



**Australian Government**  
**Department of Defence**  
Defence Science and  
Technology Organisation

# An Australian Approach to Assessing Force-Level NCW Readiness



---

**Mark Unewisse (DSTO), Shaun Wilson (Aerospace Concepts),  
Ant Perry (DSTO) & Cameron Boyd (Aerospace Concepts)**  
*Presented by Anne-Marie Grisogono on behalf of the authors*

**Command & Control Research & Technology Symposium  
June 2006, San Diego, CA, United States of America**

**A E R O S P A C E**  
**C O N C E P T S**



# Presentation Overview

---

- **Net-centric force design challenge**
- **NCW Prioritisation & Integration (NPI) methodology**
- **Applying NPI**
- **The way ahead**
- **Conclusions**



**Australian Government**  
**Department of Defence**  
Defence Science and  
Technology Organisation

# The Net-Centric Force Design Challenge

---

**Migrating to a net-centric force in an orderly manner**



**A E R O S P A C E**  
**C O N C E P T S**



# Migrating to a Net-centric Force in Australia

- Australian Defence Force 10 year plan for capability enhancement
- *Defence NCW Roadmap 2005*: key NCW milestones to 2015
- Army: *Networking the Land Battlespace* (NLB) initiative
  - and Land NCW Campaign to deliver NLB

... but

- What does NCW-capable mean?
- how should migration be managed?
- what is whole-of-force design concept?

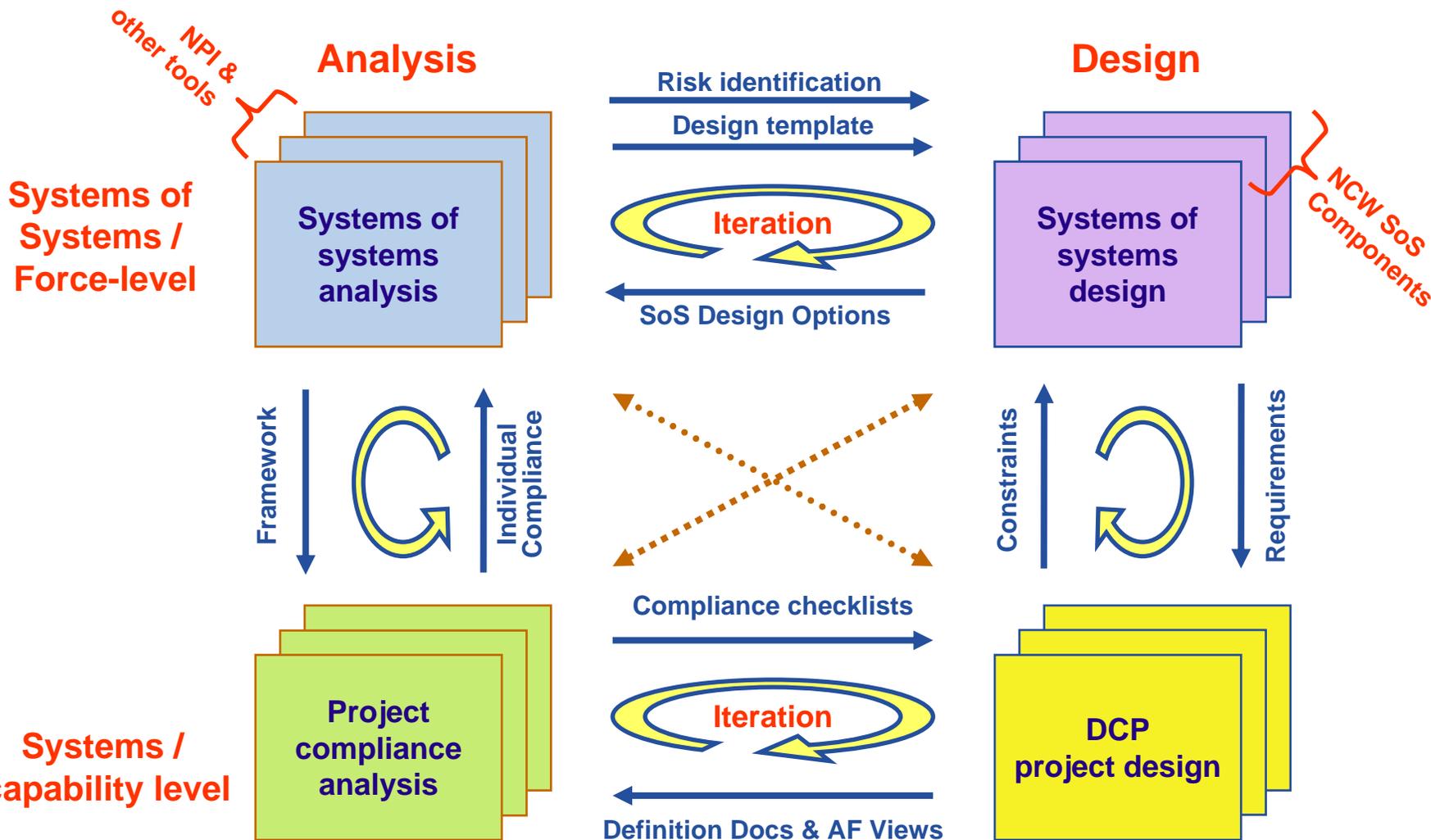
**\$50B - includes**

- New Air Combat Cap
- Air Warfare Destroyers
- Hardened Networked Army





# Force-level Design Framework Vision





**Australian Government**  
**Department of Defence**  
Defence Science and  
Technology Organisation

# NPI Methodology

---

Assessing the (potential) net-centricity of capabilities that  
will be part of the future net-centric force

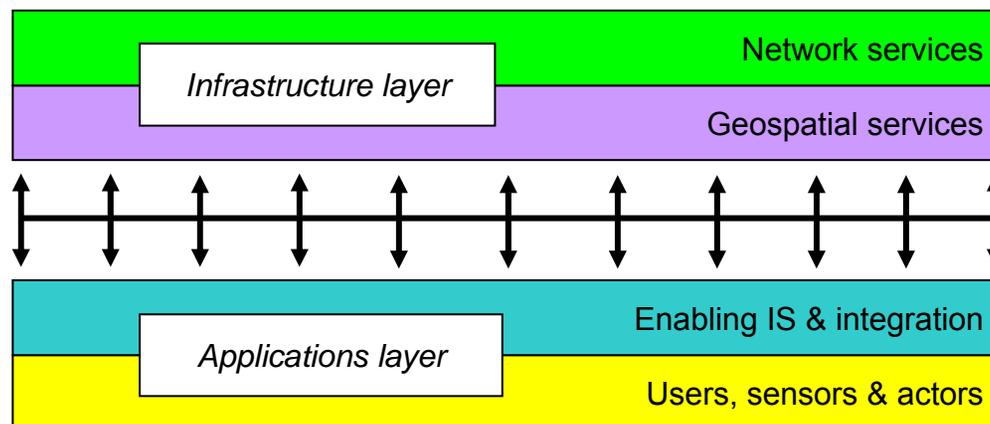
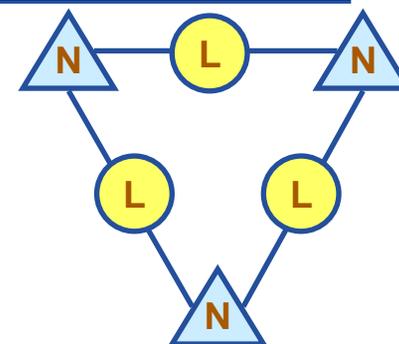


**A E R O S P A C E**  
**C O N C E P T S**



# Methodology Basis

- Modelled as a nodes-and-links network
  - Nodes are capabilities, often physical platforms
  - Links are information interactions between
- Capabilities part of a multilayered information environment
- Infrastructure layer
  - Applications layer





# Methodology Elements

---

## 1. Capability cross-impact analysis

- For prioritisation of analytical effort

## 2. Capability qualification analysis

- NCW 'fitness' of projects and capabilities in isolation

## 3. Capability-in-context analysis

- Support for project-level capability missions and tasks

## 4. Organisational analysis

- Support for organisational missions and tasks

## 5. Holistic risk & vulnerability analysis

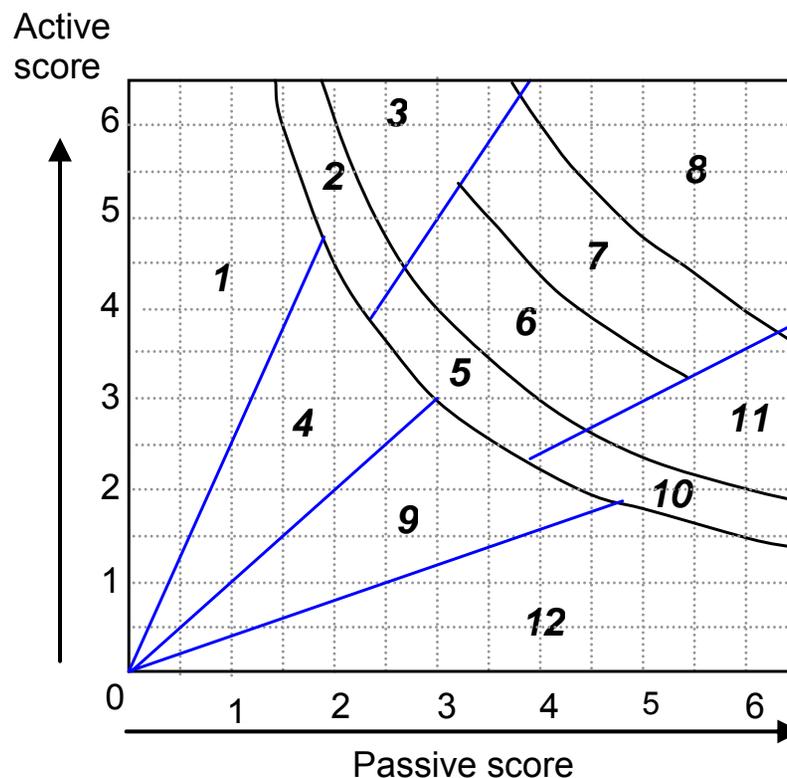
- Risks at the whole-of-capability and organisational levels



# 1. Cross-impact Analysis to aid Effort Prioritisation

*Which capabilities are more important to analyse?*

- Based on Schlange & Juttner (1997) method to help managers to identify key strategic issues faced by their businesses
  - Which capabilities are the most important and
  - the most able to be influenced?
- Only used if prioritisation of effort is necessary
  - Not needed for smaller focused assessments where the 'target' is clearly identified
    - Specific force capabilities
    - Networked battlegroup





## 2. Capability Qualification Analysis

*Assess the NCW readiness of individual military capabilities to integrate into, and contribute to, a future NCW-capable force*

### Purpose and Scope

- Assesses individual capabilities (projects) in isolation
  - *How prepared is the capability to integrate into an NCW-capable force?*
  - *Enables capability / project-level design analysis (standalone 'fitness')*
- Base building block of systems-of-systems analysis



## Three Sets of 'Key Enablers'

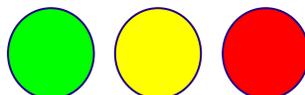
- Based on idea that 'major systems' must ...

Thus divided into 3 areas

1. Support human-centric military business processes
2. Manage information to support military business processes
3. Integrate properly to allow information management

- Support for military business processes (C2)
- Information Management (IM)
- Systems Integration (SI)

- Three-level 'rolled-up' assessment



- 'Leaves' at Level 3
- 'Branches' only at Levels 1 & 2

- Various taxonomies used, most based on qualitative scale

- None
- Some
- All / full
- Not applicable
- Unknown (blank)



# Illustrative Example of Key Enabler Outputs

Capability system [examples only]	C2			IM			SI		
	2010	2015	2020	2010	2015	2020	2010	2015	2020
Artillery	●	●	●			●	●	●	●
Armour	●	●	●			●	●	●	●
Combat aviation							●	●	●
Field logistics		●					●	●	●
C2 support systems	●	●	●						
● Poorly		● Unknown		□ Not applicable					
● Some support									
● Well									

Key enabler data aggregated to give an overall rating for C2, IM & SI for each system being assessed.

Data for illustrative purpose only



## 3. Capability-in-context Analysis

*Support for project-level capability missions and tasks*

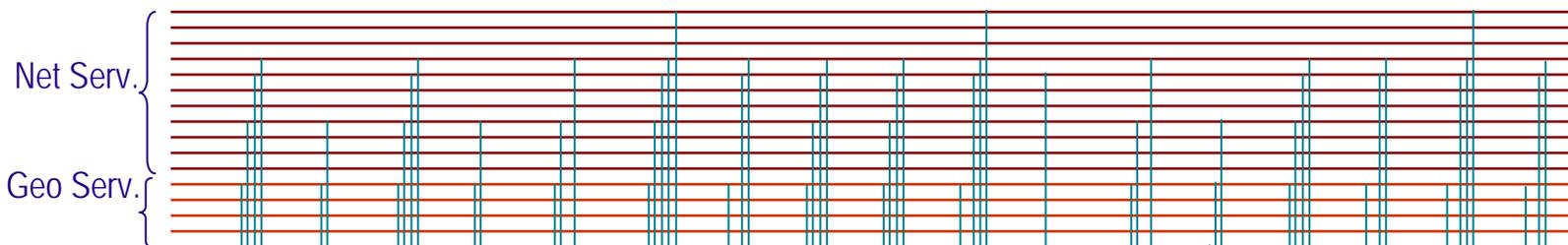
### Purpose and Scope

- **Assesses the end-to-end support for project-level capability missions and tasks**
  - *Are the specified missions and tasks realised in the operational interactions in the OVs and, as applicable, in other project OVs?*
  - *Are these operational interactions in turn realised in the systems interactions in the SVs and, as applicable, in other project SVs?*
- **Makes the NPI a project-level design analysis tool ('gap identifier')**



# Graphical Representation of Analysis Framework

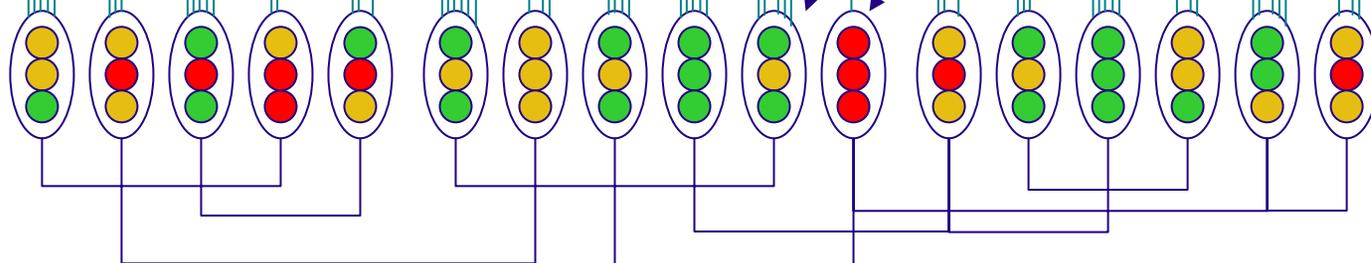
Infrastructure



Integration  
With  
Infrastructure



Application  
Layer  
Capabilities

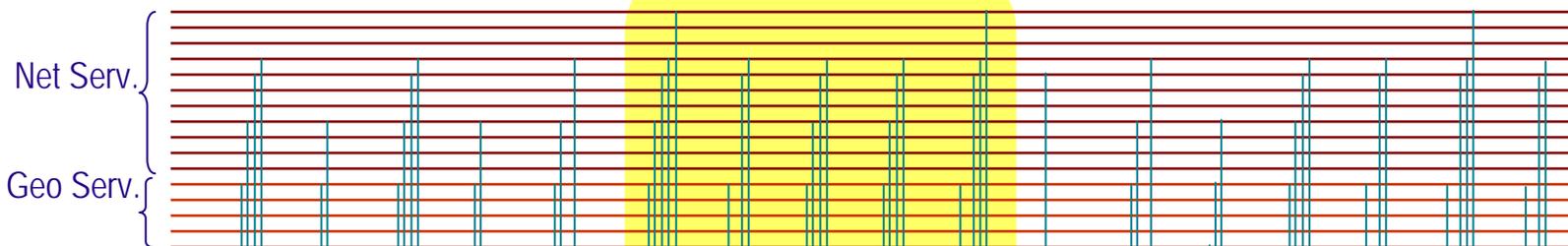


End-to-end  
Interactions



# Identify End-to-End Interactions

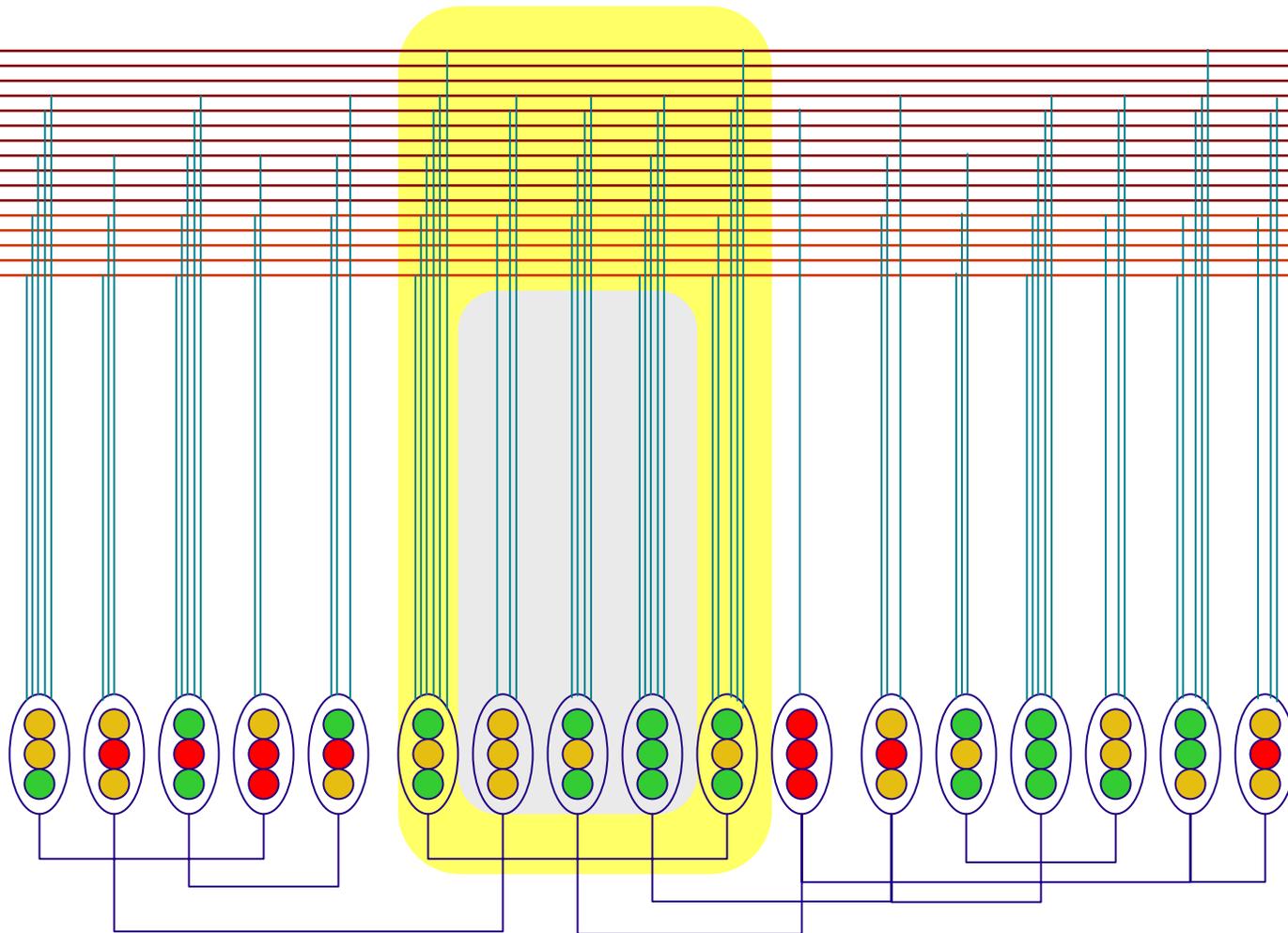
Infrastructure



Integration  
 With  
 Infrastructure

Application  
 Layer  
 Capabilities

Required  
 Interactions





# How Well versus How Much

How well is the (intermediate) capability supporting the (planned or needed) interaction?

How much of the (planned or needed) interaction set across the force does this support extend to?

-  – Not supported
-  – Supported but slower
-  – Supported

-  – < 30% of interactions
-  – 30-70% of interactions
-  – > 70% of interactions



## 4. Organisational Analysis

*Support for organisational missions and tasks*

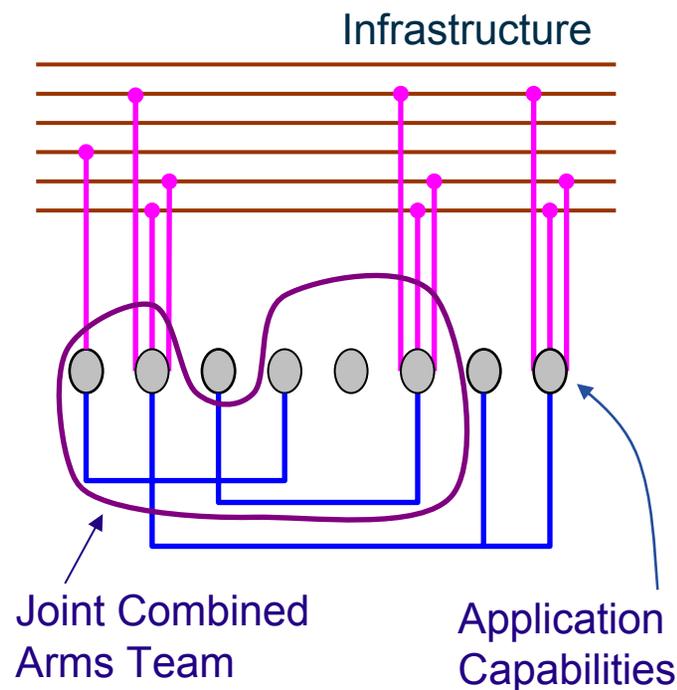
### Purpose and Scope

- Assesses the end-to-end support for organisational missions and tasks by the ‘major systems’ elements
- Use to assess defined force-level capability blocks:
  - Multi-element project, Battlegroup, Task Force, ...
- A ‘gap identifier’ at organisational level ... if the higher-level needs are actually documented!
- Potential template for Force-Level design
- **Makes NPI a force-level design analysis tool (‘gap identifier’)**



# Force-Level SoS Assessment

- Identify the key requirements and functions of the force-level capability
  - Take an effects and supporting information services approach
- Identify the key teams delivering required effects
- Identify internal and external information services
- Identify team interactions
- Driving Questions:
  - Are the Force-Level requirements realised in the collective SoS interactions described in applicable project OVs?
  - Are these operational interactions in turn realised in the systems interactions described in applicable project SVs?
- Can be used in reverse as a guide to develop force-level design





# Potential Application Areas

- Analysis of teams delivering key battlespace functions

- Joint fires
- Joint / Land manoeuvre
- Littoral operations
- Joint / Land ISTAR

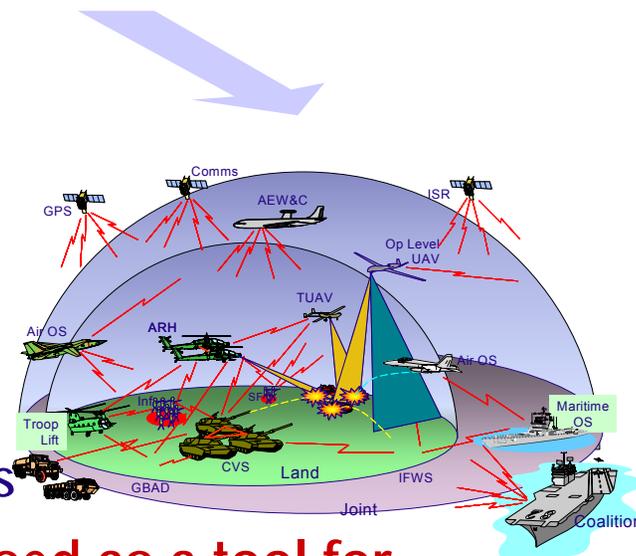


- Systems-of-systems Projects

- e.g. Australia's new amphibious warship

- Assessment of Network Land Force

- 2009 Networked Battlegroup (started)
- 2012 Networked Brigade
- Support to iterative force-level design efforts



- The methodology has to potential to be used as a tool for capability options assessment



## 5. Holistic Risk and Vulnerability Analysis

*Identification, assessment of holistic risks and vulnerabilities including treatment options and associated implementation plans*

### Purpose and Scope

- ***What risks & vulnerabilities are created by improved force integration?***
- **Identify and assess the risks at the whole-of-capability and organisational levels**
- **Focus on identifying implications for human dimension issues**
  - Concepts, Doctrine, TTPs Human Factors, Training, Personnel, Culture, ...
- **Includes identifying potential treatment options**
- **Makes NPI a force-level design analysis tool**



**Australian Government**  
**Department of Defence**  
Defence Science and  
Technology Organisation

# Applying NPI

---

What have we done with it thus far?



**AEROSPACE**  
**CONCEPTS**



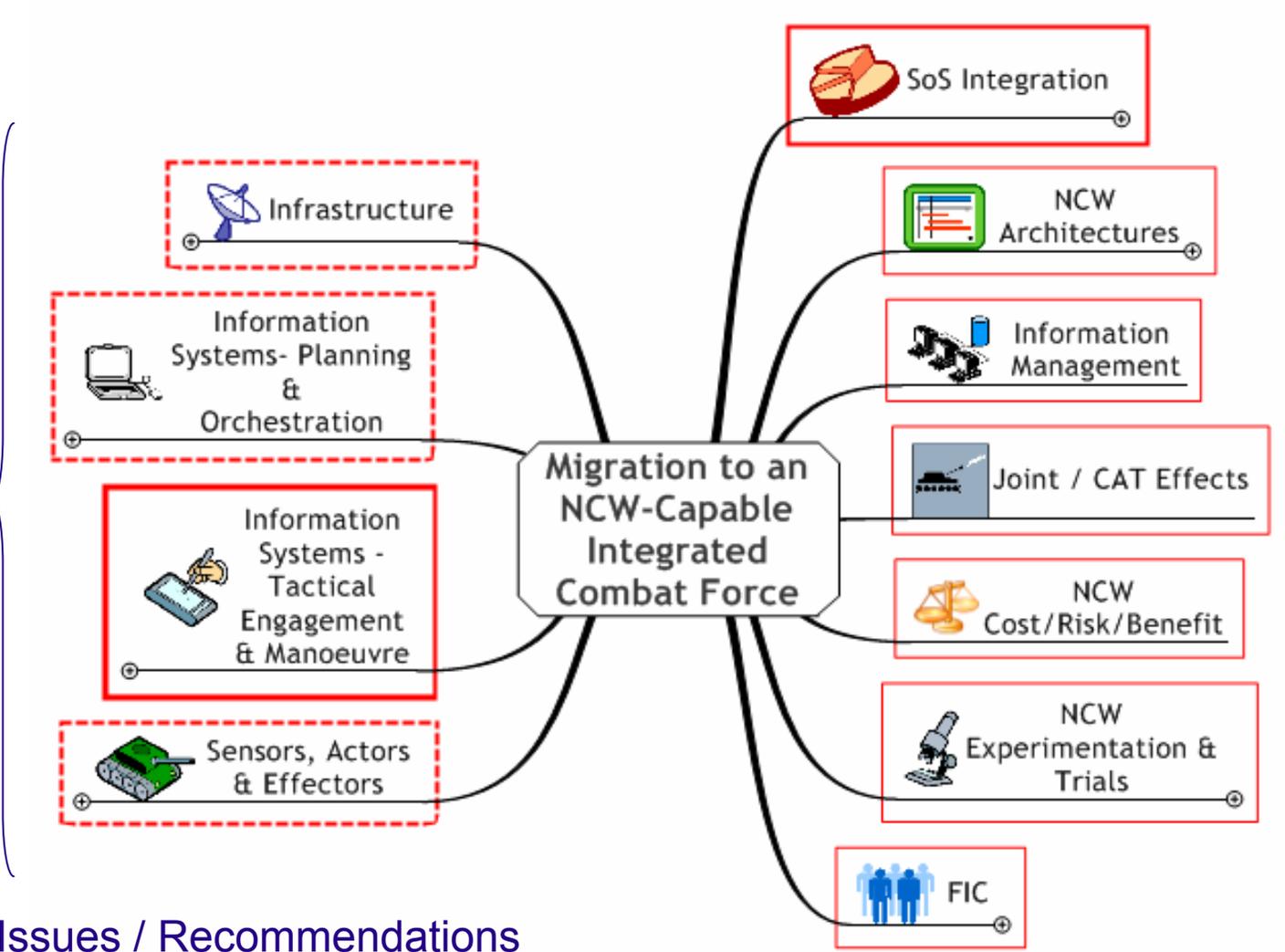
## **NPI Phase 1 – Focus on the Land Battlespace**

- **Support integration of (Land) combat capability**
  - NCW in Land not well understood
  - Currently planned level of integration not well understood
- **Developed an applied NCW concept**
  - 10 Key characteristics of NCW
  - More complex operations with comparable force at the same or lower levels of risk
- **Reviewed NCW readiness for the DCP force**
  - Review ~ 41 projects, 21 in detail
  - Land and Land-related focus



# Identified Land NCW Issues and Recommendations

Project Specific



Holistic

~ 100 Issues / Recommendations

~ 60 Issues / Recommendations



**Australian Government**  
**Department of Defence**  
Defence Science and  
Technology Organisation

# The Way Ahead



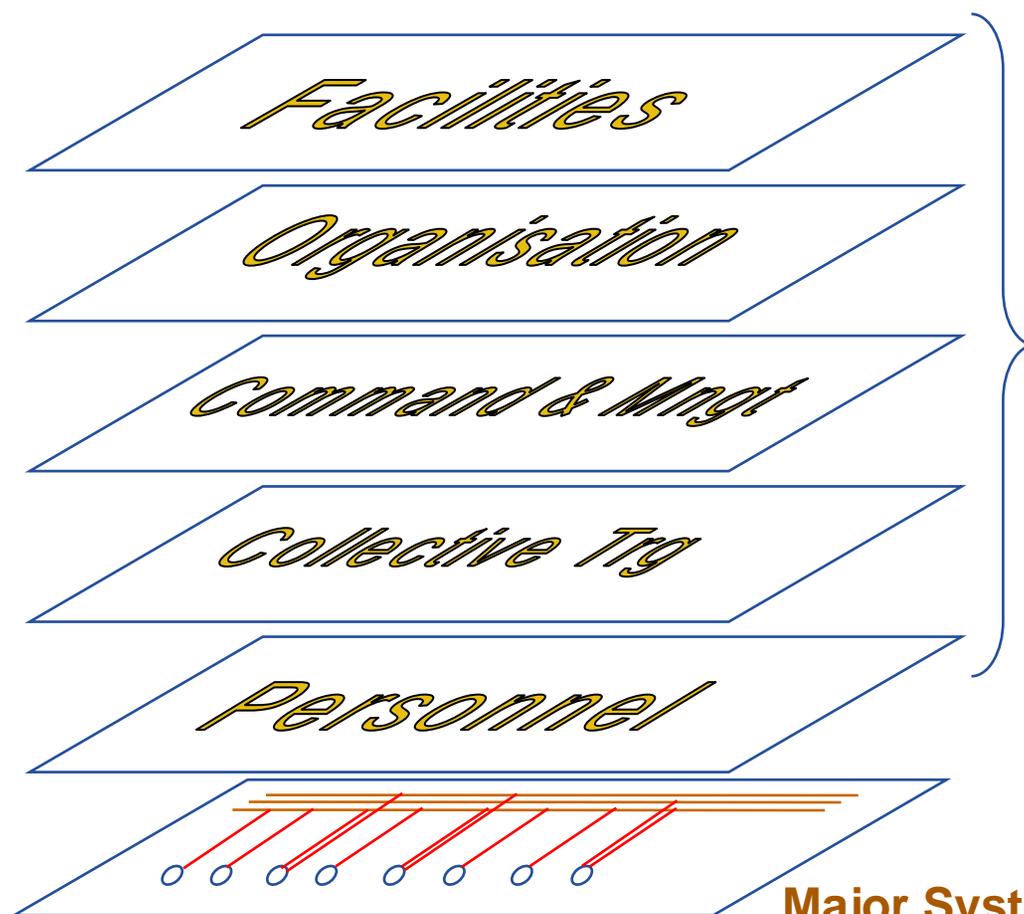
**AEROSPACE**  
CONCEPTS

---

**Extending NPI usefulness**



## Extension of NPI to Wider FIC → NPI Phase 3



- Extend beyond major systems analysis & insights to other NCW SoS elements.
- Develop analytical frameworks for issues relating to:
  - Concepts, Doctrine & TTPs
  - Collective training
  - Personnel
  - Organisation



## Extending the NPI to Programmatic Analysis

- **Achieving NCW-capable force increases acquisition demands**
  - Interdependencies are identified and planned for
  - Delivery into service of associated capabilities is coordinated
- **Flexible scheduling needed to cope with external influences**
  - Changed Government budget priorities
  - Altered strategic circumstances
  - Slips in key project delivery (e.g. JSF)
- **Demands method of determining the impact of schedule changes**
  - What is the impact of slipping a project on other projects and on higher-level organisations such as battle group ‘blocks’?
  - How far back or forward could a force-level baseline, such as a battle group ‘block’, be moved without impacting the spend-spread beyond a given level?



**Australian Government**  
**Department of Defence**  
Defence Science and  
Technology Organisation

# Conclusions

---



**AEROSPACE**  
**CONCEPTS**



# NPI Methodology

---

- **Answers three key questions**
  - How well does the system support military business processes?
  - How well does the system manage information?
  - How well does the system integrate technically into the overall force?
- **Assesses NCW readiness**
  - Individual projects
  - Wider networked system-of-systems
- **Potential to be a key component in a force-level design framework**



**Australian Government**  
**Department of Defence**  
Defence Science and  
Technology Organisation

# Questions

---



**AEROSPACE**  
**CONCEPTS**





Australian Government  
Department of Defence  
Defence Science and  
Technology Organisation

# Appendix A – Land NCW Characteristics

---



AEROSPACE  
CONCEPTS



## 10 Land NCW Characteristics

---

1. Application of mission command built on a foundation of professional mastery.
2. Increased ability for the commander to develop and implement options, via appropriate collaboration and combination of capabilities, to generate required effects
3. Exchange of complementary voice and digital information across a federated and integrated network.
4. Sharing of mission intent and relevant battlespace information to enhance team formation and the effectiveness of fighting as teams – single arms, combined arms, Joint or coalition.
5. Effective information management to ensure the required information is provided to the relevant decision-makers in a timely, robust, reliable and secure manner.



## 10 Land NCW Characteristics

---

6. Flexible management of time and tempo in order to facilitate quality decision-making.
7. Enhanced cooperative engagement through the networking of the engagement, sensor and C2 systems.
8. Broadening the spectrum of operational capabilities from traditional warfighting by facilitating geographically dispersed multi-faceted and concurrent operations.
9. Enhanced warfighting concepts, doctrine and TTPs to effectively utilise networked capabilities in order to increase force survivability and undertake more complex operations at the same or lower levels of risk.
10. Training (both individual and collective) designed to realise and sustain the potential capabilities of a networked force.



**Australian Government**  
**Department of Defence**  
Defence Science and  
Technology Organisation

# Appendix B – Architecture Framework Usefulness to NPI



**A E R O S P A C E**  
**C O N C E P T S**

---

An assessment of how useful each Architecture Framework product / view might be to an NPI assessment activity



## Common Views (CV) Relationships to NPI

View	View / Product Name	Potential Relationship to NPI	Pri
CV-1 [Essential]	Overview and Summary Information	Identification of group relationships for organisational emergent properties analysis.	High
CV-2 [Essential]	Integrated Dictionary	Definitions to support analysis activities.	High
CV-3 [Essential]	Architecture Compliance Statement	Nil	Nil
CV-4 [Supporting]	Capability Maturity Profile	May provide information on maturity of NCW-relevant functionality.	Med

Australian 'Common Views' (CV)

=

United States 'All Views' (AV)



# Operational Views (OV) Relationships to NPI

View	View / Product Name	Potential Relationship to NPI	Pri
OV-1 [Essential]	<b>High-Level Operational Concept Graphic</b>	Identification of end-to-end and group relationships for organisational emergent properties analysis.	High
OV-2 [Essential]	<b>Operational Node Connectivity Description</b>	<p>Identification of end-to-end and group relationships for organisational emergent properties analysis.</p> <p>High-level guidance on interactions between capabilities.</p> <p>May provide some guidance on the business processes supported by the capability.</p>	High
OV-3 [Essential]	<b>Operational Information Exchange Matrix</b>	Identification and characterisation of capability interactions, including internal interactions between different nodes.	High
OV-4 [Essential]	<b>Command Relationship Chart</b>	Guidance on nature of end-to-end and group relationships.	Med
OV-5 [Essential]	<b>Activity Model</b>	Guidance on nature of end-to-end and group relationships.	Med



## Operational Views (OV) Relationships to NPI

View	View / Product Name	Potential Relationship to NPI	Pri
OV-6A [Supporting]	<b>Operational Rules Model</b>	Guidance on operational constraints on business process support and information management key enabler characteristics.	Low
OV-6B (Supporting)	<b>Operational State Transition Description</b>	May provide some guidance on business process support and information management key enabler characteristics.	Low
OV-6C [Supporting]	<b>Operational Event / Trace Description</b>	May provide some guidance on business process support and information management key enabler characteristics.	Low
OV-7 [Supporting]	<b>Logical Data Model</b>	Guidance on capability information management characteristics.	Low



# System Views (SV) Relationships to NPI

View	View / Product Name	Potential Relationship to NPI	Pri
SV-1 [Essential]	<b>System Interface Description</b>	Identification of support for end-to-end relationships.	High
SV-2 [Supporting]	<b>Systems Communication Description</b>	Identification and characterisation of support for end-to-end relationships.	High
SV-3 [Supporting]	<b>Systems to Systems Matrix</b>	Guidance on identification and characterisation of capability interactions at a system level, including internal interactions between different nodes.	High
SV-4 [Supporting]	<b>Systems Functionality Description</b>	Guidance on support for military business processes and information management key enablers.	Med
SV-5 [Supporting]	<b>Operational Activity to System Function Traceability Matrix</b>	May provide some guidance on how systems implement business process support and information management key enablers characteristics.	Low
SV-6 [Supporting]	<b>System Information Exchange Matrix</b>	Identification and characterisation of capability interactions at a system level, including internal interactions between different nodes.	High



# System Views (SV) Relationships to NPI

View	View / Product Name	Potential Relationship to NPI	Pri
SV-7 [Supporting]	<b>System Performance Parameters Matrix</b>	May provide guidance on performance in business process support and information management key enablers.	Low
SV-8 [Supporting]	<b>System Evolution Description</b>	Guidance on potential changes over time (epochs) in key enabler characteristics and support for end-to-end relationships.	High
SV-9 [Supporting]	<b>System Technology Forecast</b>	Guidance on potential changes over time (epochs) in key enabler characteristics, particularly systems integration, and support for end-to-end relationships.	High
SV-10A [Supporting]	<b>Systems Rules Model</b>	Guidance on system design constraints on business process support and information management key enabler characteristics.	Med
SV-10B [Supporting]	<b>Systems State Transition Description</b>	May provide some guidance on business process support and information management key enabler characteristics.	Low
SV-10C [Supporting]	<b>Systems Event / Trace Description</b>	May provide some guidance on business process support and information management key enabler characteristics.	Low
SV-11 [Supporting]	<b>Physical Data Model</b>	May provide some guidance on information management key enabler characteristics.	Low



## Technical Views (TV) Relationships to NPI

View	View / Product Name	Potential Relationship to NPI	Pri
TV-1 [Essential]	Technical Architecture Profile	Identification of systems integration key enabler technology standards mandated for the capability.	High
TV-2 [Supporting]	Standards Technology Forecast	Identification of systems integration key enabler technology standards forecast for the capability.	High



## Summary of Key DAF Products for NPI Assessment

- CV-1 – Overview and Summary Information [Essential]
- CV-2 – Integrated Dictionary [Essential]
- OV-1 – High-Level Operational Concept Graphic [Essential]
- OV-2 – Operational Node Connectivity Description [Essential]
- OV-3 – Operational Information Exchange Matrix [Essential]
- SV-1 – System Interface Description [Essential]
- SV-2 – Systems Communication Description [Supporting]
- SV-3 – Systems to Systems Matrix [Supporting]
- SV-6 – System Information Exchange Matrix [Supporting]
- SV-8 – System Evolution Description [Supporting]
- SV-9 – System Technology Forecast [Supporting]
- TV-1 – Technical Architecture Profile [Essential]
- TV-2 – Standards Technology Forecast [Supporting]