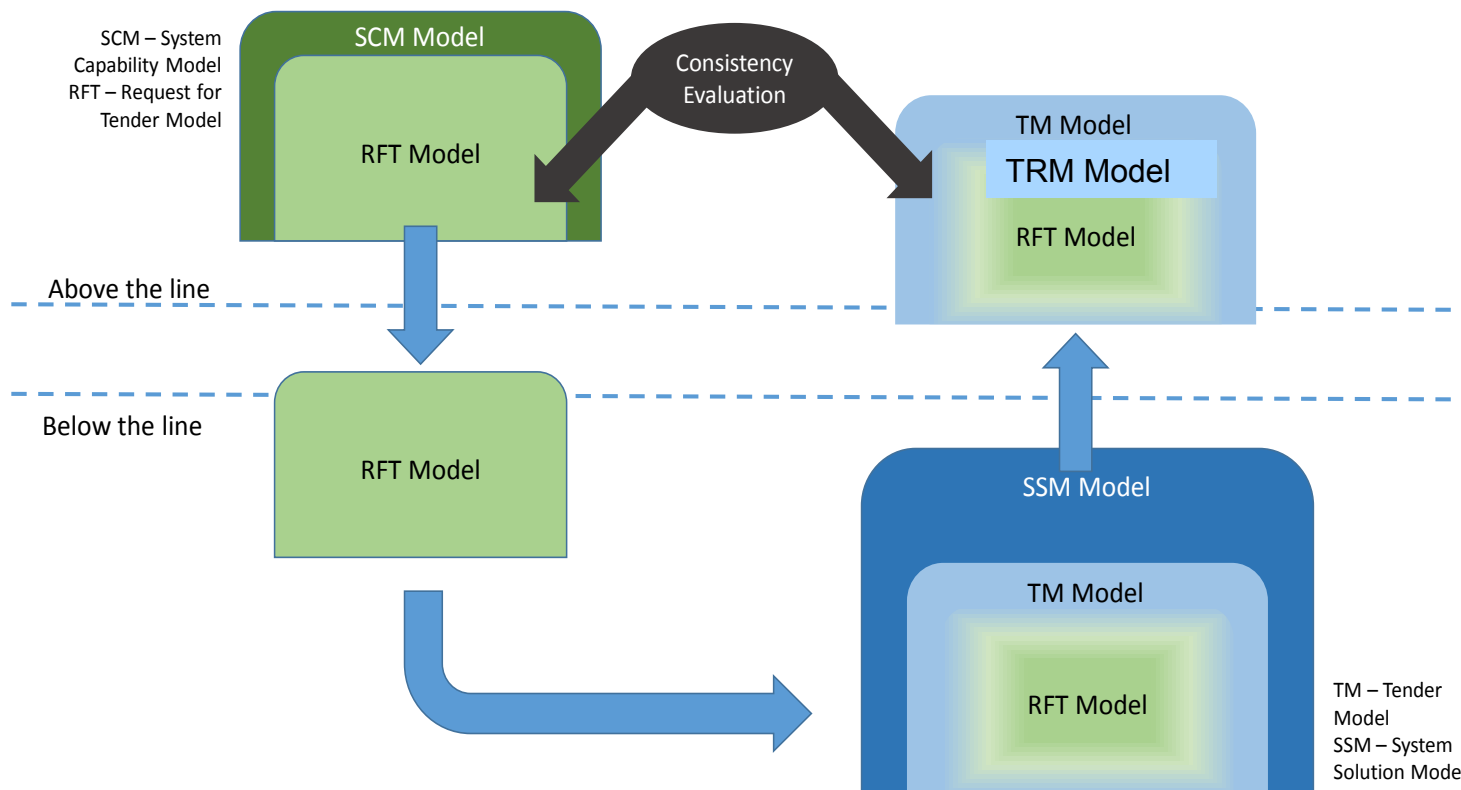
- Build on the DSTO pioneering Whole System Analytical Framework (WSAF) that utilises CORE® to capture complex system problem definition and the OCD and FPS.
- Load with an existing project definition model, and use this as the basis for a request for tender (with additional information as needed)
- Perform MB tender evaluation

- **DSIC/UniSA:** Design a tender response using traditional SE processes:

- Build technical response on RFT model
- Requirements analysis
- Functional analysis
- Synthesis
- Systems engineering analysis

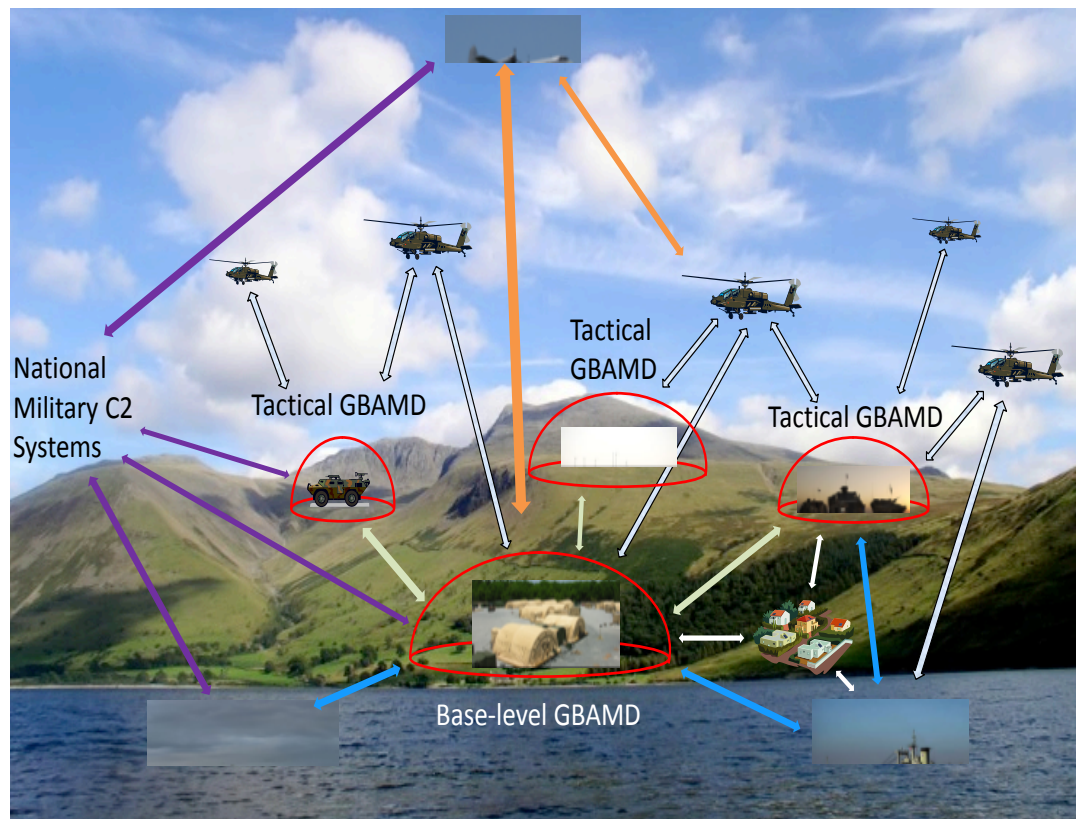
UniSA Model-Centric Acquisition Study

Model Exchange Framework



UniSA Model-Centric Acquisition Study

Case Study – Ground-Based Air Missile Defence (GBAMD) capability



UniSA Model-Centric Acquisition Study

Early Findings

- WSAF model captures the problem definition well
 - Produces a solid OCD and FPS
 - Easily modified to produce Requirements Baseline with addition of Supplier Requirements and tags for requirements traceability
 - Supports design tender response
- WSAF model was written for a purpose not entirely compatible with subsystem design and implementation
- The nature of the reference (knowledge) model starts to get complex when probity issues and contractual change are considered

Progress to Date

- Installed WSAF Schema and a project model on the DSIC research infrastructure that employs CORE[®] 9
- Examined the schema, project Sol content, and the documents derived from it (FPS, OCD)
- Examined the adequacy of the schema to support the RFT and tender response production by conducting supplier systems engineering activities:
 - Requirements analysis
 - Functional analysis
 - Synthesis
- Started implementing an approach to support tender response within CORE[®]

Discussion and Analysis of Outcomes

- Addressing the problem of sending models through the contractual boundary:
 - Form an alliance and have that alliance select the tools, methodology, and standards;
 - The alliance would then develop and maintain the system model.
- In Australia - the use of alliances is reserved for the few largest and most complex projects.
 - There is still a need to address the problem of how to pass models across the contractual interface in a way that does not stymie the competitive tendering process for smaller projects.
 - An approach to this problem is to implement a metamodel that meets the requirements listed earlier and use tools that can produce, edit and interrogate models that have been built on this metamodel.
- The tool interoperability between SysML tools (with UPDM profile) to permit models in various tools thus enabling a project to void locking in a tool vendor for the life of the capability.
- In the Australian defence sector, several tools are in use but Vitech's CORE® is the de facto standard for project conceptual definition work and has become the tool of choice for MBSE-based tendering research.

Summary

- ✓ MBSE has been applied across the contractual boundary for around twenty years in environments where mutual trust is well developed and mutual goals are well understood.
- ✓ These approaches have worked well both in Norway and Australia but challenges have surfaced such as the need to ensure that the tool environment has adequate longevity.
- ✓ A number of approaches that use a range of available tools, which continue evolve and mature.
- ✓ Some older tool paradigms continue to offer potential solutions particularly when they are well-entrenched within existing business processes and there exists a community of expertise.
- ✓ Our findings to date indicate that MBSE-based tendering is feasible and will become common practice as the issues identified in this paper are progressively addressed and the ROI becomes hard to ignore.