SysEng 6542
Model Based Systems Engineering

Defense and Industry Practices

Dr Quoc Do

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Review of MBSE Practice

Essential Components in MBSE Methodology:

- Languages
- Methods /Processes
- Tools

Leading MBSE Tools

- Enterprise Architect (Sparx Systems)
- Cameo Systems Modeller (No Magic)
- Rational Rhapsody Designer (IBM)
- Integrity Modeller (PTC)
- CORE and GENESYS (Vitech)
- etc.…

Cameo Integrity Modeller

https://www.nomagic.com/mbse/overview

CORE & GENESYS

CORE™

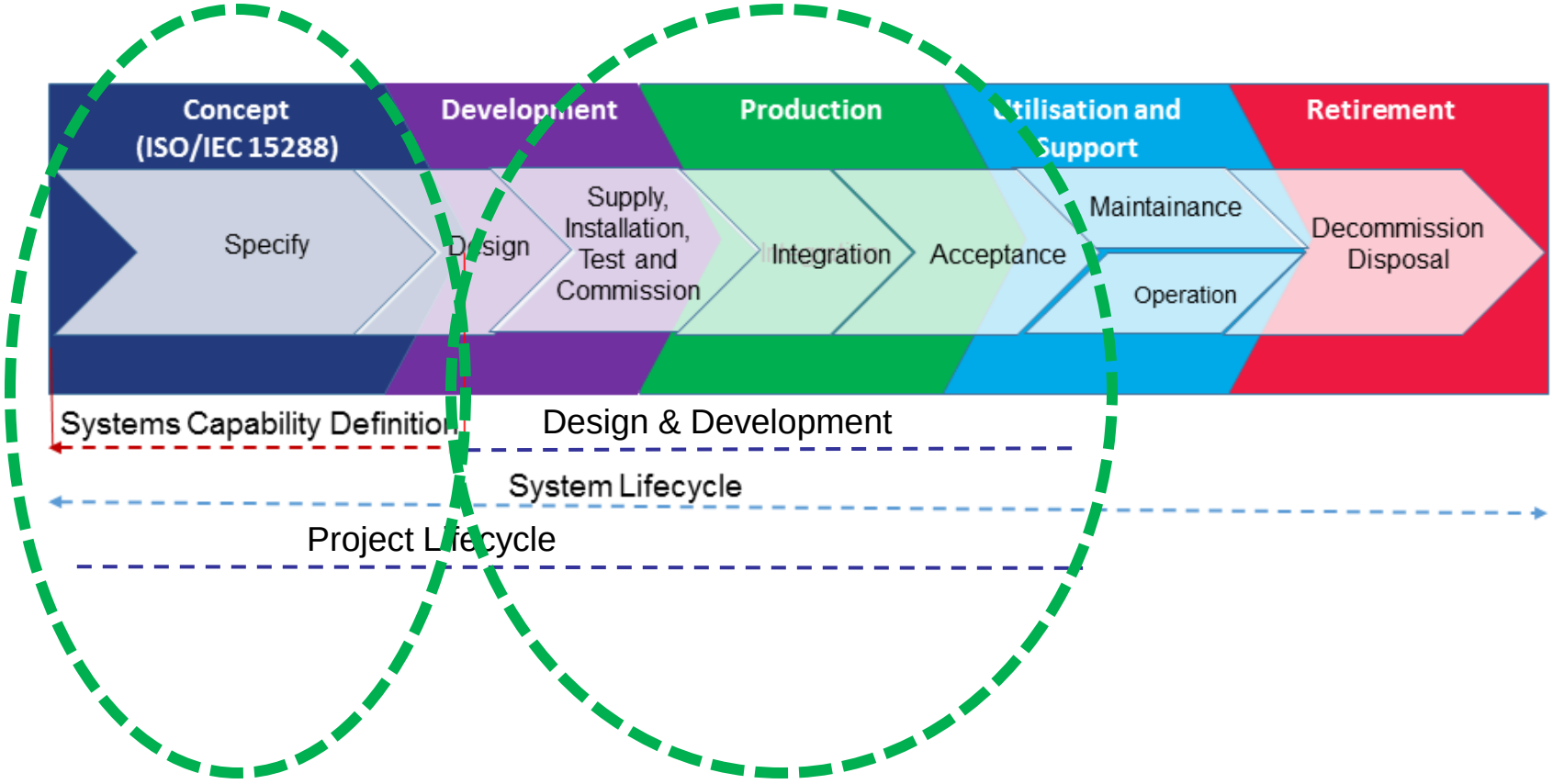
CORE™ provides engineers with a powerful solution for building highly complex system models with rich connectivity across domains. Supported by a robust simulation engine, CORE provides end-to-end coverage of the system development process from requirements to V&V.

GENESYS

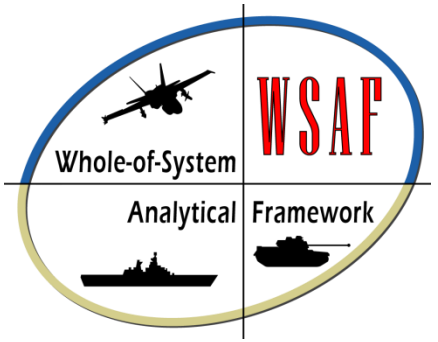
GENESYS is a scalable, enterprise-ready solution that meets the needs of teams of engineers seeking to collaborate across domains. Using an open architecture, GENESYS gives you the agility to bring together data to feed your system model from across the enterprise.

http://www.vitechcorp.com/products/index.shtml

Defence and Industry MBSE Applications



Capability Definition (Australian Perspective)

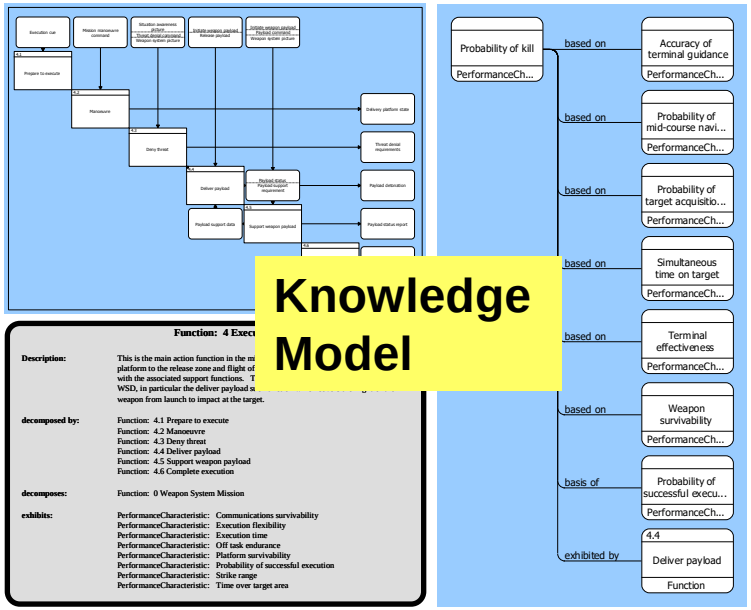


- Whole-of-System Analytical Framework
  - Implementation of Systems Engineering process and philosophy
  - Underpinned by enterprise/system architecting principles

- Knowledge Model (KM) of a system
  - Model of conceptual views and definitions
    - System behaviour, connectivity, structure, performance, etc.
- Underpinning reference model (aka meta-model)
  - Description of the properties of the KM
  - Frames, rules, constraints, etc required to develop the KM

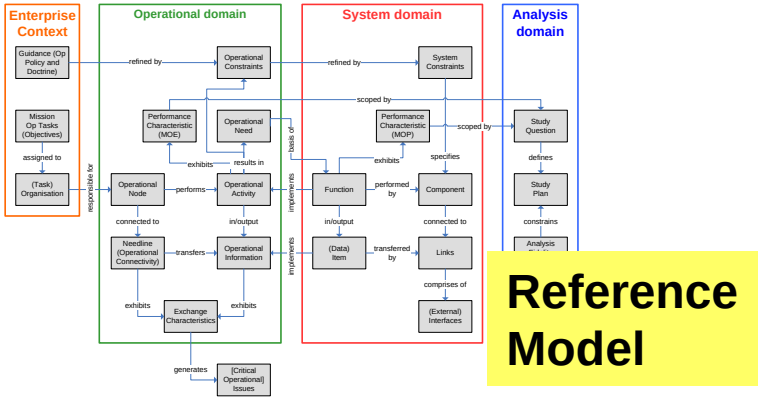
- Process model
  - Describes the method for employing the WSAF
- Portal and scripts
  - For access and export of appropriate KM datam

WSAF Components

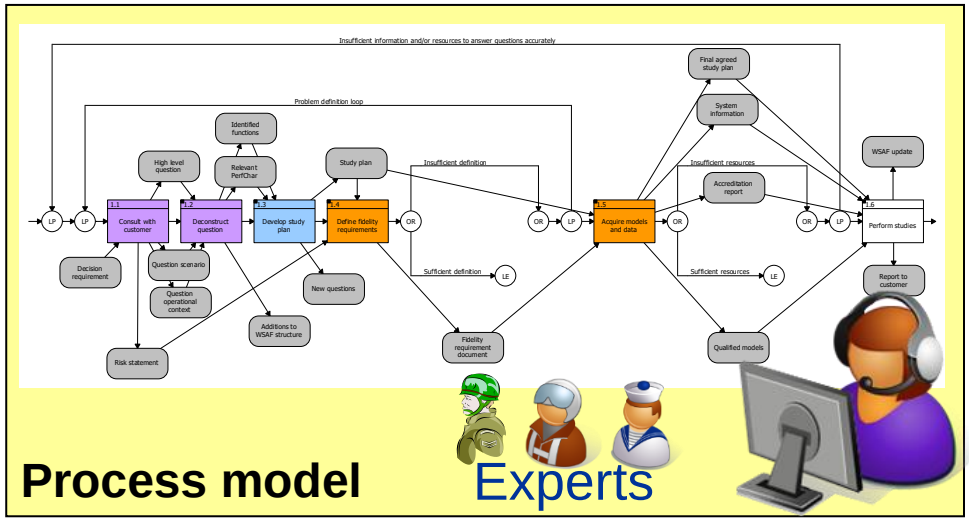


Knowledge Model

Portal and Scripts

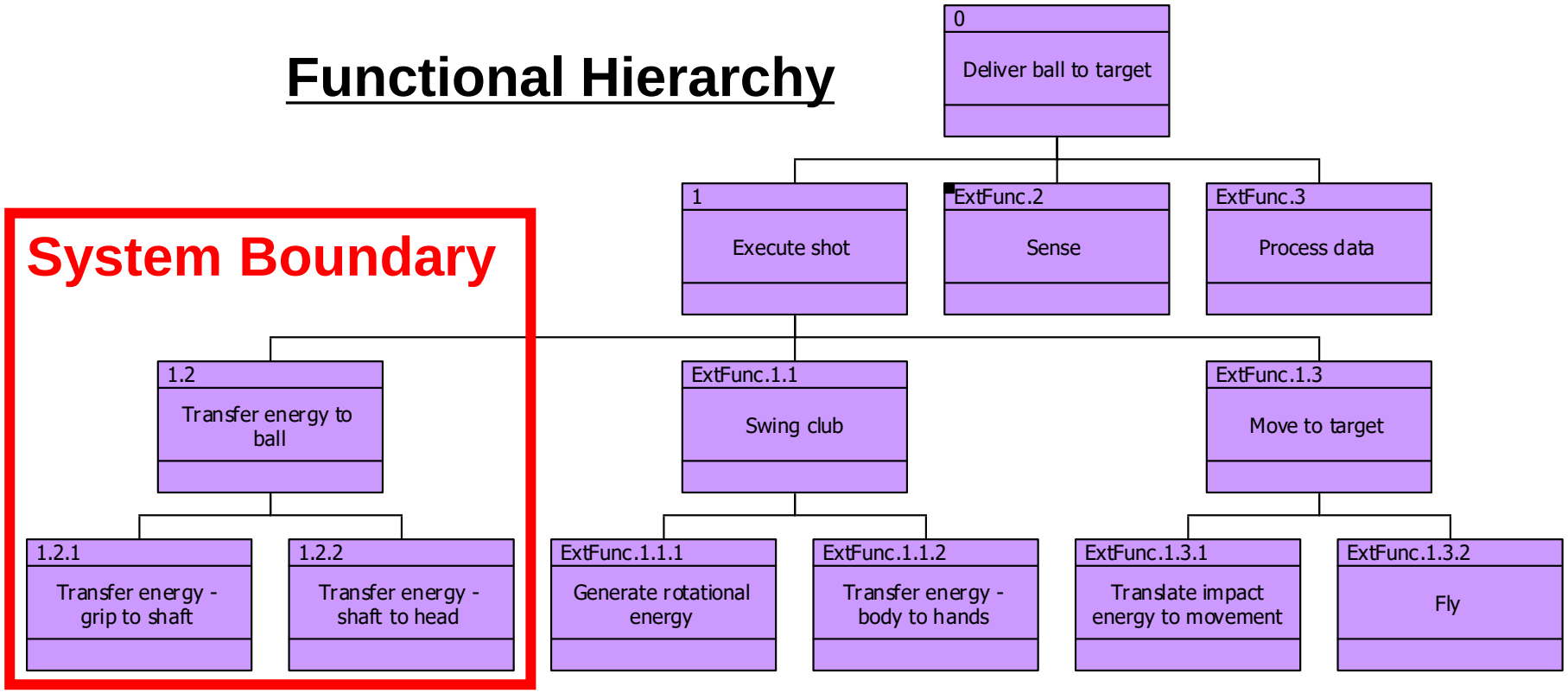


Reference Model



Knowledge Model (KM)

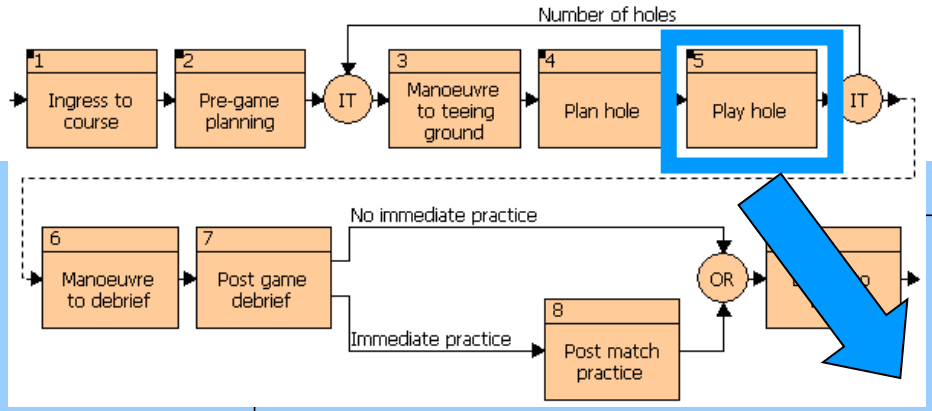
Functional Hierarchy

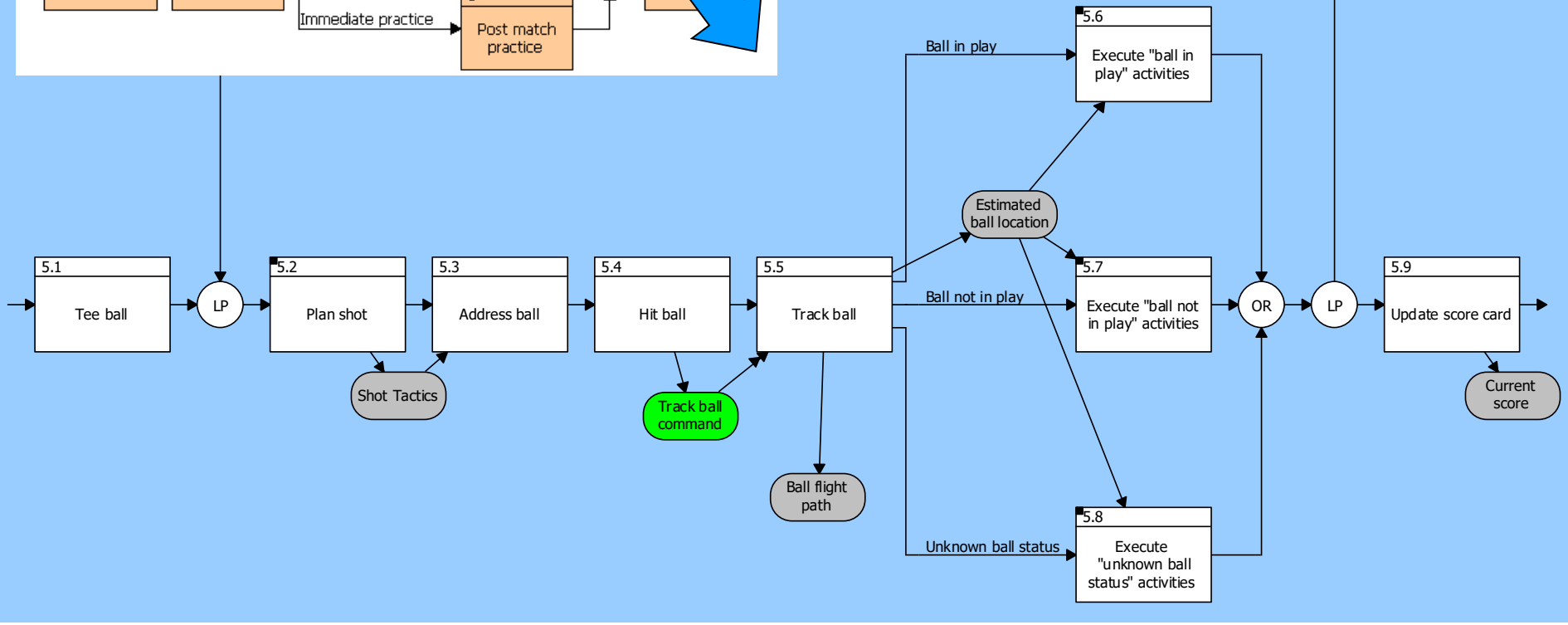


Architectural and textual definitions stored in a relational database.

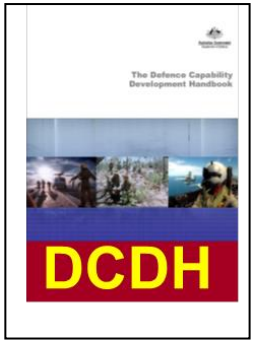
Entity – relationship (attribute)

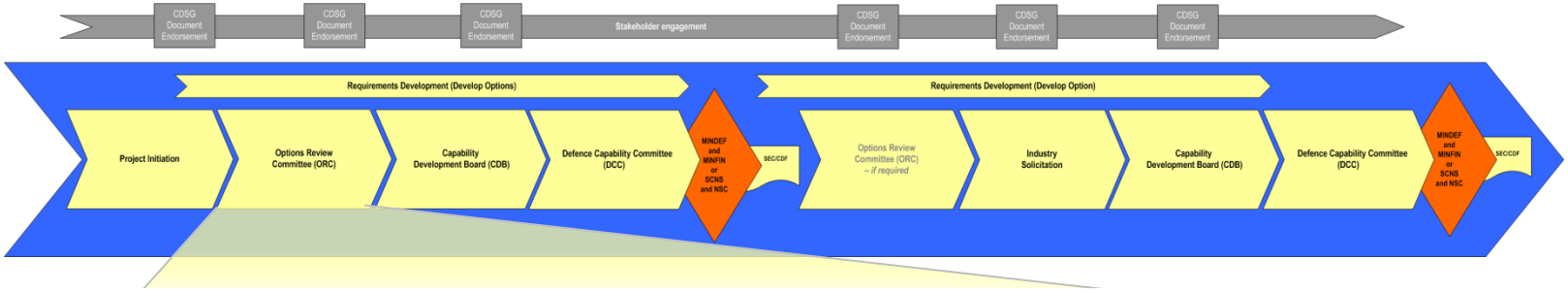
"Play Golf" operational architecture

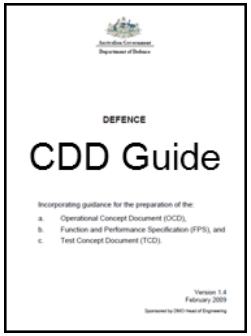


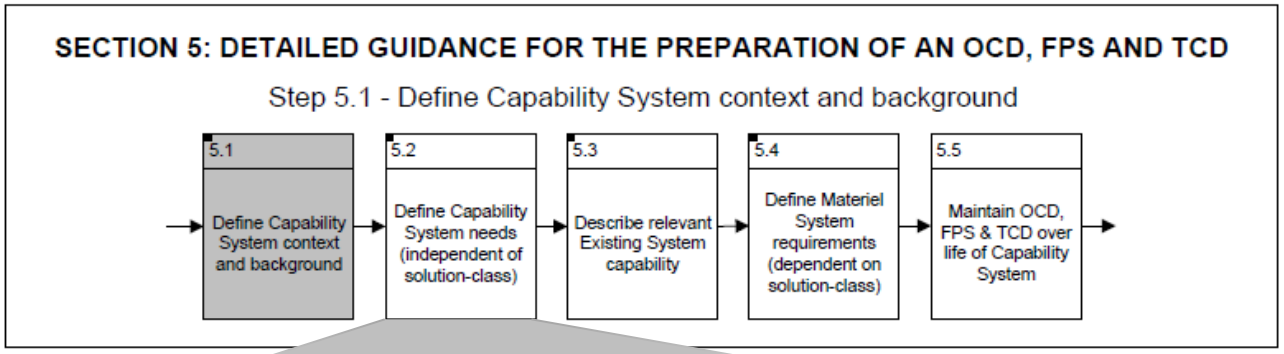


Process Model

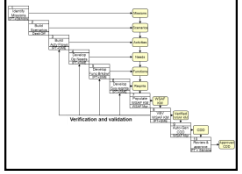








WSAF Process



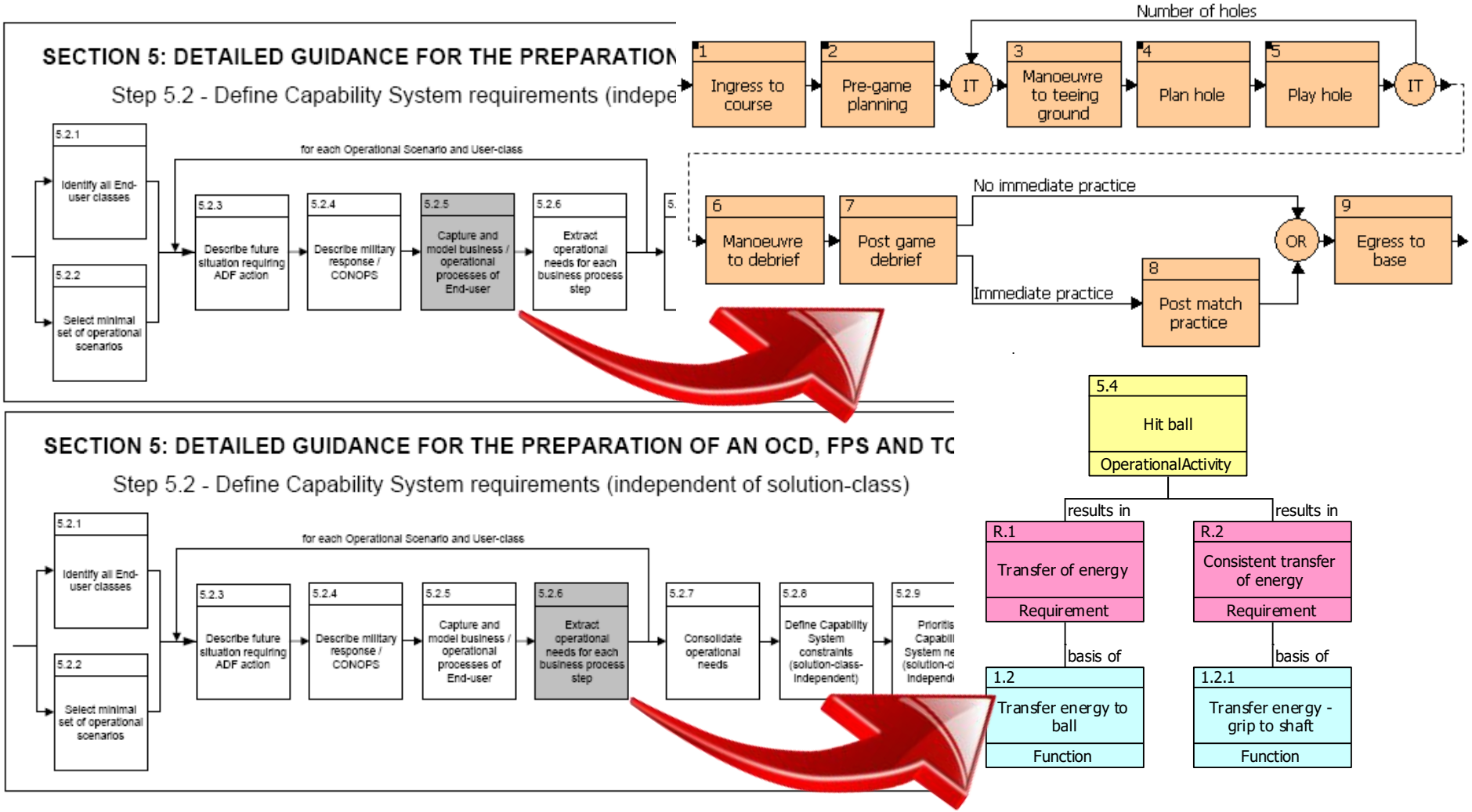
Mental design

Conceptual design

Formal design

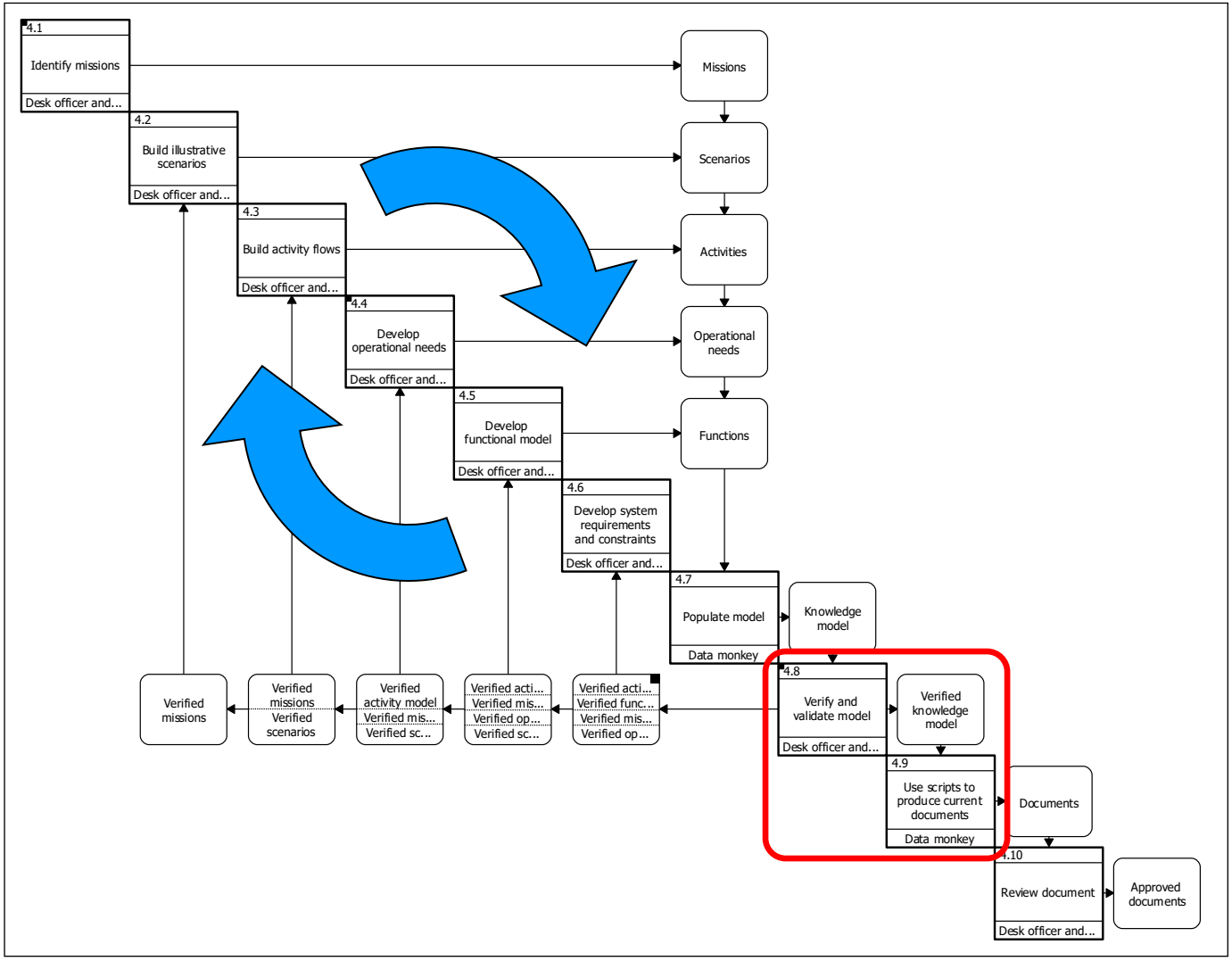
Scripting

Capability Definition Guide [11]



[11] DMO, Capability Definition Documents Guide, V1.4, February 2009

Process Model



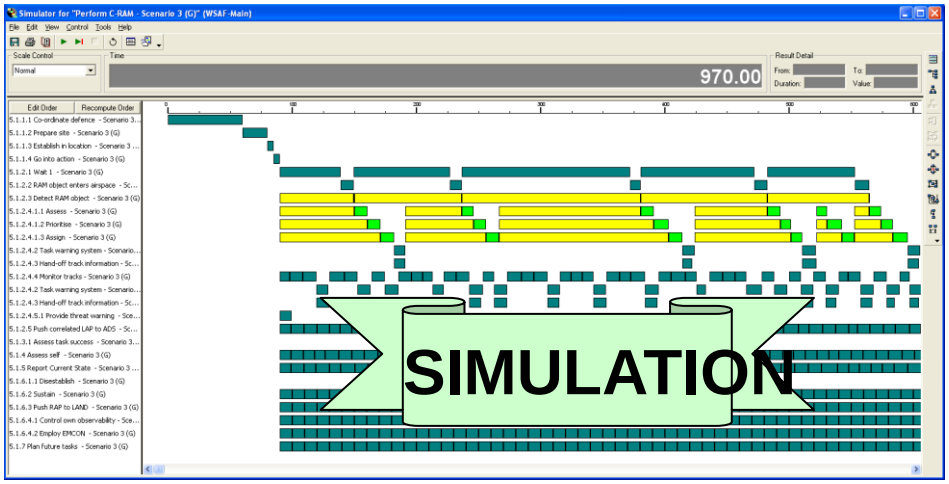
Enhancing KM credibility [11]

- Model credibility
  - Relevant and fit for purpose
    - Scope and accuracy from a stakeholders perspective
  - Model ➔ Requirements ➔ System
- Model verification and validation
  - Supports but cannot guarantee its credibility
  - Increases model correctness
  - Increases model credibility
- Accreditation
  - The official certification that the model is fit for purpose

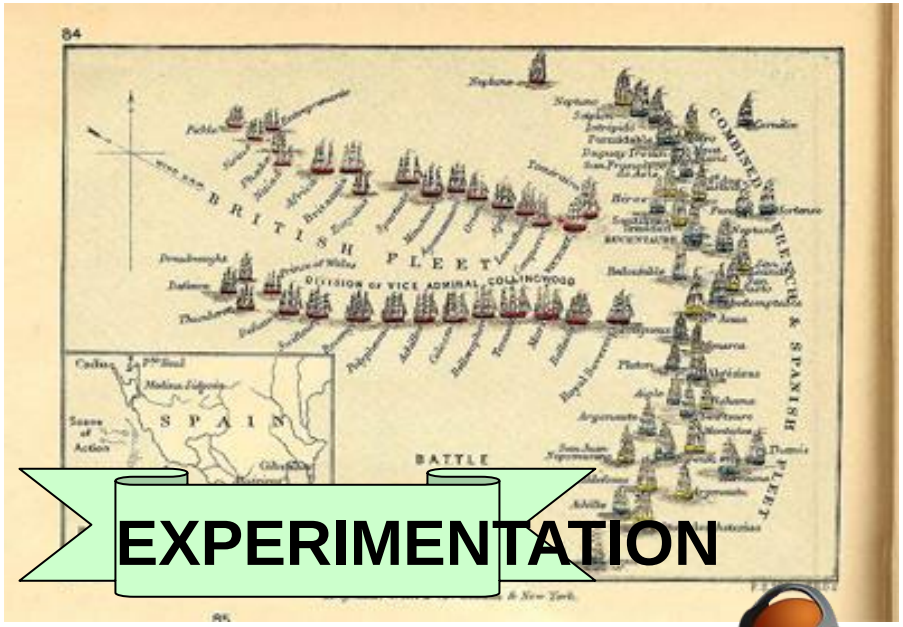
[11] US DOD M&S CO, Verification, validation and Accreditation Recommended Practices Guide, http://vva.msco.mil/, accessed December 2009

Model verification and validation

Model execution



War gaming

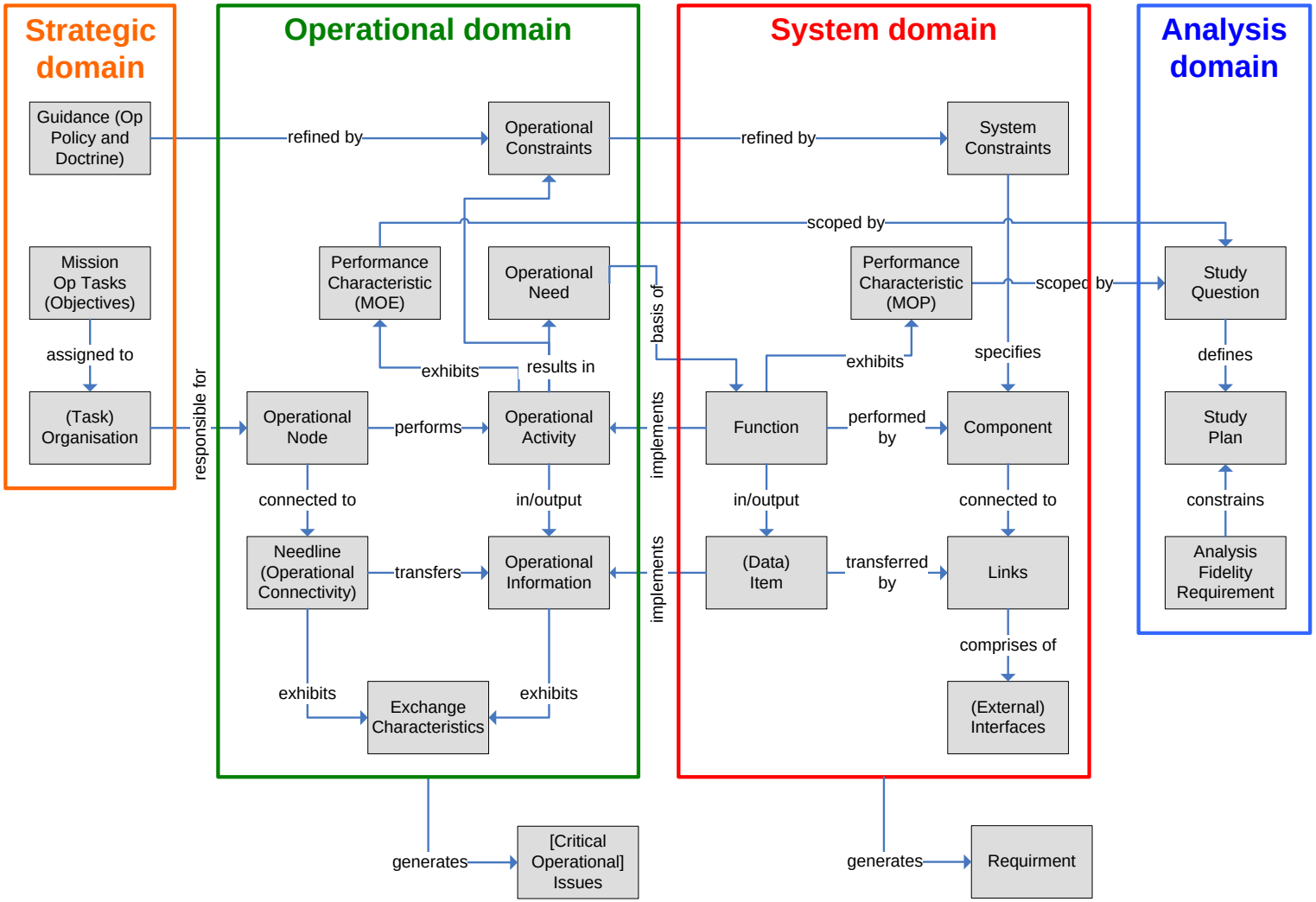


Enhancing knowledge credibility[12]

- Reference model [AKA - Reference architecture, meta-model, schema]
  - Provides a framework for credible knowledge generation
- Credible input from multiple stakeholders
  - common lexicon and taxonomy
  - common (architectural) vision
  - modularization and the complementary context
- Effective generation of knowledge
  - managing synergy
  - providing guidance, e.g., architecture principles, best practices
  - providing an architecture baseline and an architecture blueprint
  - capturing and sharing (architectural) patterns

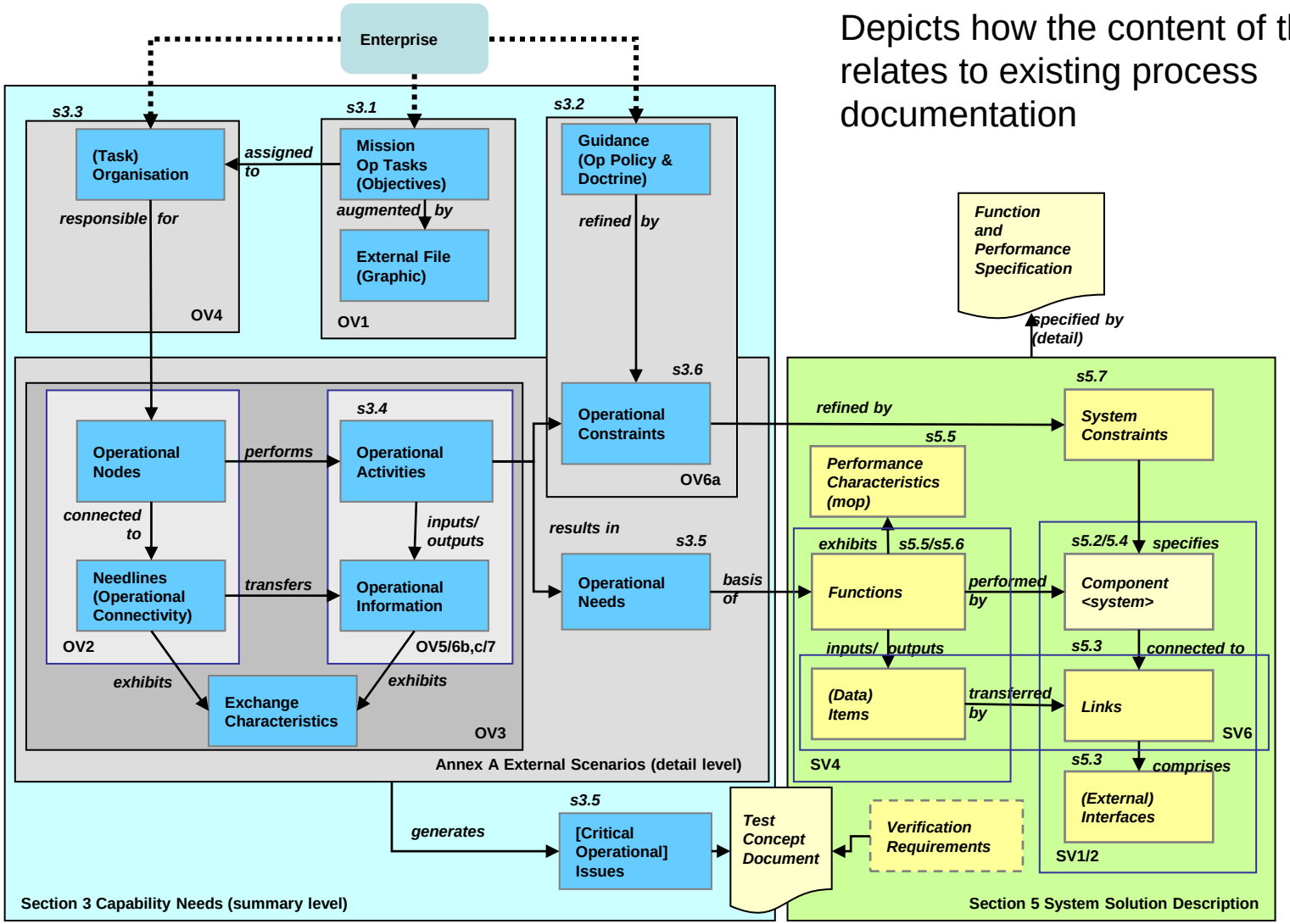
[12] R. Cloutier et al, The Concept of Reference Architectures, Systems Engineering Vol. 13, No. 1, 2010

Reference Model (RM) (Simplified)

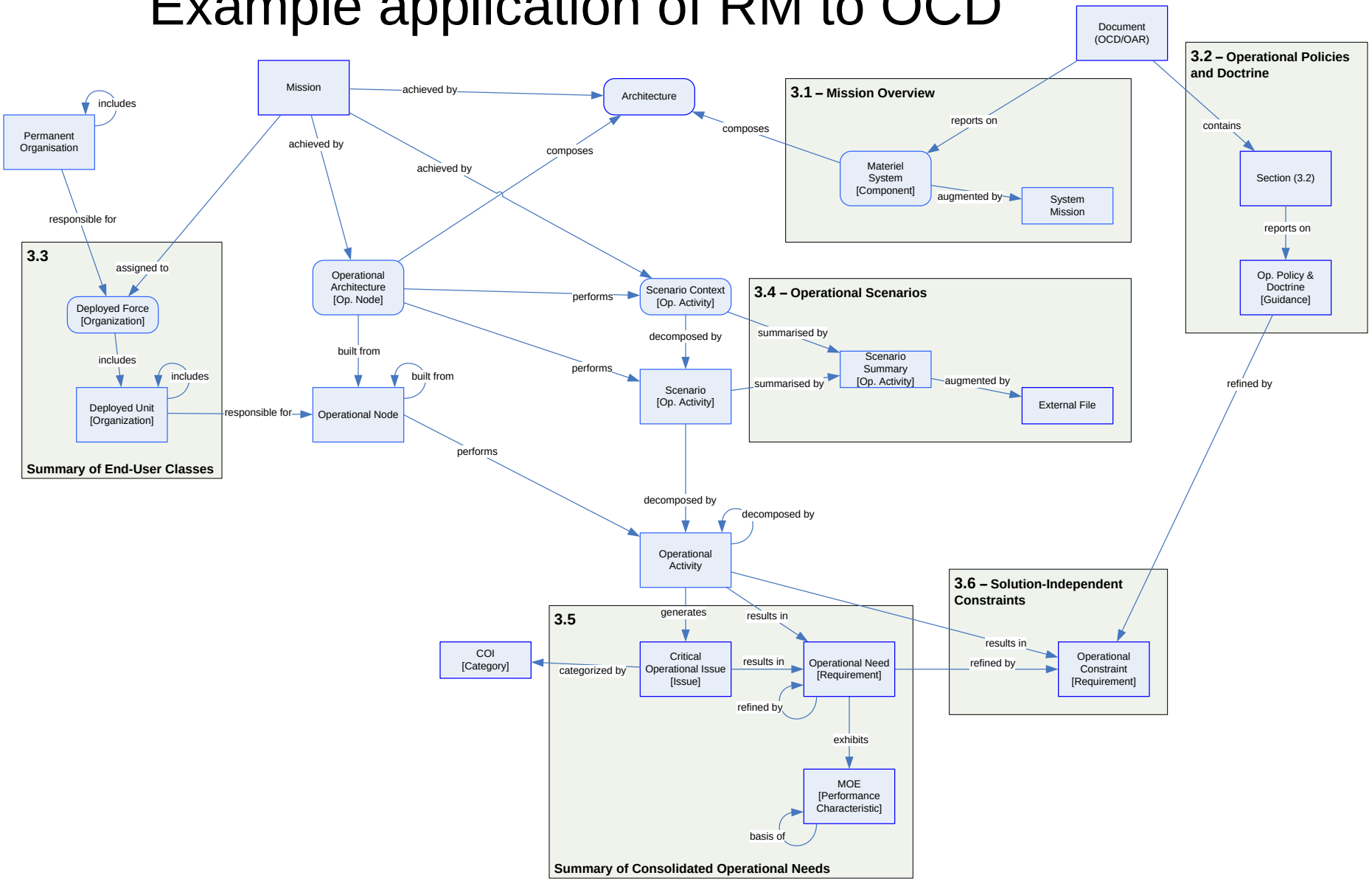


Mapping of RM to OCD, FPS and DAF

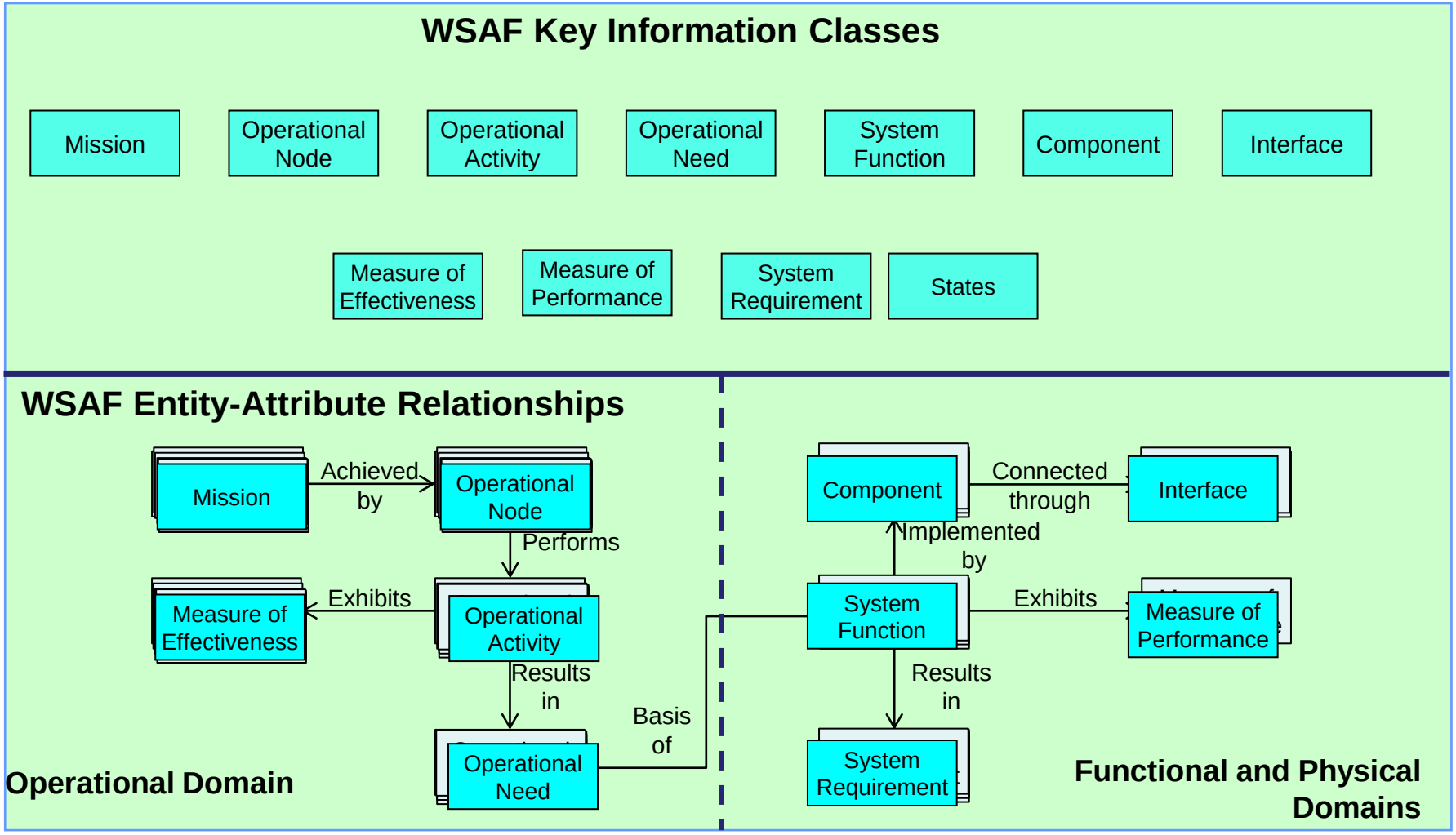
Depicts how the content of the KM relates to existing process documentation



Example application of RM to OCD

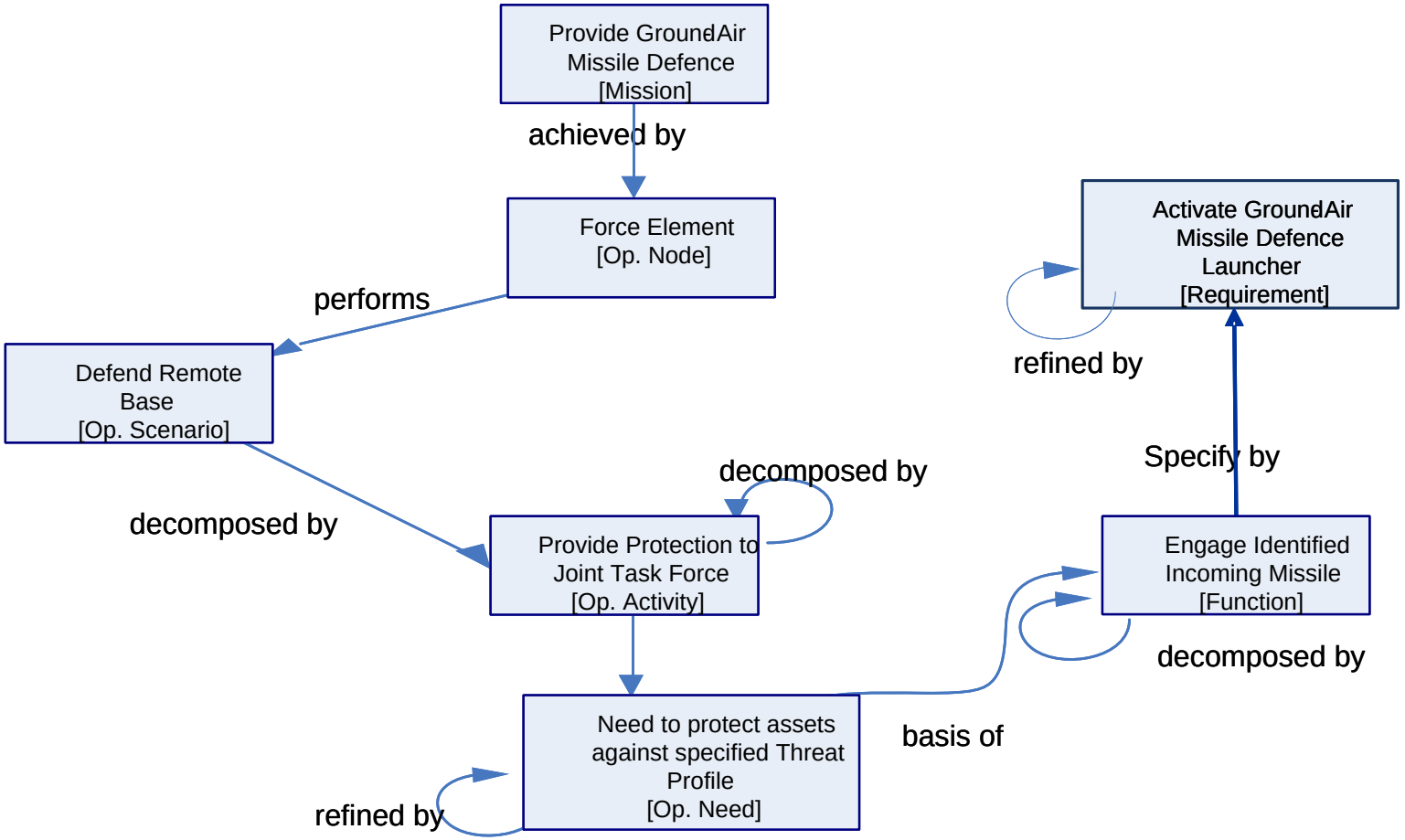


Application of RM to Capability Definition



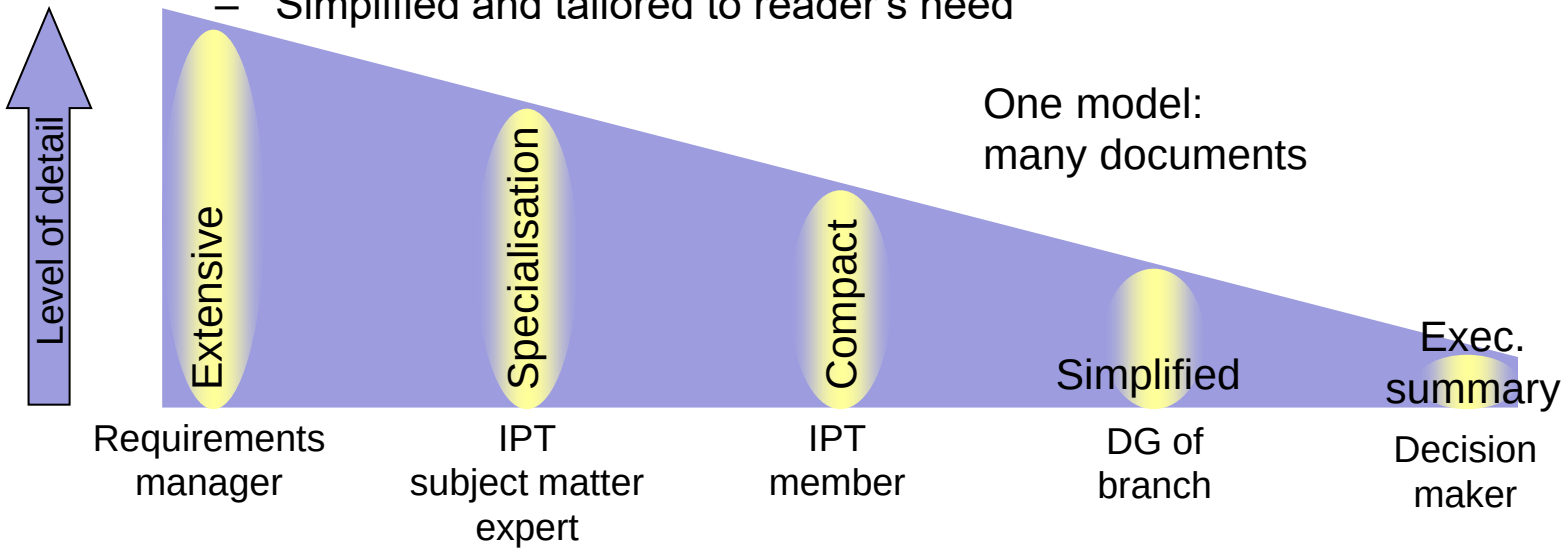
Application of RM to Capability Definition

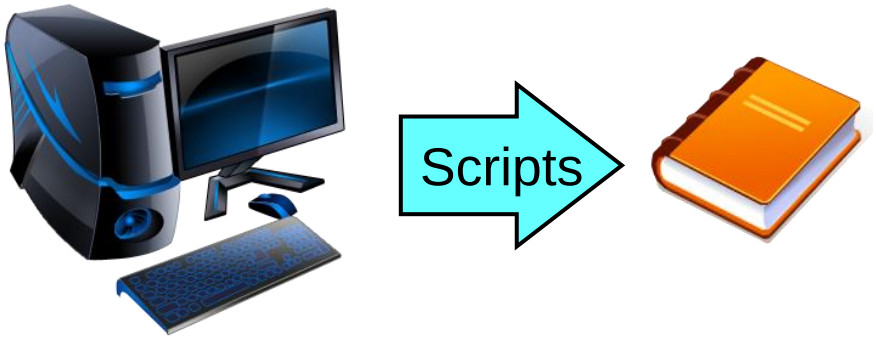
End-To-End Traceabilty Example: Ground-Air Defence Capability



Document generation – Scripts

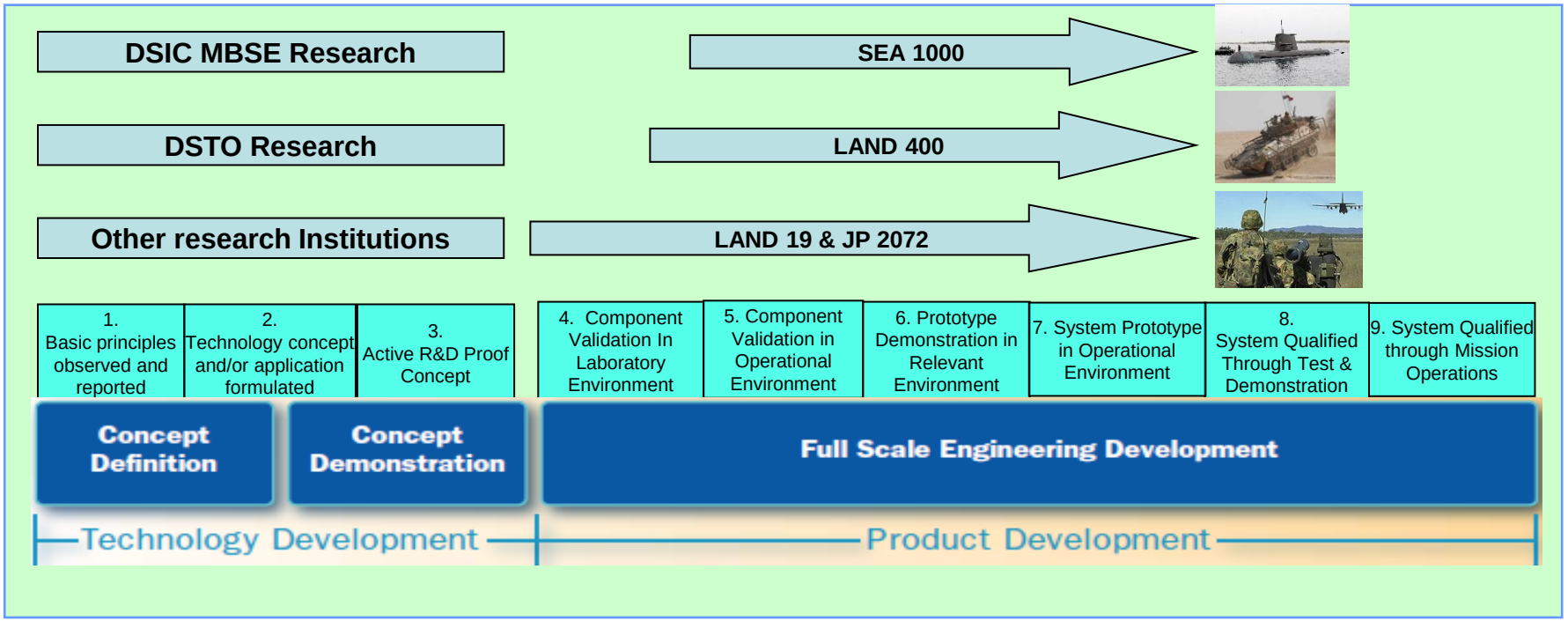
- Scripts query the model and auto-generate documents
  - Simplified and tailored to reader's need





MBSE - Defense Applications

- MBSE Technology Readiness Level (TRL)



Program Completed

Missouri University of Science & Technology