

Systems Engineering, Test and Evaluation Conference
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Leveraging lessons learned from cross-domain SE implementation for transportation applications

Transportation Panel Session

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A little about Shoal ...

- A systems engineering firm based in Australia and the United States
- We focus on early-stage design
- We help our clients –
 - Articulate strategic aims and business goals
 - Understand and document operational needs, constraints and priorities
 - Capture and translate the problem space into basis for generating alternative solutions
 - Validating proposed solutions address the problem / strategic & operational needs
- We apply systems modeling tools & techniques
 - Using well-known systems engineering techniques and concepts in a fully-traceable, iterative process

What various industry domains have in common
from an engineering perspective

COMPLEXITY AND CHANGE



Complexity in relationships are often hidden.
Inconsistencies result in problems.

Change

Common to all

- Pervasiveness of software-intensive systems
- Faster technology refresh cycles
- Population growth

Common to some

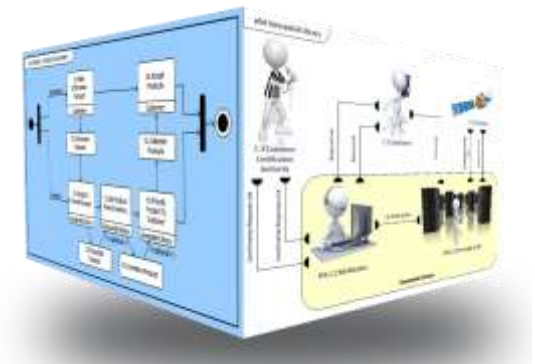
- Population shift back into cities
- Decay of infrastructure in many Western countries
- Move back to public infrastructure

What lessons are applicable? No surprises, really ...

LESSONS (BEING) LEARNED

Primary lessons from our work

1. Identify the system boundary at the highest *useful* level
2. Apply lifecycle concepts at the highest *useful* level
3. Use systems modelling to help understand complexity and communicate issues



Universal design questions

- **Why** does it do it?
 - goal and objectives => mission
- **Who** uses it? Who is impacted by it?
 - organization elements and relationships
- **Where** is it used?
 - locations, logical and / or physical
- **When** is it used?
 - time, sequence, major events, cycles
- **How** is it used?
 - processes and procedures, behavior
- What is in it & what does it do?
- How is this achieved?

Problem Definition

Operational
Analysis

*“Black Box” context
analysis*

Solution Concept

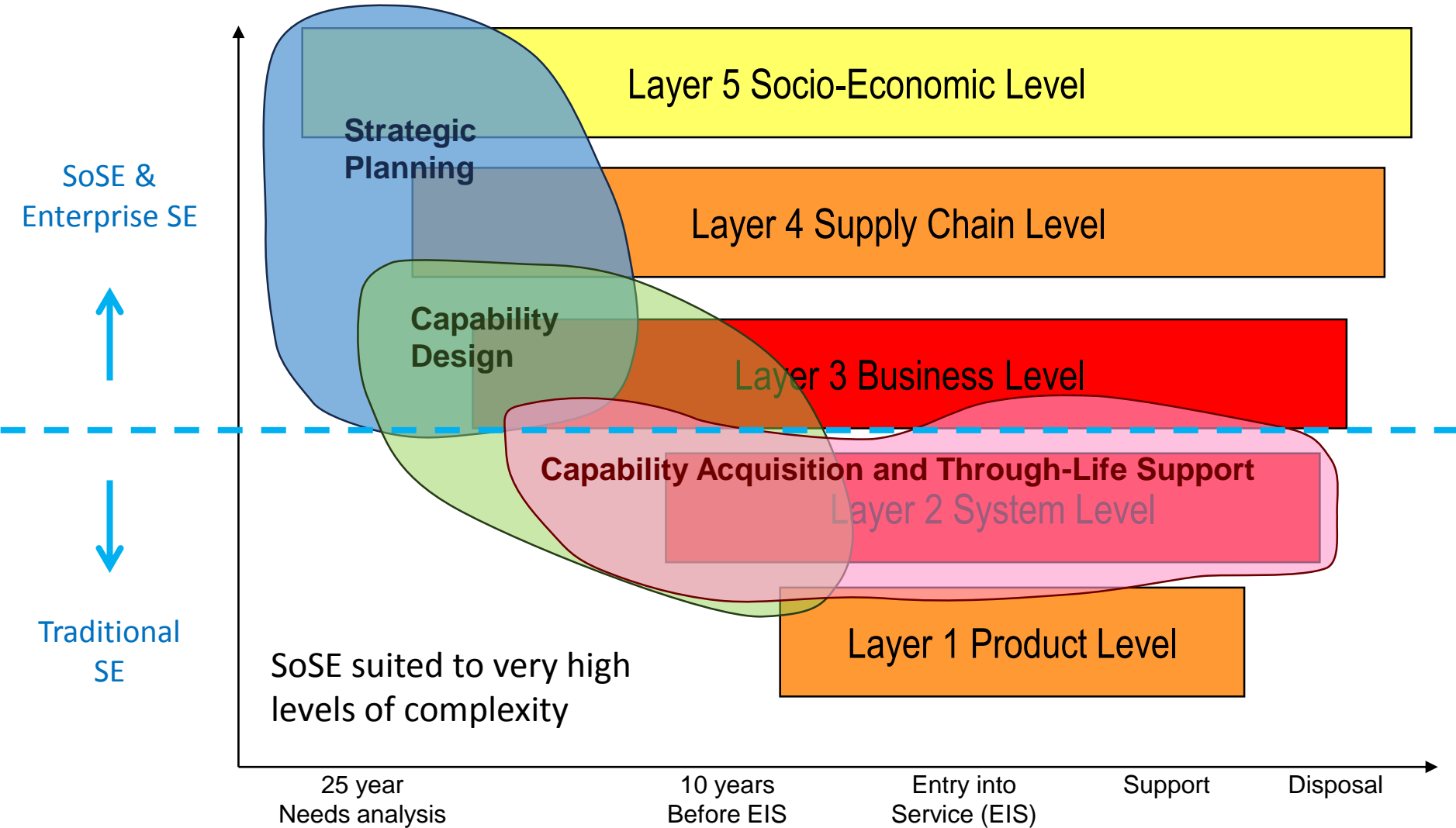
Solution Design

Where is the (useful) system boundary ... or boundaries?

1. THINK HOLISTICALLY

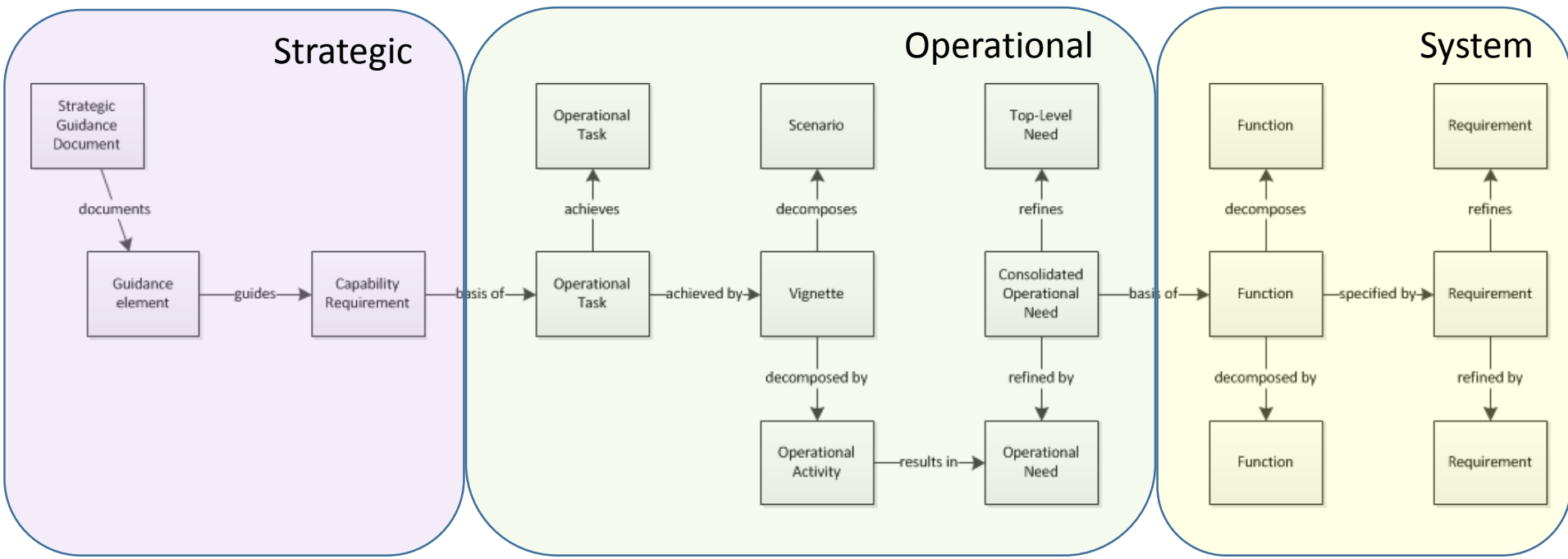
Hitchins' five-layer model

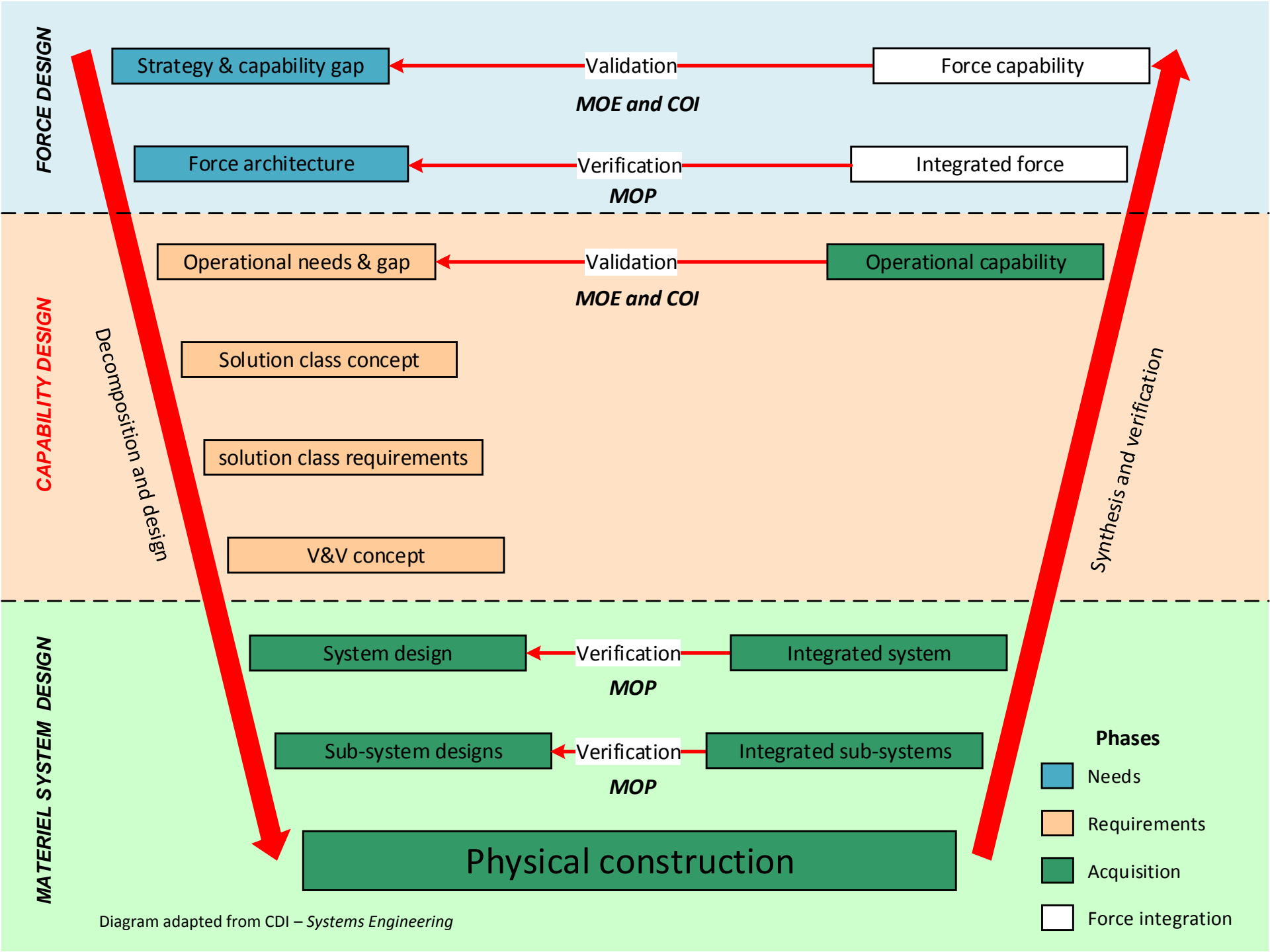
(Cook, 2003; incorporating Hitchins, 2007)



From strategy to system

Take 'corporate' guidance (Defence White Paper, Govt direction on shipbuilding, etc.) and translate to concept then to acquisition specifications





Applied to Navy surface fleet

High Level/Strategic Guidance (DWP, DPG, FMOC, IOCD etc.)

Evolving Strategic Needs/Capability Gaps/Deficiencies

Surface Combatant Force 2025-30
Operational Concept Document (OCD)

*Evolving Surface Combatant Force
Needs/Capability Gaps/Deficiencies*

*Joint Force Integration/
Interoperability Needs*

*Joint Force Integration/
Interoperability
Requirements*

ANZAC Class FFH
FPS

Hobart Class DDG
FPS

Future Frigate
FPS

CIWS FPS

SM-2/ESSM FPS

MH-60R FPS

Related 'Internal' Projects/Systems

DNPS Framework Surface Combatant FPS

AOR

OCD

FPS

OCV

OCD

FPS

LHD

OCD

FPS

MPA

OCD

FPS

Related 'External'
Projects/Systems



Very Fast Train

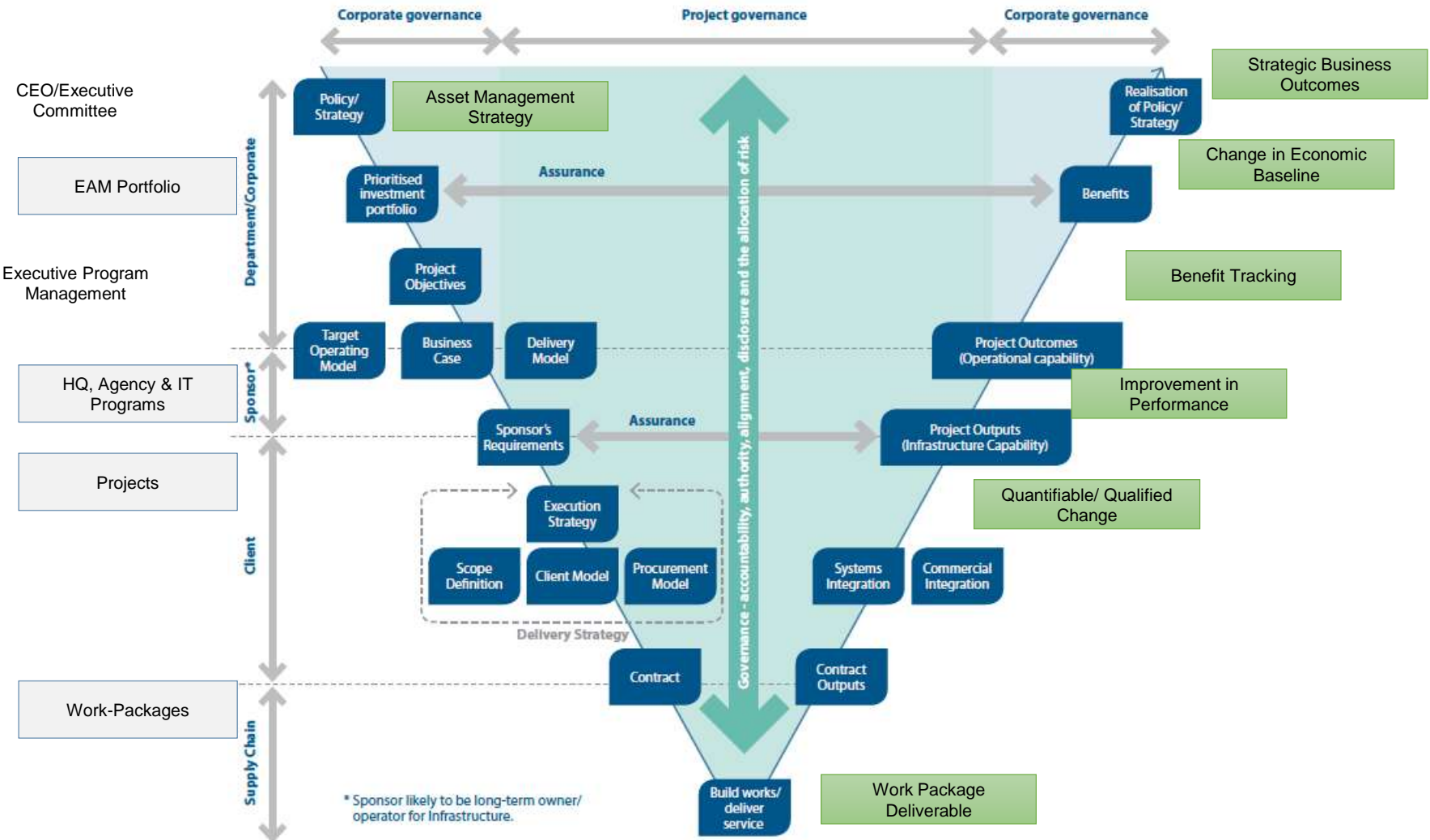
How would our lifestyles, population distribution, energy use and economy evolve if we had a fast rail link on the eastern seaboard?

Where is the *useful* system boundary?

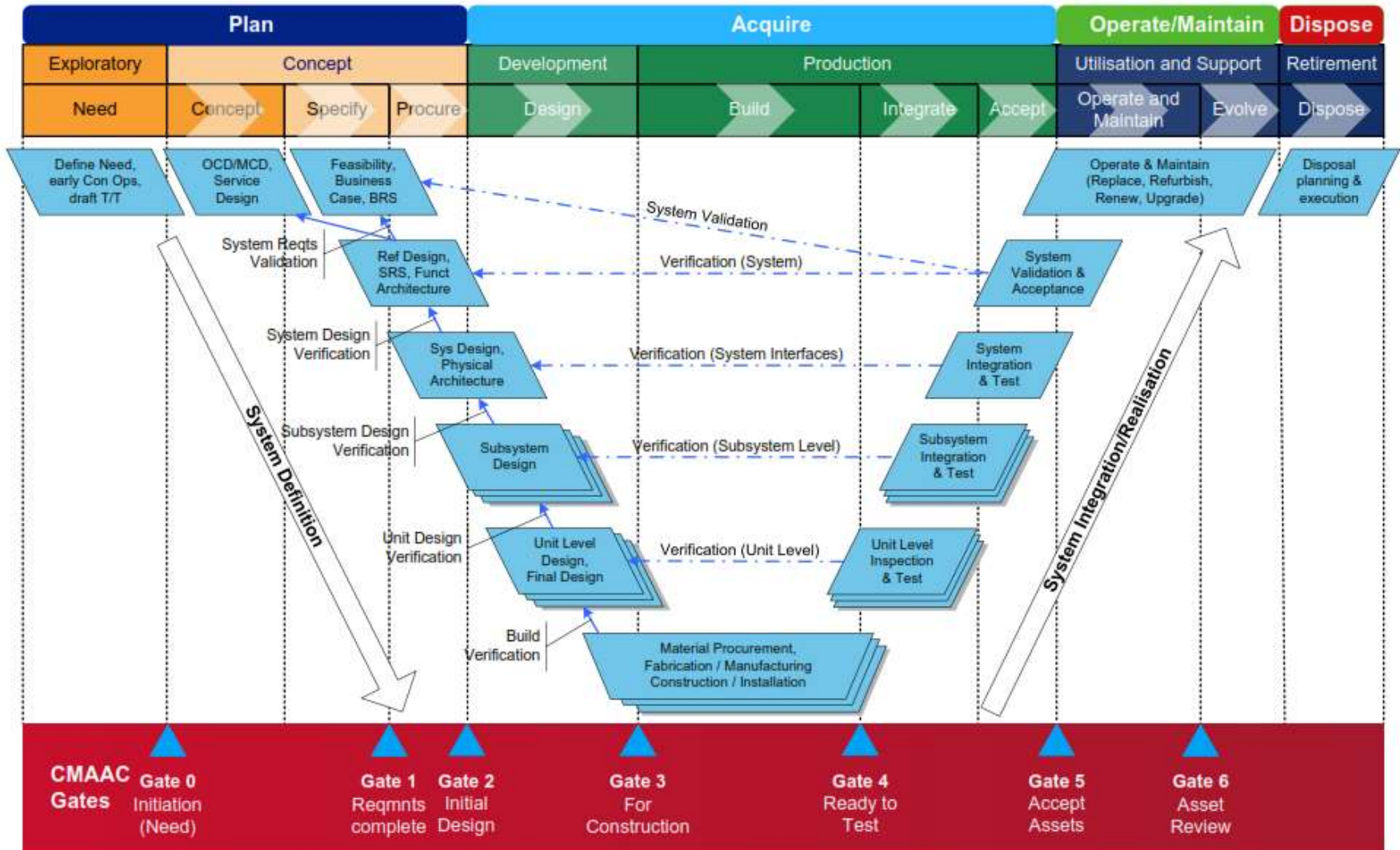
The role of Systems Engineering in
Enterprise Asset Management

2. APPLY LIFECYCLE CONCEPTS

New York MTA's EAM Program follows SE governance approach for complex programs

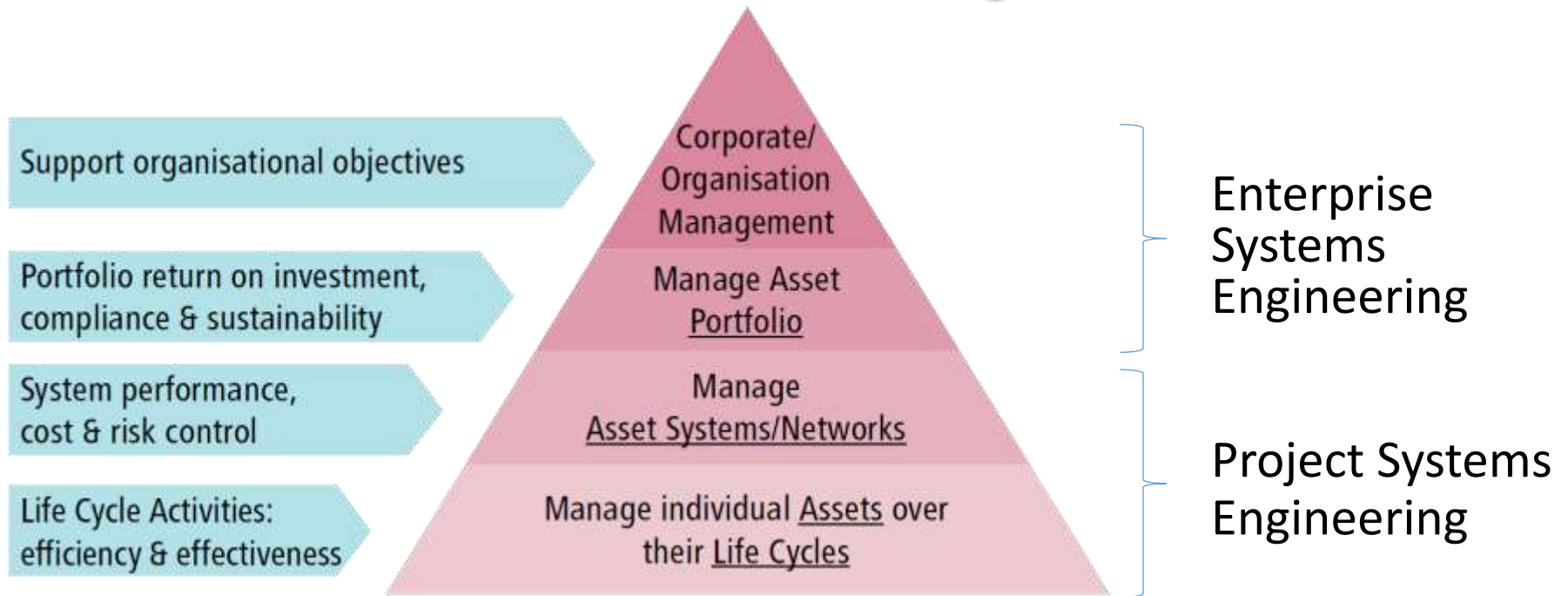


TfNSW's systems lifecycle approach



Adapted from Transport for NSW AM Framework Overview V1.0

Where can systems approaches be applied in an Asset Management context?



➤ **At all levels, especially at early stages of the lifecycle**

Use systems modelling to help understand complexity and communicate issues

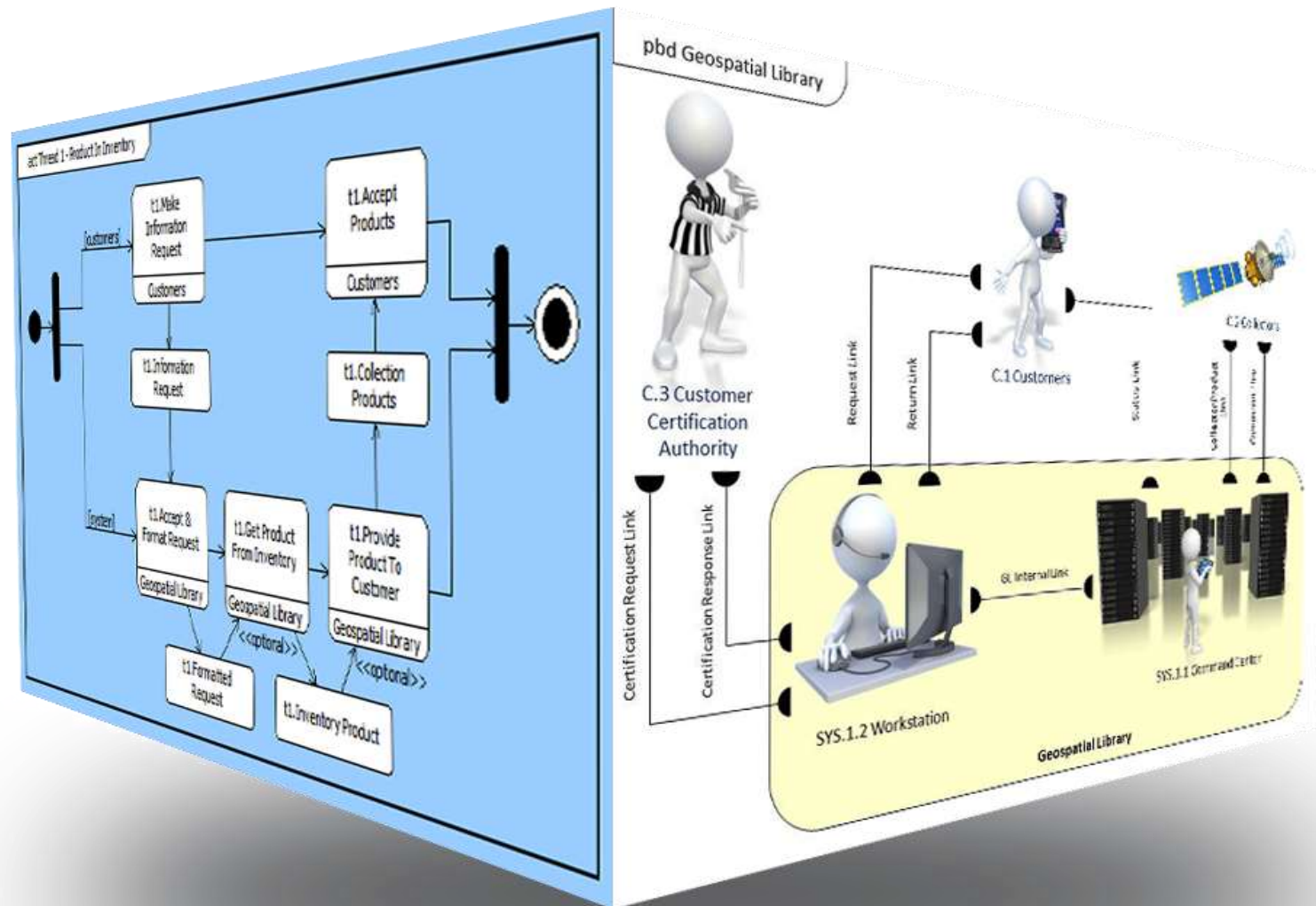
3. SYSTEMS MODELLING

Systems modeling enables understanding

- Provide data organization and structure
- Depict relationships
- Highlight and prioritize key data
- Various views provide perspective, synthesis
- Generates collective meaning



One model – many views



Benefits of systems modelling

- Coherency and consistency
 - Inter-relations inherent
 - Completeness and consistency
- Traceability & defensibility
 - Where did this come from?
 - What does it impact?



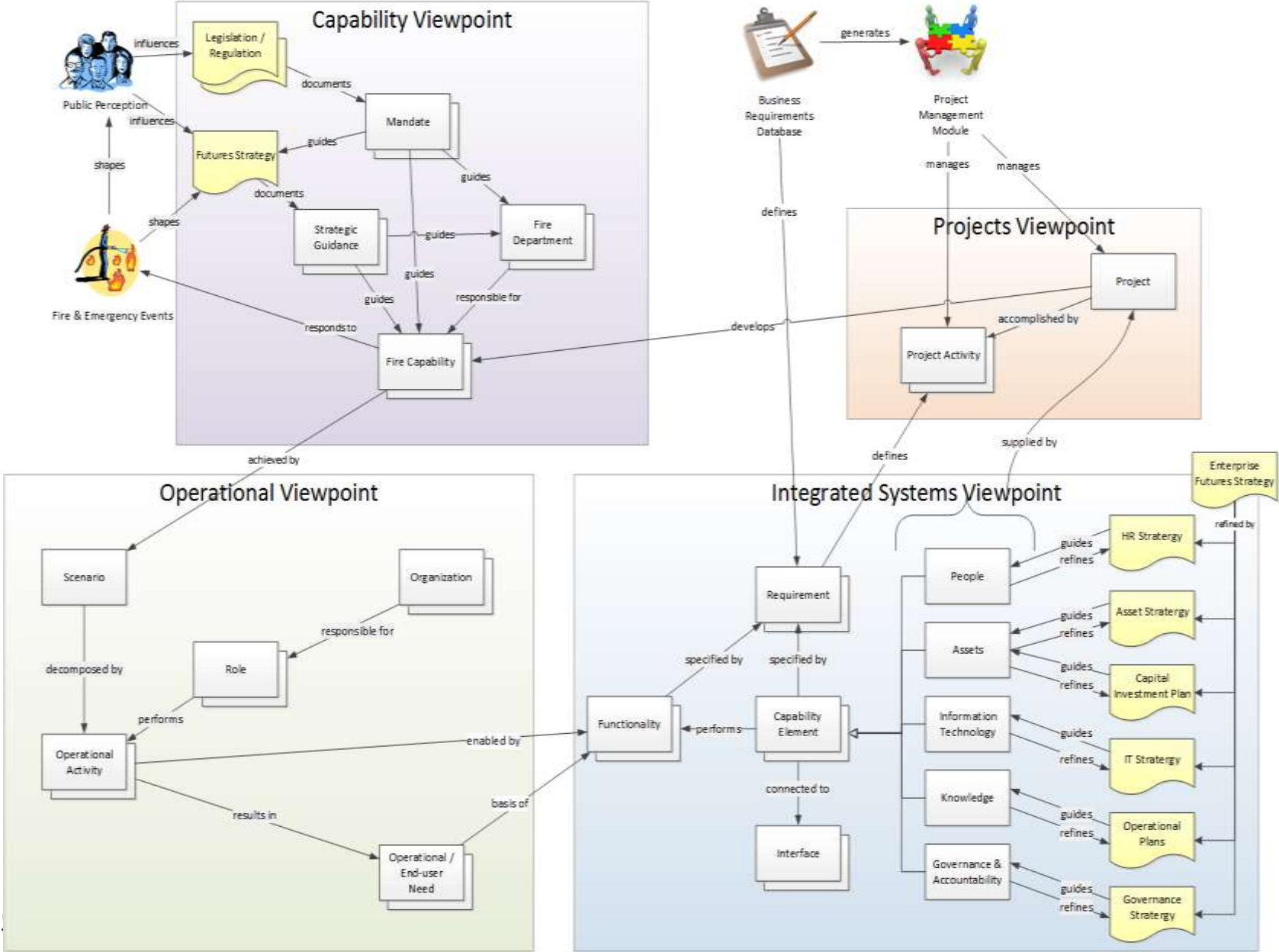
Benefits of systems modelling

- Adaptability and sharing
 - Common understanding
 - Customize views as necessary



- Model re-use
 - Reduce early-stage cost & schedule
 - Understand changing context
 - Recognise similarities and differences across enterprise

Example agency Capability Design model. Links agency strategy, operations, and integrated agency systems to the delivery of enhanced capability via capital projects



Discussion



The End

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