Capability Life Cycle and Capability Management Practices

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Capability Life Cycle (CLC)

The aim of this course is to:

• explain the intent and features of CLC policy including context, behaviours, principles and management arrangements;
• provide an overview of the CLC process;
• identify the capability management practices necessary to deliver the CLC; and
• describe the CLC artefacts and their development.
# Course Program

| Day 1 | • Background to CLC  
|       | • Context and Behaviours  
|       | • CLC Process including overview of frameworks, roles, management, documents & artefacts  
|       | • Overview of Capability Management Practices  
| Day 2 | • Systems Engineering  
|       | • Project and Program Management  
|       | • Integrated Logistics Support  
| Day 3 | • Procurement and Contracting  
|       | • Governance, Risk Management & Assurance  
|       | • CLC Documents and Artefacts  

## Background to CLC
FPR: How did we get here?

1973 – Tange Review
2003 – Defence Procurement Review
2008 – Mortimer Review
2011 – Black Review
2014 – First Principles Review

Numerous Senate Reviews and Audits

Reason for First Principles Review (FPR)

• FPR was conducted due to recognition that Defence needed to work much more effectively to meet future challenges.
• For capability development FPR found (inter alia):
  – extant processes: complicated, slow, inefficient, unclear accountabilities
  – evidence of waste, inefficiency and rework
  – delayed decisions, over-escalation of issues for decision
• So ... FPR report identified the need for:
  – simplicity
  – greater agility
  – timely delivery

Source: FPR Creating One Defence
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FPR Recommendations

Six core recommendations:

1. Strong strategic centre, stronger accountability and decision-making
2. Single end-to-end capability development function
3. Enterprise approach
4. Right skills in appropriate jobs
5. Manage staff resources for optimal use of funds
6. Commence implementation immediately

First Principles

- Clear authorities & accountabilities aligned with resources
- Outcome orientation
- Simplicity
- Focus on core business
- Professionalism
- Timely, contestable advice
- Transparency

FPR – Key Messages

“The strengthening of the strategic centre and the establishment of a single end-to-end capability development function is reshaping how we think and act.”

“...in conceiving of the future force, we need to talk about the integrated force, integrated at an organisational level and integrated technically and culturally”

“...If you follow the integration logic, we are moving, inexorably, towards a single war-fighting domain. Our ability to operate effectively across this ‘One Domain’ will depend on our ability to build an Integrated Joint Force by design”.

Source: VADM Ray Griggs, VCDF, ASPI Building the Integrated Joint Force Seminar, 7 June 2017
One Defence is Key

“Intent of the First Principles Review, to transition to a One Defence model and focus on achieving a truly integrated joint force by design.”

AVM Mel Hupfeld, Head Force Design, INCOSE IS 17 July 2017

Relationship between FPR and the CLC

“At the heart of the FPR implementation has been the Capability Life Cycle redesign, which is heavily focused on tailoring, streamlining and better integrating our capability solutions. It is equipping us to take that conceptual journey towards a single domain.”

Source: VADM Ray Griggs, VCDF, ASPI Building the Integrated Joint Force Seminar, 7 June 2017
What is the CLC?

- described as a **policy** (captured in Interim CLC Manual)
- core **business process** for realising capability solutions
- **spans** introducing, sustaining, upgrading and replacing Defence capability
- covers **major capital equipment, ICT and facilities**
- designed to support **integrated joint force by design**
- supports **One Defence Business Model**
- tailored to suit circumstances

CLC – Principles

1. Joint and integrated capability outcomes
2. Integrated planning
3. Flexible, risk-based, tailored
4. Contestability
5. Discouraging risk aversion
6. Defence focus on core business
7. Default to fastest and simplest
8. Transparency
9. Clear responsibilities and accountabilities
10. Early and transparent industry involvement

Source: Updated Interim CLC Manual
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So ….

• What has changed as a result of CLC?
• What hasn't changed?

What **has** changed as a result of CLC?

• **Emphasis on behaviours:** accountability, contestability, collaboration.
• **Modified capability development process.**
• **Additional frameworks:** eg Force Design, Smart Buyer.
• **Modified management ‘structures’:** eg CLC Accountability Model, Program layer.
• **Approach:** default to simplest, tailored, risk-based, sufficient.
• **New artefacts:** eg Capability Program Narrative (CPN).
• **Modified Industry role:** FIC, part of IPT, ‘above the line’.
What **hasn’t** changed as a result of CLC?

- **Traceability** to government direction.
- **Requirements** to be defined.
- **Enabling Practices** to be applied eg Project Management, Systems Engineering, Integrated Logistics Support.
- **Compliance** with applicable legislation and regulations.
- **Accountability** for proper use of Commonwealth resources by Commonwealth officers (even if activities are contracted out).

### Snapshot of key changes post-CLC

**Modified Process and Decision Points up to Acquisition Phase**

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<th>Risk Mitigation &amp; Requirements Setting</th>
<th>Acquisition</th>
<th>In-Service and Disposal</th>
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#### Behaviours and Approach
- One Defence
- Joint/integrated
- Transparency
- Tailored
- Sufficiency
- Risk-based

#### Additional frameworks
- Force Design (incl DCAP)
- Contestability
- Smart Buyer
- Integration and Interoperability

#### New Management roles and ‘structures’
- Investment Committee
- Integrated Investment Program
- Management layers: Portfolio (Capability Streams), Program, Product, Project
- CLC Accountability Model: roles, responsibilities and relationships

#### New Artefacts
- Program: CPN, Program Strategy, PIOC
- Proposal: JCN, JCNS, PES, Business Case, IPMP

#### Industry Role
- Engage early, Part of FIC, IPT and ‘above the line’ support
FPR and CLC: Recap

- One Defence: enterprise approach.
- Single warfighting domain: integrated Joint Force by Design
- Strategy-led: traceable to Government Direction.
- Single end-to-end capability development: whole of life, asset management.
- Approach to Capability Management: tailored, risk-based, simple, sufficient.
- Contestability: test and improve proposals.

CLC – Implementation

- Transition – commenced 1 Apr 16 and matured 1 Jul 17.
- Full description:
  – CLC Manual on VCDF CLC website; and
  – DRN CLC Website.
- Supporting policy and guidance being progressively rolled out eg Project and Product Management Manuals.
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Applying the CLC

CLC and capability development: challenge

Management of Public Monies

+ 

Technical endeavour to deliver and support capability

Accountability
Legal obligation
Govt processes

Significant Complexity
Science & Engineering
Precision and rigour

Intersection of Public Sector obligations and technical endeavour.
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Capability Development Practices

- Strategy and Concepts
- Risk Mitigation and Requirements Setting
- Acquisition
- In-Service and Disposal

Practices
('Toolkit')
- Program, Product and Project Management
- Engineering and Technical/Systems Engineering
- Logistics/ILS
- Commercial/Procurement and Contracting
- Risk Management and Assurance

Established, proven Practices that enable the CLC.

Context for CLC

- Legislative, Regulatory, and Policy Context
- Behaviours
- CLC Process

- Capability Management Practices
  - Program, Product and Project Management
  - Systems Engineering
  - Logistics/ILS
  - Procurement and Contracting
  - Risk Management and Assurance
CLC examples

- In context of CLC:
  - consider how CLC might be applied to real situations
  - to illustrate contains a mix of actual and hypothetical elements
- Examples:
  - Program: Integrated Air and Missile Defence (IAMD)
  - Project: Electronic Support (ES) system

Program Example: IAMD

- The term ‘IAMD’ commonly used by defence organisations.
- Generally described as defence against:
  - conventional air threats eg aircraft, unmanned aerial vehicles, helicopters, (air defence)
  - missiles eg ballistic and cruise missiles (missile defence)
- Integrated: operational and technical collaboration between systems
IAMD example

- “A modern and integrated ground-based air defense system is needed to protect our deployed forces from increasingly sophisticated air threats, both globally and within our region”.
  Ref: Minister for Defence, 10 April 2017
- Dependent on coordinated approach to information exchange between sensors and effectors
- Good reference: The Sir Richard Williams Foundation

Possible components of IAMD
IAMD example

- IAMD is an example of a Program
- Relevant to CLC discussion on:
  - Programs
  - System of Systems (SoS)
  - Joint Force by Design
  - Integration and Interoperability (I2)
  - Program-level documents and artefacts

SEA 1448 Ph4A: Project Example

- SEA 1448 Ph4A Project Electronic Support Measures (ESM) project—actually undertaken before CLC introduced.
- Chosen as example because it was a highly successful project which displayed a range of CLC elements.
- Background described in the book: *Integrating Program Management and Systems Engineering: Methods, Tools, and Organizational Systems for Improving Performance*, Eric Rebentisch (Editor-in-Chief), Wiley.
SEA 1448 Ph4A Project: ESM

- Electronic Support Measures (ESM)
  - used on RAN ships to detect and identify (classify) adversary’s radars
  - a bit like a music recognition app
- Comprises antenna and processing equipment
- Integrates and displays on the Combat System

![Source: www.harris.com](image-url)

SEA 1448 Ph4A Project: Key Factors

- Installed on multiple existing platforms across 3 different classes of ship
- Installation to be synchronised with availability of platforms
- Different installation requirements dependent on class:
  - physical installation differences
  - differences in RF ‘noise’ situation
- Multiple vendors to create the system
- Multiple contractors to install the systems on ships
- Time pressure to enable deployment of vessels with this capability
SEA 1448 Ph4A Project Example

We will look at the case study in terms of what would have been done and produced under the CLC touching on:

- CLC process, frameworks and management constructs eg Programs, Smart Buyer etc
- Enabling Practices:
  - Systems Engineering
  - Project Management
  - ILS
  - Procurement and Contracting
  - Risk Management and Assurance
- Artefacts and documents to be developed
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Applying the CLC

Legislative, Regulatory, and Policy Context

Behaviours

CLC Process

Strategy and Concepts
Risk Mitigation and Requirements Setting
Acquisition
In-Service and Disposal

Gate 0
Gate 1
Gate 2

Capability Management Practices

Program, Product and Project Management
Systems Engineering
Logistics/ILS
Procurement and Contracting
Risk Management and Assurance

Applying the CLC

Legislative, Regulatory, and Policy Context

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Capability Management Practices

Program, Product and Project Management
Systems Engineering
Logistics/ILS
Procurement and Contracting
Risk Management and Assurance
Legislative, Regulatory and Policy Context

Defence and its officials operate in an environment of legislation, Commonwealth policy, and Defence policy and regulation with which you must comply.

- Commonwealth Legislation
- Commonwealth Policy
- Defence Policy
- Defence Regulation

Key Commonwealth Legislation

Including but not limited to…

- Public Governance Performance and Accountability Act (PGPA) 2013
- Public Service Act 1999
- Defence Force Discipline Act 1982
- Work Health and Safety Act 2011
- Crimes Act 1914
- Defence Act 1903
- Archives Act 1983
- Public Interest Disclosure Act 2013
- Environment Protection and Biodiversity Conservation Act 1999
PGPA Act 2013

• The PGPA Framework requires Defence officials to:
  – not be inconsistent with the policies of the Australian Government;
  – use and manage public resources in an efficient, effective, economical and ethical manner;
  – exercise ‘care and diligence’ in performing their duties;
  – “act honestly, in good faith and for a proper purpose” performing their duties;
  – not improperly use their position in performing their duties
  – not improperly use information; and
  – disclose interests in relation to the performance of their duties.

Source: DPPM April 2017, Paragraph 21

Key Commonwealth Policies

• Including but not limited to:
  – Commonwealth Procurement Rules;
  – Procurement Connected Policies (such as Indigenous Procurement Policy); and
  – Commonwealth Risk Management Policy.
Commonwealth Procurement Rules

• Commonwealth Procurement Rules (CPR) have effect under the PGPA Act 2013.
• CPR:
  – set out the rules that officials must comply with when they procure goods and services;
  – indicate good practice;
  – are the keystone of the Government’s procurement policy framework; and
  – are fundamentally focused on achieving value for money.

Key Defence Policies

• Including but not limited to…
  – Defence Environment Policy;
  – Defence Industry Policy Statement 2016;
  – Defence Procurement Policy Manual (DPPM); and
Defence Procurement Policy

• Defence Procurement Policy Manual (DPPM) incorporates:
  – CPR, and
  – additional Defence Procurement Policy Directives.
• Must be complied with by Defence officials for procurement.
• Promotes responsible and accountable spending by Defence officials when procuring goods and services for Defence.
• Supports proactive management of risks relating to procurement, as required by the CPR.

Source: DPPM April 2017

Key Regulations

Including but not limited to…

Defence Technical Regulation

Provides confidence to users about the safety and technical integrity of their systems and equipment across:
• fitness for service
• safety
• environmental compliance.

Commonwealth Legislation
Commonwealth Policy
Defence Policy
Defence Regulation
Technical Regulation

• Seaworthiness: Defence Seaworthiness Management System Manual (DSwMS) (Jun 17).
• Airworthiness: Defence Aviation Safety Regulation (DASR) introduced in 2016 and replaced the Military Operational and Technical Airworthiness Regulations.
• Explosive Ordnance Regulation: Technical Airworthiness Advisory Circular.

Bottom Line on Context

• Those involved in the CLC must comply with legislative, regulatory and policy requirements.
• Defence Policy leads and Centres of Expertise (COE) are responsible for ensuring that the policies, processes and tools they provide satisfy those requirements.
• By complying with Defence policy, processes and tools you will be satisfying your obligations.
Applying the CLC

Legislative, Regulatory, and Policy Context

Behaviours

CLC Process

Strategy and Concepts

Risk Mitigation and Requirements Setting

Acquisition

In-Service and Disposal

Gate 0

Gate 1

Gate 2

Capability Management Practices

Program, Product and Project Management

Systems Engineering

Logistics/ILS

Procurement and Contracting

Risk Management and Assurance

CLC Behaviours

- CLC features:
  - more flexibility in how work is conducted;
  - greater integration between stakeholders;
  - more interdependencies;
  - greater need for collaboration; and
  - less strictly defined boundaries.

- Sound Behaviours are critical to making this work.
CLC Behaviours

- Acceptance of Accountability at all levels.
- Embracing Contestability.
- Discipline in documentation.
- One Defence: Partnership, cooperation and collaboration.
- Strong behavioural leadership at all levels.
- Demonstrably delivering on Government direction.
- Improved relationships within Defence and between Defence and Central Agencies.
- Deal with ambiguity and manage risk – don’t be risk averse.

Key Behaviour: Embrace Contestability

- Culture of wanting ideas, proposals and agendas contested.
- Makes proposals robust and helps improve decisions (not make them).
- Establish and maintain trust with Government and Central Agencies.
- Engage with Contestability early so can be ‘built into’ brief.
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Key Behaviour: One Defence

• Collegiate approach: open, transparent and collegiate approach to all CLC activities.
• Critical to development of the Joint Force.
• To be demonstrated from working level practitioners through to senior committees (such as Investment Committee) and other fora (such as Independent Assurance Reviews).

Key Behaviour: Tailoring and Sufficiency

• Tailor: Implement to circumstances including risk—no prescribed approaches and not a ‘cookie cutter’ approach.
• Sufficiency: Work and documentation is only done to the extent necessary.
• Discipline in Documentation: Selecting only the level and volume of detail necessary.
• Those accountable and responsible must define and argue the tailored approach.
Key Behaviour: Discipline in Documentation

- Proposals and Briefs must reflect discipline:
  - Simple, readable, plain English:
    - ‘tell the story’;
    - not excessive technical language;
    - write for final audience—Ministers;
    - clearly link effort to Government priorities;
      - Capability Streams,
      - Show support for Government’s broader view,
    - evidence-based, identify risks, identify unknowns; and
    - include Contestability.
- CM prepares Cabinet Submissions (CabSub) and Ministerial Submissions (MinSub).

Source: Defence CLC Seminar Feb 2017

Key Behaviour: Manage Risk

- Deal with ambiguity, manage risk, and discourage risk aversion.
- Conscious risk reduction mindset throughout the CLC.
- Clearly identify risks and associated risk mitigation efforts.
- Use risk profiles to define work including tailored approval authorities and pathways.
CLC Behaviours add to Extant Values

- APS Values and Code of Conduct
- Defence-wide Values (PLICIT)
- Single-Service Values
- One Defence Leadership Behaviours (CLARITI)
- Professional Codes of Ethics

Defence-wide Values

- Defence-wide Values (PLICIT):
  - Professionalism
  - Loyalty
  - Integrity
  - Courage
  - Innovation
  - Teamwork

- PLICIT Values apply to ADF members and APS employees.
- APS employees are obliged to follow APS Values, Employment Principles and the APS Code of Conduct.
- PLICIT Values do not replace or override the Single Service or APS Values—they are complementary
- PLICIT applies to everyone in Defence.
One Defence Leadership Behaviours (CLARITI)

- Comprises:
  - Contributor,
  - Learner,
  - Accountable,
  - Risk Manager,
  - Inclusive,
  - Team Builder, and
  - Innovator.
- Managers and teams are expected to model their leadership approach around these behaviours.

Practices: Codes of Ethics

- Specialist practitioners who support the CLC are also subject to Codes of Ethics.
- Project Management: AIPM Code of Ethics: Act with Integrity; Practice Competently; Demonstrate Leadership; Act with Responsibility (Source: www.aipm.com.au).
- Engineering: Engineers Australia Code of Ethics: demonstrate integrity; practice competently; exercise leadership; promote sustainability (Source: Engineers Australia Code of Practice).
Specialist Practitioners: Codes of Ethics

- Key Features: Professionalism, Integrity, Competence:
  - Act on the basis of a well-informed conscience.
  - Act on the basis of adequate knowledge.

Implications for Defence Managers

- Defence officials will employ specialist (non-core) skills sets.
- Must assure that those employed have appropriate competencies and comply with applicable codes of ethics.
- Defence officials are accountable to ensure value from non-core support.
- When employing non-core personnel Defence officials should be able to:
  - clearly define work to be done;
  - assess necessary competencies; and
  - assure outcomes and deliverables.
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CLC Process

Implementing the CLC

Legislative, Regulatory and Policy Context

Behaviours

CLC Process

- Strategy and Concepts
- Risk Mitigation and Requirements Setting
- Acquisition
- In-Service and Disposal

Gate 0  Gate 1  Gate 2

Capability Management Practices

- Program, Product and Project Management
- Systems Engineering
- Logistics/ILS
- Procurement and Contracting
- Risk Management and Assurance
Overview: Phases of the CLC

The CLC is a four-phase, risk-based decision-making process which:
1. Identifies capability needs.
2. Defines and decides capability solutions.
3. Acquires the capability and introduces it into service.
4. Supports the capability through its life including disposal.

CLC Gates

There are three decision gates:
- Gate 0: Defence decision to progress a proposal to the next Gate. All proposals go through Gate 0.
- Gate 1: Government decision to approve and progress complex and high-risk proposals to Gate 2 including select a specific option(s).
- Gate 2: Government decision to acquire a fully defined and costed capability.
CLC Process

- Our description of the CLC is structured as follows:
  - Frameworks, Roles, and Management Structures that are relevant to the CLC.
  - CLC Process including decision points.
  - Documents and Artefacts that are to be produced.
- This will be followed by a description on how to apply supporting ‘toolkit’ of Practices to implement the CLC.

Implementing the CLC

Legislative, Regulatory and Policy Context

Behaviours

Frameworks, Roles, and Management Structures

CLC Process

Documents and Artefacts

Strategy and Concepts

Risk Mitigation and Requirements Setting

Acquisition

In-Service and Disposal

Gate 0

Gate 1

Gate 2

Capability Management Practices

Program, Product and Project Management

Systems Engineering

Logistics/ILS

Procurement and Contracting

Risk Management and Assurance
Defence Frameworks, Roles, and Management Structures

Frameworks

1. First we will look at each framework individually:
   - Force Design Framework
   - Smart Buyer Framework
   - Contestability Framework
   - CLC Management Layers
   - CLC Accountability Model

2. Then we will see how these are used in CLC process.
**Force Design Framework**

**Strategy and Concepts Phase**

- **Force Design cycle**: ‘front-end’ to the CLC and core function of Strategy and Concepts phase.
- **Defence Capability Assessment Program (DCAP)** identifies capability needs.
- ‘Joint Force by Design’ is a key aspect of Force Design.
- Outcome is Gate 0 proposal to the Investment Committee (IC) for an ‘investment’ in capability.
Force Design Cycle: DCAP

- DCAP outcomes are prioritised capability investment recommendations:
  - traceable to strategic guidance; and
  - for potential inclusion in the Integrated Investment Program (IIP).

- Often shown as an annual program of activities supporting the Force Design Cycle.
DCAP: Modes of Operation

- Annual: considers gaps and opportunities on an annual basis drawing on inputs from Force Design analyses and Capability Managers.
- Agile: rapid assessment and resolution of specific gaps and opportunities inside the annual cycle eg urgent operational requirement and/or in response to specific Government direction.
- Fundamental: conducted approximately every four years as the basis of the Force Design Update.

Fundamental Mode

- Addresses gaps and opportunities in greater depth.
- Provides options for fundamental change to both force structure and Defence strategy
- Basis for:
  - review of force structure,
  - update to strategic guidance,
  - Defence White Paper, and
  - new Investment Program.
Smart Buyer Framework

What is Smart Buyer?

• Decision-making framework that helps:
  – analyse circumstances for a capability gap or opportunity identified through DCAP;
  – define how to best progress the capability need;
  – develop proposals appropriate to the capability need; and
  – ensures that strategy is tailored to circumstances.

• Explicitly addresses:
  – risks, opportunities and drivers;
  – all relevant factors eg technical, commercial, financial;
  – whole of capability lifecycle; and
  – securing required capability outcomes, value for money.
Smart Buyer: Main steps

- **Understand the circumstances** eg capability considerations, strategic factors, industry capability, finance constraints existing plans.
- **Identify the risks and drivers** and develop a ‘profile’ across a number of categories.
- **Develop a tailored strategy** ie Project Execution Strategy (PES) based on four strategies:
  - Approval Strategy.
  - Acquisition Strategy.
  - Sustainment Strategy.
  - Project Management Strategy.

Smart Buyer Workshops

- Core to Smart Buyer activities are structured workshops:
  - Risk and drivers analysis.
  - Tailored strategy development.
- Workshops facilitated and supported using members of the CASG Independent Assurance Review (IAR) team.
- Explicitly considers the project context, objectives, risks and drivers to develop a tailored approach captured in the PES.
- First Smart Buyer workshop conducted prior to Gate 0.
Smart Buyer: flexible application

• Analysis and strategy development method which can be used across the CLC.

• Can be applied to:
  – early definition of a Project ie pre-Gate 0;
  – during the In-Service and Disposal Phase;
    • changes to sustainment activities; or
    • upgrade Projects within the In-Service Phase.

Smart Buyer ‘Risk and Drivers’

• Acquisition
  – Requirements
  – Technology
  – Schedule
  – Commercial
  – Project Integration
  – Defence Integration
  – Financial
  – Strategic
  – Industry

• Sustainment
  – In-service Requirements
  – Obsolescence
  – Commercial
  – FIC
  – Financial
  – Strategic
  – Operational
  – Industry

For each Project/Proposal these are rated as:
High, Medium-High, Medium-Low or Low.
Smart Buyer Framework

Contestability Framework
Contestability Framework

- Key assurance function.
- Function complements the behaviours.
- Reviews force design outputs and all Gate proposals.
- Reviews proposals to check:
  - alignment with strategic capability and resource guidance;
  - acceptable basis for decision-making;
  - plans can be executed;
  - risk assessments and treatment strategies are appropriate; and
  - cost and schedule estimates.

Contestability across the CLC

- Assess Force Design outputs.
- Assess key artefacts eg Joint Concepts, CPN, JCNS.
- Check before major decision or approvals (Gates 0, 1, 2).
- Assess Programs as they change strategy.
- Assess changes to Sustainment Strategies.
- Review contract renewals.
Contestability Model across the CLC

- Current focus on Gate considerations
- Will be conducted across CLC

Contestability

- Is this the right thing to do?
- Will we receive the outcome we expect?
- Have things been done right?
Benefits of Contestability

- Makes submissions robust.
- Helps improve decisions (not make them).
- Checks key content such as Joint Capability Needs Statement (JCNS) before Smart Buyer workshops.
- Key to establishing and maintaining trust with Government and the Central Agencies.
- Supports a strengthened Defence strategic centre.

Integration and Interoperability Framework (I2F)
I2 Framework (I2F)

- I2F is based on four elements:
  - I2 Reference Set: Defence I2 design, configuration status, standards, requirements (incl C4ISR Design).
  - Tailoring of I2 requirements appropriate to each Program, Project, and Product.
  - Assurance of tailored I2 requirements with focus on Gates 0 to 2.
  - Demonstration of I2 achievement over the CLC.
I2 Framework (I2F)

I2 Reference Set

Required I2 Practices:
- Demonstration Traceability
- Use of DCMILC
- Consultation
- Compliance Agreements
- National Assessment Pathways
- Configuration Control of I2 info.

Compliant with:
- Joint Force Outcomes
- Supporting Joint Concepts
- Integrating (I2) Objectives
- Directed (I2) requirements

Authorized Reference Designs:
- C2 Design
- Program Architectures
- System Architectures
- Product Baselines

Authorized I2 Requirements:
- Joint Force Outcomes
- Supporting Joint Concepts
- Integrating (I2) Objectives
- Directed (I2) requirements

I2 Implementation

Program
- Drives Project/Product I2 requirements

Project
- Decide Project I2 requirements
- Systems and Interface Specifications

Product
- Product Baseline
- Product Baseline

External Obligations and Agreements

I2 Assurance, Approval

Assure and approve Investment Proposals for compliance with I2 Reference Set Requirements

Assure Program, Project and Product Realisation for I2 compliance with approved requirements

Assure ongoing in-service I2 compliance of Products against approved I2 requirements

Management Layers in the CLC
CLC and Capability Management Practices

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CLC Management Layers

1. **Portfolio**: whole view of Defence capability investment.
2. **Capability Stream**: ties investment to strategic outcomes.
3. **Program**: Groups of related Projects, Products, activities.
4. **Product**: whole lifecycle view of capability system (all FIC).
5. **Project**: delivers/establishes all FIC for Product lifecycle.

Implementation of the CLC relies on layers of management:

- **Portfolio** view of capability investment including capital investment and operating costs.
- **Capability Stream** ties investment to strategic outcomes.
- **Programs** are capability groupings of related activities which deliver joint force outcomes and supports an improved strategic view.
- **Products** enable clear recognition of the whole capability outcome which is delivered through **Projects**.
Portfolio

- Two key investment concepts introduced as part of the CLC:
  - Investment Portfolio: constitutes all approved and non-approved proposals and concepts.
  - Integrated Investment Program (IIP): how these are actioned and realised.
- Investment Portfolio creates pipeline of Programs or proposals that may eventually enter the IIP.
- Portfolio view: holistic view of currently approved and potential future investment.

Portfolio: benefits

- The Portfolio approach provides comprehensive visibility of Defence investment as it relates to capability.
  - Ensure as a whole, investments achieve Defence’s strategic goals.
  - Optimise the use of allocated resources.
  - Be able to manage risks at a Portfolio level.
  - Adjust investment actions as necessary.
Portfolio: Managing Investment

- The Defence capability investment Portfolio is managed through:
  - an Integrated Investment Program (IIP)
  - comprising multiple Programs of initiatives
  - which clearly reflect Defence’s strategic goals
- ‘Managing the Portfolio’ means balancing Defence’s prioritised strategic capability needs against the business realities of risk, resources, and changes over time.

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<th>Capability Stream</th>
<th>Program</th>
<th>Product / Project</th>
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Portfolio Engagement with Government

- Cycle:
  - IIP approved annually as part of Budget.
  - Bi-annual IIP performance updates to the Minister.
- Continuous engagement with Central Agencies and Minister.
- Individual Project and Program engagement:
  - Timely, transparent and two-way engagement.
  - Supported by Contestability and Investment Portfolio Management Branch.
Integrated Investment Program (IIP)

- Rolling ten-year expenditure plan approved annually by government.
- Managed through the Investment Committee (IC) and Defence Committee (DC).
- Includes activities and projects approved via:
  - DWP.
  - Program update.
  - Gate 1.
- Spans all investment activities, including Major Capital Equipment and Enterprise ICT and Estate initiatives, over the entire CLC.

Integrated Investment Program (IIP)

- The IIP is structured into six Capability Streams taken from the Defence White Paper.
- Organised into 40 Programs mapped to the Capability Streams.
- Provides the Portfolio view.
- Capability Stream provides better communication with Government and others of Defence’s higher-level priorities.

Six Capability Streams
Six Capability Streams

- Six Capability Streams:
  - ISREW, Space and Cyber.
  - Air and Sea Lift.
  - Land Combat and Amphibious Warfare.
  - Strike and Air Combat.
  - Maritime and Anti-Sub Warfare.
  - Key Enablers.

- Used for:
  - Structuring the IIP
  - Seeking innovation proposals (Defence Innovation Hub)
  - Defence Industrial Capability Plan.
CLC Programs

- Significant change is CLC focus on Programs rather than individual Projects.
- Programs deliver capability outcomes in support of Government-endorsed Capability Streams.
- To deliver capability outcomes at Program level there needs to be a Program Management approach across a number of dimensions including:
  - operational,
  - Functional,
  - technical, and
  - delivery and in-service management.

Program Features

- A Program is:
  - a group of related Projects, Products and activities.
  - an enduring capability outcome.
  - supports joint capability outcomes.
  - managed by a Program Sponsor. and
  - to be managed to optimise capability outcomes within allocated resources.
CLC and Capability Management Practices

Dr Mike Ryan & Dr Shari Soutberg

Program

Program is made up of Products, Projects, and Activities which:
- deliver a capability outcome,
- have relationships, and
- likely need to be synchronised or coordinated.

![Program Diagram]

Capability Stream to Program Matrix

![Capability Stream to Program Matrix Diagram]

Source: Interim CLC Manual
CLC and Capability Management Practices

Dr Mike Ryan & Dr Shari Soutberg

Capability Streams and Programs

- **Vertical Streams:**
  - Structure for Defence Business – prioritisation.
  - Communication with Government.
  - Make Defence efforts visible.

- **Horizontal Streams:**
  - CM domains.
  - Both major capital and key enablers.
  - Whole of FIC and Whole of Life and all investment.
  - 40 Capability Programs.
  - Strategic narratives in DWP16 and FSR inform Program definition.
  - Plan for proposals to Government to be at Program level.

Program Approach - Benefits

- IC and Capability Stream Leads can prioritise across the Defence Portfolio.
- Improves the strategic view for government direction.
- Efficiencies across groups of similar Products and Projects.
- Facilitates Joint Force by Design
- Provides a common reference across operational, functional, technical and management interdependencies for each project and sustainment activity.
Product

- Product:
  - Capability (based on Platform, equipment or commodity) managed in a Program.
  - Includes all FIC.
  - Whole of life cycle (concept to disposal).
  - Delivers capability effect.

- Project:
  - Activity which delivers Products including all FIC.
  - Requires Integrated Project Management.

CLC Product/ Project Relationship

A Project is:

- A unique, finite, multidisciplinary and organised endeavour to realise discrete changes to the capability managed in a Program.

- The means by which a Product/s are delivered.
CLC Product/ Project Relationship

A Project is:

- A unique, finite, multidisciplinary and organised endeavour to realise discrete changes to the capability managed in a Program.
- The means by which a Product/s are delivered.
Programs and the Joint Force

- Programs enable management of interdependencies between capability systems and therefore Joint Force outcomes across CLC:
  - Force Design.
  - Requirements Setting.
  - Acquisition.
  - Integration and Interoperability.
  - Acceptance into Service.
  - Sustainment.

---

Joint Force: Programs/Products/Projects
Aspects of Interdependency

- Requires management of **four aspects of interdependencies** between capability systems in Proposal, Project, or Product ‘stage’:
  - **Operational needs and requirements** (based on CONOPS).
  - **Function and Performance** requirements.
  - **Technical requirements**: system and interface requirements.
  - **Implementation management** including planning, assignment, contracting, and assurance across all FIC.

Program Management for Joint Capability

- What are the operational interdependencies between the related capability systems?
- What are the function and performance dependencies between the capability systems that deliver the required operational effects?
- What are the technical requirements and constraints between capability systems (system interface requirements, system requirements and associated standards) that will enable the required function and performance outcomes?
- What are the Program, Project and Product management interdependencies (such as system development activities, contracting actions, T&E events) that must be coordinated and synchronised to enable definition, realisation, and ongoing management of system interdependencies?
Roles in the CLC

CLC Leadership

Two types of CLC leadership:

1. Governance of the CLC Policy and Process:
   - VCDF: CLC Policy, Chair of Investment Committee (IC), Managing the Integrated Investment Program (IIP), Joint Force Authority, C4ISR Design Authority
   - Associate Secretary: Contestability
   - DEPSEC CASG: Smart Buyer

2. Implementing the CLC:
   - as per CLC Accountability Model.
CLC and Capability Management Practices

Dr Mike Ryan & Dr Shari Soutberg

CLC Accountability Model

- Two vertical streams of accountability:
  - Customer – left
  - Delivery/Supplier – right

- Integrated teams from both 'sides'

- Partnerships are key
Customer: Defence Committees

Defence Committee (DC):
- Chaired by Secretary.
- Primary decision making committee for Defence.

Investment Committee:
- Chaired by VCDF.
- Supports DC on capability investment.

Enterprise Business Committee
- Chaired by Associate Secretary.
- Ensures effective running of Defence organization.
- In-year sustainment allocations for capability systems that are in-service.

Investment Committee (IC)
- Subsidiary of the Defence Committee.
- Ensures resourcing consistent with Defence’s strategic priorities and strategy.
- Gate 0 decisions for majority of proposals (major capital equipment, ICT and infrastructure).
- Oversees implementation and integrity of IIP.
- VCDF (Chair), Assoc Sec, CJC, DEPSEC SP&I, CFO, CN, CA, CAF, DEPSEC CAS, CDS, FAS Contestability, Central Agencies (Finance, PM&C).
**Capability Managers (CM)**

- Accountable to raise, train and sustain capabilities as directed by Secretary and CDF.
- Considered the ‘customer’.
- CMs are:
  - Chief Joint Capabilities: Joint Integration
  - DEPSEC Strategic Policy and Intelligence: Intelligence and Cyber.
  - Chief of Navy: Maritime.
  - Chief of Army: Land.
  - Chief of Air Force: Air and Space.
  - Chief Joint Capabilities/ Associate Sec: Key Enablers.

**Capability Manager (CM)**

- Develops the capability needs as tasked by VCDF.
- Makes funding available to the Delivery Group.
- Closely supports Delivery Group’s development of the PES.
- Responsible for Gate proposals including development and managing its progression to the Investment Committee.
**CLC and Capability Management Practices**

Dr Mike Ryan & Dr Shari Soutberg

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### Capability Stream to Program Matrix

**Capability Streams (to prioritise over multiple domains)**

- **ISREW, Space and Cyber**
- **Air & Sea Lift**
- **Land Combat & Amphib Warfare**
- **Strike & Air Combat**
- **Maritime & Anti-Sub Warfare**

**Key Enablers**

- **Chief Joint Capabilities**
- **Chief of Navy**
- **Chief of Army**
- **Chief of Air Force**

Source: Interim CLC Manual

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### Program Sponsor

- Program Sponsor represents the CM for Programs.
- Accountable to CM for outcomes of all Program activities.
- Accountable for ensuring Program remains aligned with Defence strategic objectives.
- Is pivotal to managing across related Projects, Products, and activities.
- Is key to Joint Force integration.
Project/Product Sponsor

- Project/Product Sponsor represents both CM and the Program Sponsor.
- Liaises directly with the Integrated Project and Product Managers (IPM/IPdM).
- Sets direction for Project.
- Ensures Project activities and outputs are consistent with capability needs and priorities of capability user.

Delivery Groups

- Includes CASG (materiel), CIOG (ICT), SP&I (classified projects) and E&IG (facilities).
- Support CM in developing Proposals, strategies.
- Develop the Project Execution Strategy (PES).
- Conduct Independent Assurance Reviews (IAR).
- Coordinate early Industry involvement.
- Execute Integrated Project Management Plan (IPMP) for CM.
- Sustain capability as directed & resourced by CM.
- Dispose of capability and provide advice to CM on sustainment obsolescence and disposal.
Program Manager

- Appointed within Delivery or Enabler Group to conduct Program Management for acquisition and sustainment activities.
- Pivotal to:
  - coordinating across related Projects, Products, and activities.
  - Program Manager optimisation of available resources.
- Program Manager related policies and practices are in development.

Integrated Project/Product Manager

- Integrated Project Manager (IPM) responsible to:
  - plan and deliver the Project;
  - inclusive of all agreed FIC; and
  - to the specified scope, schedule and budget.
- Integrated Product Manager (IPdM) responsible (to SPO Director and Product Sponsor) to:
  - ensure all FIC identified and available to sustain the Product;
  - plan and coordinate inputs from FIC providers including industry;
  - coordinate development, management of delivery agreement including the Product Schedule.
Contestability Division

- Independent assurance to VCDF, Secretary, CDF, Central Agencies, Ministers and Government.
- Ensures Defence’s capability needs and requirements aligned with strategy and resources and can be delivered in accordance with government direction.

Enabler Groups

- Develop FIC and enabler components, coordinated by the Delivery Group.
- Subject matter expertise to:
  - Force Design Division;
  - Contestability Division; and
  - Delivery Group’s Integrated Project/Product Management.
- Contribute to CM’s Program Strategy.
Integrated Project/ Product Teams

- **IPT**: established to manage Project functions up to end of Acquisition Phase.
- **IPdT**: established before end of the Acquisition Phase to conduct asset management activities for a Product.
- In both Project and Product cases:
  - customer and supplier sides share a partnership; and
  - comprise representatives from all relevant stakeholders.

### Summary of Accountability Model

- Partnerships and close coordination are core.
- Program Sponsor and Program Manager relationship is integral especially for realising joint capability.
- Integrated Project/Product Teams comprise representatives from all relevant Defence stakeholders.
- IPM/IPdM coordinates delivery and integration of FIC.
CLC and Capability Management Practices

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Preview of CLC Documents and Artefacts

Overview: CLC Artefacts and Relationships

What and Why
- Defence White Paper
- Force Design

How
- PGPA Act
- CPRs
- Smart Buyer
- DIP
- DPPM

Strategic Guidance
- AMS

Concepts
- FOE
- JCF
- AJOC
- FJOC

Issued by JCA in PEO CM
- JCN

Raised within Force Design as Program level direction
- CPN

Program Strategy
- PIOC

Proposal or Sponsor’s Paper + JCNS + PES
- JCNS

IPMP

Project WBS
- OCD

IMS
- FPS 1

Selected Innovation Suite
- Tender and Contract Documents
- FPS 2
Phases of the CLC

Overview: Phases of the CLC

The CLC is a **four-phase, risk-based** decision-making process which:

1. Identifies **capability needs**.
2. Defines and decides **capability solutions**.
3. **Acquires** the capability and introduces it into service.
4. **Supports** the capability through its life including disposal.
CLC and Capability Management Practices

Dr Mike Ryan & Dr Shari Soutberg

CLC Gates

There are three decision gates:

- **Gate 0**: Defence decision to progress a proposal to the next Gate. All proposals go through Gate 0.
- **Gate 1**: Government decision to approve and progress complex and high-risk proposals to Gate 2 including select a specific option(s).
- **Gate 2**: Government decision to acquire a fully defined and costed capability.

Investment Approval Pathway

<table>
<thead>
<tr>
<th>Strategy and Concepts</th>
<th>Risk Mitigation and Requirements Setting</th>
<th>Acquisition</th>
<th>In-Service and Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate 0</td>
<td>Gate 1</td>
<td>Gate 2</td>
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</tbody>
</table>

STRATEGY AND CONCEPTS
Strategy and Concepts Phase: Force Design

- Draws on a continuous force design cycle to evolve joint capability concepts and identify capability needs.
- Identifies current, forecast or potential capability gaps, risks and issues and opportunities that may need further investment.
- Develops capability options to meet missions stated or derived from strategic guidance.
- Basis for a CM to develop the Gate 0 Proposal.
- Emphasis on ‘Joint force by Design’ to realise integration and interoperability of Defence capabilities.
• **Force Design:**
  - Centralised.
  - Core function of Strategy & Concepts.
  - ‘Joint Force by Design’: force integration and interoperability.

• **Defence Capability Assessment Program (DCAP):**
  - Annual, Agile, Fundamental modes.
  - Prioritised capability investment recommendations for IIP.
Force Design

- Core to the Force Design effort is the DCAP framework which identifies force design options.
- Force Design Division uses a combination of activities:
  - Experimentation,
  - war-gaming,
  - simulation and modelling,
  - operations analysis, and
  - options development and analysis.

Strategy and Concepts Phase: Force Design

- Output: Joint Capability Narrative (JCN)
- Capability Manager (CM) assigned
- Output: Joint Capability Needs Statement (JCNS)

Need (‘what’) defined
**Strategy and Concepts Phase: Smart Buyer**

- **Gate 0**
  - Force Design Framework (DCAP)
  - Output: Joint Capability Narrative (JCN)
  - Capability Manager (CM) assigned
  - Output: Joint Capability Needs Statement (JCNS)

**Smart Buyer Framework**

- **Need**
- **Risk/Driver Profile**
- **Analysis/Tailoring**
- **Strategy**
  - Approvals Strategy
  - Project Mgt Strategy
  - Acquisition Strategy
  - Sustainment Strategy

**PES**

**JCNS**

- Requirements
- Technology
- Schedule
- Commercial
- Project Integration
- Defence Integration
- Financial
- Strategic
- In-Service
- Obsolescence...
Strategy and Concepts Phase: Smart Buyer

- Strategy and Concepts
- Risk Mitigation and Requirements Setting
- Acquisition
- In-Service and Disposal

Gate 0
- Force Design Framework (DCAP)
  - Output: Joint Capability Narrative (JCN)
  - CM assigned
  - Output: Joint Capability Needs Statement (JCNS)

Gate 1
- Smart Buyer Framework
  - Delivery Group assigned
  - IPM assigned and IPMT initiated
  - Output: Project Execution Strategy

Gate 2
- Strategy (‘how’) defined

Strategy and Concepts Phase: Contestability

- Strategy and Concepts
- Risk Mitigation and Requirements Setting
- Acquisition
- In-Service and Disposal

Gate 0
- Force Design Framework (DCAP)
  - Output: Joint Capability Narrative (JCN)
  - CM assigned
  - Output: Joint Capability Needs Statement (JCNS)

Gate 1
- Smart Buyer Framework
  - Delivery Group assigned
  - IPM assigned and IPMT initiated
  - Output: Project Execution Strategy

Gate 2
- Contestability Framework
Contestability Model across the CLC

- Current focus on Gate considerations.
- Will be conducted across CLC.

Source: Department of Defence
Strategy and Concepts Phase: Gate 0

Gate 0 Proposal

- Proposes business case/argument comprising:
  - What and Why: Joint Capability Needs Statement (JCNS).
  - How: Project Execution Strategy (PES).
- Proposes activities and outcomes to next Gate including:
  - risk reduction activities and funding requirements; and
  - expected outcomes eg requirements definition, down selection of options, risk profile, costings.
- Contains sufficient argument and level of detail appropriate to risk, complexity to make decision on Investment Proposal.
Gate 0 Proposal: JCNS + PES

- Presents the need, argument and strategy
- Documents risk profile* and funding needs
- Proposes tailored strategy:
  - Approval:
    - Authorities, for example National Security Committee (NSC), One/Two Ministers.
    - Pathway, for example:
      - fast track from Gate 0 to Gate 2; and
      - significant risk reduction studies Gate 0 to Gate 1.
  - Acquisition.
  - Sustainment.
  - Project Management.

* Smart Buyer risk profiling eg Financial, Requirements, Integration, Industrial

Industry Engagement

- Prior to Gate 0, CM and Delivery Groups are expected to engage with industry* to:
  - support analysis,
  - promote innovation,
  - procure industry services, and
  - test concepts.

* Defence Industry Policy discussed in greater detail later.
Tailoring for Gate 0 Proposal

- Tailor investment strategy appropriate to circumstances: complexity, cost, and risk.
- Smart Buyer informs tailored investment approval pathway, strategies and level of contestability.
- Tailoring allows simpler capability investments to be expedited, freeing up resources for more complex initiatives.
- Tailored and innovative CLC implementation demands greater understanding of capability management and CLC.

Tailoring Practices

Every capability development proposal and its implementation must be tailored to particular circumstances:

✓ Must be:
  • ‘fit for purpose’,
  • sufficient, and
  • cognisant of unique factors especially risks.

X Must not:
  • be a ‘cookie cutter’ application of other efforts, and
  • use templated content.
Gate 0 - Proposal

Comprises:

- **Sponsor Paper:**
  - Business Case argument.
  - Contestability Statement.
  - Total Cost of Ownership (TCO).
  - Industry considerations.
- **Joint Capability Needs Statement (JCNS).**
- **Project Execution Strategy (PES).**

> Addressed later in discussion on 'artefacts'.

---

**Strategy and Concepts Phase: Gate 0**

- **Force Design Framework (DCAP):**
  - Output: Joint Capability Narrative (JCN)
  - CM assigned
  - Output: Joint Capability Needs Statement (JCNS)
- **Smart Buyer Framework:**
  - Delivery Group assigned
  - IPM assigned and IPMT initiated
  - Output: Project Execution Strategy
- **Contestability Framework:**
  - Contestability Division engaged
  - Output: Assurance statement
- **Gate 0 Proposal:**
  - Output: Gate 0 Proposal comprising: Submission; JCNS; PES

Proposal submitted
**Strategy and Concepts Phase: IC consideration**

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<td></td>
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<td></td>
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<td><strong>consideration</strong></td>
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<td></td>
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<td><strong>Output</strong>: Gate 0 Proposal comprising: Submission; JCNS; PES</td>
</tr>
</tbody>
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**Gate 0 – Overview**

- **Internal** Defence decision which considers capability need, possible options, risk and strategy to progress.
- **Gate 0 Proposal** presented by CM and prepared with support from Delivery Group/s and FIC providers.
- IC approves further development of feasible and achievable options with agreed requirements, timeframes, and funding:
  - to Gate ; or
  - agreement to proceed directly to Gate 2.
- **Gate 0 approval** is issued by the VCDF.
- **Gate 0 Proposal** evolves for Gate 1 and Gate 2.
Gate 0 - Outcomes

- Constitutes formal endorsement of the PES and funding (including any adjustments as necessary).
- Endorses activities and defines expected outcomes for next Gate.
- Can initiate entry into IIP through higher delegation.

### Strategy and Concepts Phase: IC consideration

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<thead>
<tr>
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<th>Gate 2</th>
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</tr>
<tr>
<td>Investment Committee consideration</td>
<td>Output: Project Direction</td>
<td>Output: Product Delivery Agreement</td>
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RISK MITIGATION AND REQUIREMENTS SETTING

Risk Mitigation and Requirements Setting

- Objective is to **reduce risk** and **define requirements** to:
  - provide sufficient basis for government approval to acquire;
  - establish a firm contractable position to proceed with the acquisition; and
  - Project prepared for Acquisition Phase.

- Includes:
  - develop and select capability options; and
  - preferred supplier identified (generally).
RM&RS activities - purpose

- **Risk reduction** needed so that:
  - approvals to spend public monies can be made with confidence and are defendable; and
  - less likelihood that the Project will fail.
- **Requirements definition** needed so that there is:
  - clear understanding of what is being acquired; and
  - clear basis to seeks tenders and contract.

RM&RS activities - actions

- **Risk reduction**:
  - based on the Smart Buyer risk profile, and
  - activities approved at Gate 0.
- **Requirements definition**:
  - derived from needs documents (JCN and JCNS); and
  - captured in detailed requirements suite OCD, FPS, and TEMP used for solicitation and contract.
RM&RS activities – interrelated

- **Inter-related actions**: improving understanding, reducing or eliminating risky aspects, making choices (e.g., ‘design’ decisions), defining requirements in greater detail.

- Decreasing risk and better definition enables progressively greater expenditure commitment.

RM&RS – progressive commitment

- Progress is achieved so that more definitive proposals are presented at each decision point (Gates 0, 1, 2).

- Level of risk and definition of requirements corresponds to the level of commitment being made by Defence.
RM&RS – progressive commitment

- At Gate 0 higher uncertainty is acceptable when less funding is being committed (e.g., just for risk reduction activities).

RM&RS – progressive commitment

- At Gate 1 the risk or uncertainty must be reduced so that there is confidence to approve funds as part of the Defence IIP.
**RM&RS – progressive commitment**

- At Gate 2 the risk or uncertainty must be low enough that the Commonwealth is prepared to enter into a contract.

**RM&RS – sufficient definition to contract**

- The requirements must be derived and developed so that Commonwealth can seek tenders and eventually enter into a contract.
RISK MITIGATION

Managing risk is an absolutely crucial part of the redesigned CLC.

“We often think that having a 6,000 line item risk register will solve all our problems; it doesn't. So where our focus is now on identifying the risk at that point of the life cycle that is appropriate, and then working out the controls, making sure those controls are effective and monitoring the outcomes. We really need to rethink what we think risk management is all about”.

VADM Ray Griggs, VCDF 2016
What is Risk in the context of the CLC?

“Risks are events or occurrences that prevent a program from achieving its cost, schedule, or performance objectives”.

Source: MITRE, Risk Matrix User's Guide, V2.2

- CLC-related Risk is that capability investment (Project) will fail:
  - delivered capability will not meet the need,
  - costs become unaffordable,
  - will be too late to address capability gap,
  - can’t be maintained, and
  - unsafe.
- Impact is that Defence capability is deficient and taxpayer money is wasted.

Risk Management in the CLC

General risk management process:
1. Identify the risk ‘events’ or occurrences.
2. Estimate the likelihood of these happening (probability).
3. Estimate what the impact will be.
4. Figure out the level of risk level and ranking between risk events.
5. Plan what to do to control, reduce, eliminate the risk events.
6. Implement risk management (mitigation, reduction).
Risk Mitigation and Smart Buyer

- Smart Buyer is a structured approach for this process:
  - defined risk and drivers categories across Project, Product
  - method to identify risk events, features and impacts (analysis, workshops)
  - matrix to capture risk profile:
    - risk rating
    - ranking
  - PES captures the risk reduction plan
- Gate decisions provide a key mechanism to secure funding and approvals to commit funds to risk mitigation, reduction

Smart Buyer ‘Risk and Drivers’

- **Acquisition**
  - Requirements
  - Technology
  - Schedule
  - Commercial
  - Project Integration
  - Defence Integration
  - Financial
  - Strategic
  - Industry

- **Sustainment**
  - In-service Requirements
  - Obsolescence
  - Commercial
  - FIC
  - Financial
  - Strategic
  - Operational
  - Industry

For each Project/Proposal these are rated as:
High, Medium-High, Medium-Low or Low.
Implementing Risk Mitigation

Smart Buyer Risk Profile

PES

Risk Reduction Studies
- Technical and implementation risks
- Eg RFI (commercial risk)
- Trade-off studies

System Engineering Activities

Further Requirements Definition

System Reviews

REDUCING UNCERTAINTY AND MITIGATING RISK

REQUIREMENTS SETTING
Requirements Setting Overview

- **Purpose:** Define what is to be acquired:
  - clear basis (legal obligation) for spending public monies;
  - need it to enter into a contract; and
  - can confirm that what has been delivered is acceptable.

- **Activity:** Converting approved high level needs (from Strategy and Concepts Phase (JCN, JCNS)) into a contractable requirement ie contract docs incl specifications.

- **Method:** Structured Systems (Requirements) Engineering.

- **How much is to be done?:** Sufficient to provide adequate certainty about requirements which meets risk appetite of decision-makers and you can tender and contract.

- **Who is involved?:** CM, Systems Engineer / Requirements SME, FIC providers, and Delivery Group/s.
Sufficiency of Requirements

“Requirements need to be developed to a sufficient level of specificity to support industry engagements, capability acceptance, and detailed analysis (particularly of implications for the fundamental inputs to capability) to understand the full scope and broad feasibility and risks of the proposal.”

Source: Para 2.69 Updated Interim CLC Manual
Program-level Requirements Aid Efficiency

All artefacts shall satisfy the CLC expectation of **sufficiency**.

That is, each subordinate artefact leverages the parent artefact and other information so that only the essential ‘delta’ is developed.

Requirements Scope and Considerations

- All FIC Elements
- Whole of life cycle
  - Risk Reduction activities
  - Acquisition activities
  - Transition into Service
  - Sustainment
  - Operational Support
  - Disposal
- Joint Force Integration and Interoperability
- Legislative and Regulatory requirements
  - Seaworthiness, Airworthiness, Technical Regulation
  - WHS Act, EPBC Act etc
- **Must be unambiguous, testable etc**
Fundamental Inputs to Capability

• FIC Elements:
  – Command and Management,
  – Organisation,
  – Major Systems,
  – Personnel,
  – Supplies,
  – Support,
  – Facilities,
  – Collective Training,
  – Industry.

FIC must be integrated and managed to realise and sustain a capability: a deficiency in any one adversely impacts the whole.

Requirements for Mission Systems

• The scope of requirements considerations for a mission system can be extensive such as:
  – Capability: operational, function, and performance.
  – Interfaces and Interoperability.
  – Materiel Safety (including WHS).
  – Security.
  – Human factors.
  – Reliability, Maintainability, Obsolescence, Supportability.
  – Software.
  – Electromagnetic Environmental Effects.
  – Environmental factors.

• Systems engineering and expertise should be sought to determine what is applicable to a particular situation and what is sufficient for an acquisition.
Requirements for Support Systems

- The scope of requirements considerations for a support system can also be extensive such as:
  - personnel requirements for maintenance activities;
  - sovereign capability requirements;
  - technical data requirements;
  - location constraints;
  - component packaging;
  - transportability;
  - deployability, fault isolation and maintainability; and
  - disposal requirements.

- Systems engineering and materiel logistics expertise should be sought to determine what is applicable to a particular situation and what is sufficient for an acquisition.

Requirements Effort Across the CLC

- IPT develops high level requirements based on JCN, CPN, PIOC, JCNS
- IPT further develops requirements appropriate to risk drivers and appetite
- Refinement of requirements through solicitation activities
- Refinement of requirements and use of requirements in validation, verification and assurance
- Ongoing management and use of requirements as reference for sustainment activities

Use of Requirements
- Down Select solution options
- Cost/Capability tradeoffs
- Government endorsed requirements as reference for upgrades etc.

Level of Effort
- IPT: Reqs effort
- Requirement monitoring throughout
- Test and Trials design

- In-Service and Disposal
- Acquisition
- Risk Mitigation & Requirements Setting
- Strategy and Concepts

Gate 0  Gate 1  Gate 2
Dedicated Requirements SME sourced from the Engineering COE will allow warfighter and other SME to focus on their specialist contribution to the IPT.

**Requirements SMEs**

- **Engineering Centre of Expertise (COE)**
  - Policy and Practice
  - Requirements Advice
  - Engagement of Industry support
  - Requirements Service

**IPT**

- **Project/Product Sponsor**
- **Program Manager**
- **Integrated Project/Product Manager**

---

**RISK MITIGATION AND REQUIREMENTS SETTING (Gate 1)**

- **Strategy and Concepts**
- **Risk Mitigation & Requirements Setting**
- **Acquisition**
- **In-Service and Disposal**

**Gate 0**  **Gate 1**  **Gate 2**
Gate 1

- Gate 1 approval may be required for complex and high risk proposals or when a government decision is required in order to narrow the field of options.
- Gate 1 is the Government decision to:
  - select a specific option or options; and
  - proceed with agreed timeframes, technical requirements and financial commitments to Gate 2.
- Gate 1 approval is not a commitment to acquire a new capability; it only gives approval to conduct the necessary work to progress to Gate 2.

Gate 1 Considerations and Artefacts

- Gate 1 Proposal describes:
  - results of risk reduction activities since Gate 0;
  - progress in reducing options;
  - progress in requirements definition, cost estimation;
  - plans (incl risk mitigation activities) to proceed to Gate 2; and
  - Industry engagement outcomes.
- Incorporates:
  - updated PES; and
  - Draft Submission to Government.
- CM is responsible for Gate 1 Proposal.
Gate 1 Outcomes

- Project included in IIP.
- Options agreed to progress to Gate 2.
- Plans approved to progress the proposal to Gate 2.
- Approval to engage industry through solicitation activities.

Gate 0 to Gate 1: Summary

- Output: Achieved reduced risk profile
- Output: Requirements Documentation eg Preliminary OCD, FPS, TEMP
- Output: Contestability statement
- Output: Gate 1 Proposal including:
  - draft Approval Submission to Govt
  - proposed option/s
  - updated PES
  - cost, schedule estimates
  - IPMP
- Output: Project in IIP
- approval to conduct solicitation
Gate 0 to Gate 1: Summary

- Output: Achieved reduced risk profile
- Output: Requirements Documentation eg Preliminary OCD, FPS, TEMP
- Output: Contestability statement
- Output: Gate 1 Proposal including:
  - draft Approval Submission to Govt
  - proposed option/s
  - updated PES
  - cost, schedule estimates
  - IPM
- Output: Project in IIP
- approval to conduct solicitation

SOLICITATION AND SOURCE SELECTION
Solicitation and Source Selection

- Pre-Gate 2, industry engagement often called solicitation
- Form of risk mitigation:
  - understanding possible solutions,
  - narrowing options,
  - choosing best solution, and
  - defining contracted requirements.
- Flexibility to adapt solicitation to circumstances (within legal and policy obligations):
  - Invitation to Register Interest (ITR).
  - Request for Tender (RFT).
  - Offer Definition Activities (ODA).

Sound Requirements are Critical

- Requirements used in solicitation must be traceable to government direction through artefacts such as:
  - Operational Concept Document (OCD).
  - Function and Performance Specification (FPS).
  - Test and Evaluation Master Plan (TEMP).
- Sound Requirements underpin:
  - what is to be acquired;
  - work to be done to implement the acquisition and sustainment outcomes;
  - Basis of Estimates (BoE) in terms of work, cost, schedule; and
  - confirming that deliverables are satisfactory.
Defining Work is also Key to Solicitation

• Work Breakdown Structure (WBS) captures the products to be developed or acquired and the activities needed to deliver these.
• WBSs are generally constructed at the:
  – Project-level.
  – Contract-level.
• WBS underpins the development of cost and schedule estimation.

Solicitation and Source Selection Documents

<table>
<thead>
<tr>
<th>Defence Documents</th>
<th>Tenderer Responses</th>
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<tbody>
<tr>
<td>ASDEFCON Suite including:</td>
<td>Tender documents which details the offer includes:</td>
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<tr>
<td>• Conditions of Tender</td>
<td>• Compliance Matrix</td>
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<tr>
<td>• Conditions of Contract</td>
<td>• Specifications</td>
</tr>
<tr>
<td>• SOW</td>
<td>• Plans</td>
</tr>
<tr>
<td>• OCD, FPS, TEMP</td>
<td>• Costs</td>
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<tr>
<td>• Data Item Descriptions (DIDs)</td>
<td>• Schedules</td>
</tr>
</tbody>
</table>

Source Evaluation

• Tender Evaluation
• Source Evaluation Report

Must be robust and fully defensible
RISK MITIGATION AND REQUIREMENTS SETTING (Gate 2)

Summary of pre-Gate 2 Activities

• Updating the PES.
• Risk Management.
• Requirements.
• Options Refinement.
• Cost Estimation.
• Industry Solicitation and Evaluation.
• Source Selection report development.
• Initial negotiations (if appropriate).
• Project Management and Sustainment Planning.
Gate 2

- Solicitation outcomes and source selection recommendations are presented to Gate 2.
- Focus on acquisition based on solicitation results including:
  - Final PES.
  - Preferred Contractor.
  - Draft Govt Submission.
  - Contestability Statement.
- Government decision to acquire a fully defined and costed capability including:
  - acceptance of risks,
  - authority to conduct acquisition and sustainment and
  - assignment of budget, schedule, scope.

Gate 2 Outcomes

- IC considers the Submission.
- Government approval allows commencement of the Acquisition Phase.
- As a result of Gate 2, Defence has authority, budget and timeframe to acquire a selected Product.
Gate 1 to Gate 2: Summary

**Gate 0**
- Output: reduced risk profile including options
  - final requirements docs (OCD, FPS, TEMP)

**Gate 1**
- Output: Source Evaluation Report: preferred solution / tenderer
  - Negotiating position

- Output: Contestability statement

**Gate 2**
- Output: Gate 2 Proposal including:
  - draft Approval Submission to Govt
  - final PES
  - preferred contractor
  - updated PES
  - cost, schedule estimates

- Output: approval to acquire

**Gate 1 to Gate 2: Summary**

**Gate 0**
- Output: reduced risk profile including options
  - final requirements docs (OCD, FPS, TEMP)

**Gate 1**
- Output: Source Evaluation Report: preferred solution / tenderer
  - Negotiating position

- Output: Contestability statement

**Gate 2**
- Output: Gate 2 Proposal including:
  - draft Approval Submission to Govt
  - final PES
  - preferred contractor
  - updated PES
  - cost, schedule estimates

- Output: approval to acquire
### Summary of what to take to the IC

<table>
<thead>
<tr>
<th>Use</th>
<th>Gate 0</th>
<th>Gate 1</th>
<th>Gate 2</th>
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<tbody>
<tr>
<td>Government</td>
<td>CabSub or MinSub</td>
<td>CabSub or MinSub</td>
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<td><strong>Investment</strong></td>
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<tr>
<td><strong>Committee</strong></td>
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<td><strong>• Draft Approval Submission to Government either Ministerial submission or Cabinet Submission</strong></td>
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<td><strong>• IC Synopsis</strong></td>
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<td><strong>• Sponsor Paper:</strong></td>
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<tr>
<td><strong>- Business Case argument</strong></td>
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<td><strong>- Contestability Statement</strong></td>
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<td><strong>- Total Cost of Ownership (TCO)</strong></td>
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<td><strong>- Industry considerations</strong></td>
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<td><strong>- JCNS</strong></td>
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<td><strong>- PES</strong></td>
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</tbody>
</table>

**Key Considerations**

- **Business Case**, Risk Assessment and mitigation actions, Acquisition and Sustainment Strategies, IPMP, Cost Estimates, Workforce Estimates, Whole FIC
- **Business Case**, Risk Assessment and mitigation actions, costs and schedule estimates, IPMP, Requirements (OCD, FPS, TEMP)
- **Business Case**, Risk Assessment and mitigation actions, costs and schedule estimates, IPMP, Requirements (OCD, FPS, TEMP), Source Evaluation

---

### ACQUISITION

- **Strategy and Concepts**
- **Risk Mitigation & Requirements Setting**
- **Acquisition**
- **In-Service and Disposal**
Acquisition

- **Objective**: acquire the Capability System inclusive of FIC elements and introduce it into service.
- **Activity**: Delivery Group progressively and formally transitions the systems to the Capability Manager who receives a system which satisfies the requirements previously agreed.
- **Primary task**: IPM manages Project in accordance with:
  - Gate 2 approval; and
  - corresponding documents and agreements.

---

**Key Points**

- IPM conducts acquisition in accordance with:
  - Gate 2 outcomes
  - Approved PES
  - Approved PDA
  - Approved IPMP including IMS
  - Contracts
  - Other approved agreements eg strategic partnership agreements
Acquisition: FIC

- IPM is responsible for delivery of FIC in two ways:
  - Delivers FIC for which lead Delivery Group is responsible.
  - Coordinates and integrates all FIC.
- Respective FIC delivery groups accountable for delivering their elements as agreed in the key planning documents and agreements (IPMP, PDA).

Acquisition: Transition

- Transition from Acquisition key milestones:
  - Initial Operating Capability (IOC).
  - Final Operating Capability (FOC).
- At FOC the Project is closed and IPMT stood down.
IN-SERVICE AND DISPOSAL

In-Service and Disposal Phase

- In-Service and Disposal Phase:
  - operates capability;
  - sustains Products that form the capability throughout their operational life; and
  - withdraws the Products from service before they are disposed of or sold.
### In-Service and Disposal Phase

- In-Service and Disposal Phase commences when Products accepted by CM from Delivery Group—that is, declaration of IOC.
- Acquisition and Sustainment can occur concurrently between IOC and FOC.

#### Acceptance of capability by CM

Acceptance of capability by CM is the key objective based on a range of factors including:

- **compliance:**
  - legislative requirements (eg environment and safety); and
  - regulatory requirements from Defence seaworthiness, airworthiness, and technical regulatory frameworks;
- **appropriate transition** into service activities; and
- **acceptable sustainment** arrangements.
CLC and Capability Management Practices

Dr Mike Ryan & Dr Shari Soutberg

In-Service and Disposal: Key aspects

- Integrated Product Manager (IPdM) appointed.
- Integrated Product Management Team (IPdMT) established.
- Product Delivery Agreement / Materiel Support Agreement.
- Product Delivery Schedules.

Sustainment Business Cycle

- Focus on meeting specified preparedness requirements at minimised life-cycle cost.
- PDA/MSA reviewed, updated at least annually:
  - ensure resources match agreed performance levels; and
  - basis for budget allocations and sustainment performance management and reporting.
Projects within the In-Service Phase

- Projects can be established during In-Service and Disposal Phase.

- Project construct and Project Management principles apply including:
  - Project Sponsor appointed.
  - IPM appointed.
  - IPMT established.
Key CLC Artefacts

- Key CLC artefacts can be divided into two broad categories:
  - Program for proposals or as common references for subordinate projects/products.
  - Project/Product for proposals.
Program

Program is made up of **Products**, **Projects**, and **Activities** which:
- deliver a capability outcome;
- have relationships; and
- likely need to be synchronised or coordinated.

---

**Program-level Artefacts**

<table>
<thead>
<tr>
<th>What and Why</th>
<th>How</th>
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</thead>
<tbody>
<tr>
<td>Defence White Paper</td>
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<td>Concepts</td>
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<tr>
<td>Program Strategy</td>
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</tbody>
</table>

Raised within Force Design or Program level direction

Proposed + Sponsor’s Paper + JCNS = PES

- Tender and Contract Documents

---

**Program**

Product A

Disposal

Project 1

Product

Disposal

Project 2

Product

Disposal

Product B

Disposal

Activity: eg preparedness analysis

Activity: eg modelling

---

**How**

- Tender and Contract Documents
- Project WBS
- IPMP
- IMS

**Program Strategy**

- CPN
- PIOC

**Portfolio**

- JCNS
- OCD
- FPS 1
- FPS 2
Program Artefacts

- **Program-reference:**
  - Capability Program Narrative (CPN).
  - Program Strategy.
  - Program Integrating Operational Concept (PIOC).

### Program Layer as ‘Umbrella’ Reference

<table>
<thead>
<tr>
<th>Defence Strategic and Operational Guidance</th>
<th>Joint Capability Narrative (JCN)</th>
<th>Program 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Capability Program Narrative (CPN)</td>
<td>Program Strategy</td>
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<tr>
<td></td>
<td></td>
<td>Program Integrating Operational Concept (PIOC)</td>
</tr>
</tbody>
</table>

#### Efficient
- **leverage** common content in ‘parent’

#### Aligned
- Related Projects and Products have common reference
Capability Program Narrative (CPN)

- Raised by Force Design Division.
- Provides CM with a synopsis of:
  - operational environment,
  - joint force needs,
  - constraints,
  - governance, and
  - sustainment arrangements and priorities where relevant.
- Distils strategic and conceptual guidance into actionable deliverable terms.
- All CPNs drafted.
I2 Framework (I2F)

I2 Reference Set

II. Authorized I2 Requirements
- Joint Force Outcomes
- Supporting Joint Concepts
- Integrating (I2) Objectives
- Directed I2 Requirements

II. Authorized Reference Designs
- Common Design Standards
- Program Architecture
- System Architecture
- Product Baseline

II. Required I2 Practices
- Demonstrated Traceability
- Use of Standards
- Consultation
- Established I2 Agreements
- Tailored Assurance Pathways
- Configuration Control of I2 Info

Joint Force Guidance

I2 Implementation

PROGRAM
- Drives Project/Product I2 requirements

PROJECT
- Decide Project I2 requirements
- Systems and Interface Specifications

PRODUCT
- Product Baseline

I2 Assurance, Approval

Assure and approve Investment Proposals for compliance with I2 Reference Set Requirements

Assure Program, Project and Product Realisation for I2 compliance with approved requirements

Assure ongoing in-service I2 compliance of Products against approved I2 requirements
I2 Framework (I2F)

Joint Force Guidance

I2 Reference Set
- Joint Force Outcomes
- Supporting Joint Concepts
- Integrating (I2) Objectives
- Directed I2 Requirements

I2 Implementation
- Defines Project/Program I2 requirements
- Decide Project I2 requirements
  Systems and Interface Specifications
  - Approved requirements test
  - Back into Reference Set
- Project
  - Product Baseline
  - Written by Program/Project Sponsor

I2 Assurance, Approval
- Ensure I2 compliance with Joint Reference Set
- Assure Program Project and Product realisation
- Assure ongoing in-service I2 compliance

I2 Framework (I2F)

Program Integrating Operational Concept (PIOC)

- Focus on Joint Force outcomes: Integration and Interoperability (I2).
- Consistent overarching design direction for relevant Programs, Products and Projects.
- Includes Program level operational architectures.
- Draws on joint warfighting architecture (C4ISR Design).
- Written and owned by Program Sponsor.

Source: Update Interim CLC Manual
Program Strategy (PS)

- Describes how the Program outcomes (CPN) will be achieved.
- Developed by Program Sponsor when a Program is established and then maintained.
- Intent:
  - maintain a pipeline of proposals, Programs, activities; and
  - manage Program gaps and opportunities.
- Used to coordinate:
  - activities for constituent Projects and Products (all FIC);
  - activities within and between Programs;
  - industry activities; and
  - scheduling and resourcing.

Proposal-level Artefacts

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>What and Why</th>
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<td>FIJC</td>
<td>Smart Buyer</td>
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<table>
<thead>
<tr>
<th>Program</th>
<th>CPN</th>
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<tr>
<td>PIOC</td>
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<table>
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<tr>
<th>Product</th>
<th>JCNS</th>
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<tbody>
<tr>
<td>OCD</td>
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<td>FPS 1</td>
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<td>FPS 2</td>
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<table>
<thead>
<tr>
<th>Proposal</th>
<th>Proposal = Sponsor’s Paper+JCNS+PES</th>
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<tbody>
<tr>
<td>PES</td>
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<td>IPM</td>
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<td>IMS</td>
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</table>

| Tender and Contract Documents |

- Issued by JCA in FEP GM
Proposal Artefacts

- Proposal Artefacts at Project or Product level:
  - Joint Capability Narrative (JCN).
  - Joint Capability Needs Statement (JCNS).
  - Project Execution Strategy (PES).
  - Business Case which supports Proposals & Submissions
  - Integrated Project Management Plan (IPMP).
  - Capability Definition Documents (CDD):
    - Operational Concept Document (OCD).
    - Function and Performance Specification (FPS).
    - Test and Evaluation Master Plan (TEMP).

Joint Capability Narrative (JCN)

- Who develops it?
  - Force Design Division (Force Options and Plans Branch).
- When is it developed?
  - when a capability need or enabling gap or opportunity identified.
- Why is it produced?
  - used to task appropriate CM to develop a more detailed JCNS; and
  - prepared as the rationale for an investment proposal.
Proposal Artefacts

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<tr>
<td>Tender and Contract Documents</td>
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</table>

JCNS

- Who develops it?
  - Program Sponsor as tasked by CM through a tasking statement.
- When is it developed?
  - when a capability need or enabling gap or opportunity identified through a JCN and the CM assigns a Program Sponsor; and
  - a key output of the Strategy and Concepts Phase.
- Why is it produced?
  - agreed statement of military or enabler need, which determines the capability required.

Source: Update Interim CLC Manual
PES

- Who develops it?
  - Delivery Group in close consultation with CM.
- When is it developed?
  - prior to Gate 0 and evolves after that, and
  - remains relevant until Project closure but may be updated.
- Why is it produced?
  - IC for decision making for the project at Gates 0, 1 and 2 of the CLC; and
  - FIC providers as a common reference for defining their activities.
- Four strategies: Approvals, Project Management, Acquisition, Sustainment.

CLC Business Case

- Evolves over the CLC Process (Gates 0 to 2).
- “Business Case presents an argument which demonstrates that the benefits or outcomes are worth the commitment of the planned resources ($, people, time)” (Defence CLC Seminar Feb 2017).
- Business Case argument addressed five 'cases':
  - Strategic Case.
  - Economic Case.
  - Financial Case.
  - Commercial Case.
  - Management Case.
CLC and Capability Management Practices
Dr Mike Ryan & Dr Shari Soutberg

CAPABILITY MANAGEMENT PRACTICES

CLC and capability development: challenge

Management of Public Monies

+ 

Technical endeavour to deliver and support capability

Accountability
Legal obligation
Govt processes

Significant Complexity
Science & Engineering
Precision and rigour

Intersection of Public Sector obligations and technical endeavor
CLC, capability development context

- Significant complexity, scale and cost:
  - Interdependencies.
  - Many stakeholders.
  - High cost.
  - Leading edge technologies.
  - Changing environment.

- Successful capability development depends on:
  - proven professional methods and techniques beyond organisational processes;
  - established Practices.

Capability Development Practices

- Developed by experts in each field.
- Captured in:
  - International and Australian standards; and
  - Bodies of Knowledge (BoK).
- Proven and flexible techniques, methodologies that are based on best practice.
- Frameworks that can be tailored to specific circumstances.
Capability Development Practices

- Practices are the ‘toolkit’ for implementing CLC.
- Core CLC Practices are:
  - Program, Product and Project Management.
  - Systems Engineering (SE).
  - Integrated Logistics Support (ILS).
  - Procurement and Contracting.
  - Assurance and Risk Management.
- There are more, such as Financial Management.
- Each provides a different ‘lens’ on capability development.

### Practices (‘Toolkit’)

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<th>Practices ('Toolkit')</th>
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<td>Program, Product and Project Management</td>
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<td>Procurement and Contracting</td>
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<td>Assurance and Risk Management</td>
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Practices are applied throughout the CLC Process tailored to the CLC Phase and the nature of effort.
Capability Development Practices

Practices are not separate activities rather need to be managed as inter-related streams of work throughout the CLC.

Lifecycle views of CLC Practices

- Capability Lifecycle
- Project Lifecycle
- Product Lifecycle
- System Engineering Lifecycle
- Procurement Lifecycle
A program is a group of related projects managed in a coordinated manner to obtain benefits not available from managing them individually. Program management is the application of knowledge, skills, tools and techniques to meet program requirements.

Source: PMI website

A Program, in the context of managing Defence capability, is defined as a group of related Projects, Products, and activities that are managed in a coordinated way to optimise capability outcome within allocated resources.

Program Management and Defence

• Two core Defence challenges:
  – achieving warfighting advantage: modern warfare increasingly reliant on asset integration and interoperability; and
  – resource constraints: optimisation of resource use (cost and schedule) through ‘leveraging’ related activities.

• Challenges mean managing relationships and interdependencies which can be:
  – complex and complicated; and
  – endure over time.

• CLC Programs provide the management and governance environment to support this.

Program Management and CLC

• Program Management practices can be applied to both:
  – Capability Programs (eg IAMD)
  – ‘Delivery’ Programs (eg Radar SPO)
Program Management and the CLC

- Program Management practice important in the CLC:
  - prioritisation of the Integrated Investment Program;
  - coordinate related, interdependent efforts across Projects, Products, and other Programs;
  - joint capability outcomes or other shared objectives;
  - efficiencies in resource constrained environment eg common-sensor fit across platforms; and
  - management approach which supports enduring and evolving capability development (as opposed to finite Project deliverables).

Program Management application

Program Management for Projects, Products which:
- are related, interdependent;
- possess shared objectives;
- managed separately;
- likely at different stages of life cycle;
- accountable authority for shared, joint outcomes;
- enduring over long-term; and
- involve System of Systems (SoS)*.

* SoS Engineering is an emerging Practice for realisation of systems which provide valuable emergent properties eg joint force.
SoS Engineering

- Structured engineering approach to defining, designing and developing systems with significant interdependencies.
- Program Management and SoS Engineering address the same context of multiple related systems which have a common objective eg joint capability.
- SoS Engineering provides a structured engineering approach to delivering capability Programs (like Systems Engineering (SE) Projects).

Key Enablers for Program Management

- CPN and JCN: narratives on the expected operational effects of the group of capability systems.
- PIOC: operational relationships between capability systems both within the Program and with other Programs.
- PS: activities, management arrangements, including integrated schedule across Projects and Products.
- Program Architectures: Program features using Defence Architecture Framework (DAF) conventions.
- I2 Framework: I2-Focussed guidance and requirements to achieve joint force outcomes.
- Program and Materiel Standards Governance Fora: Intra and inter-Program governance bodies such as PMSG and working groups.
I2 Framework (I2F)

Program Management

- Program Management is about managing complex relationships and interdependencies
- Program Management enables Defence to coordinate, synchronise and leverage related activities across the CLC including:
  - Requirements Setting.
  - Technical and engineering coordination.
  - Acquisition.
  - Integration and Interoperability.
  - Acceptance into Service.
  - Sustainment.
Defence Program, Product, Project Management

- Each CLC management layer (Program, Project, Product) requires appropriate management approach.
- CASG is Defence policy lead for:
  - Program Management.
  - Project Management.
  - Product Management.
  - Project Controls.

PRODUCT MANAGEMENT
Asset Management

- The Asset Management Council defines asset management as, “the life cycle management of physical assets to achieve the stated outputs of the enterprise”.

- ISO 55000 Asset Management defines:
  - an asset as “an item, thing or entity that has potential or actual value to an organisation”; and
  - Asset Management as “the coordinated activity of an organisation to realise value from assets.

- Emphasis on:
  - holistic view; and
  - value to the organisation.

The Asset Life Cycle

- An Asset can be viewed as having a lifecycle made up of stages which “…can start with the conception of the need for the asset through to its disposal…” Ref: ISO 55000:2014 (E)

- Generic view:

<table>
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<tr>
<th>Planning</th>
<th>Acquisition</th>
<th>Operation and Sustainment</th>
<th>Retirement/ Disposal</th>
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<td>Asset Lifecycle</td>
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</table>

- ISO 55000: 2014 (E): “…naming and number of stages and the activities under each stage usually vary in different industry sectors and are determined by the organisation.”
CLC Product

- Product:
  - Platform, equipment or commodity.
  - Includes all FIC.
  - Whole of life cycle (concept to disposal).
- Product Management is the ‘end to end’ management of the Product inclusive of the Project that realises it ie holistic view.

Benefit of Asset and Product Management

- Asset and Product Management provides an holistic view which ensure balance across all factors across the CLC when pursuing value for the organisation including:
  - Defining capability and performance outcomes.
  - Acquisition activities and outcomes.
  - Asset availability and performance.
  - Support and Operational costs.
  - Total Cost of Ownership (acquisition and sustainment).
  - Organisational Risk.
Defence Product Management

Defence Product Management policy and guidance follows the principles from the ISO 55000 suite of Asset Management standards:

- ISO 55000: Asset management – Overview, principles and terminology
- ISO 55001: Management systems: Requirements
- ISO 55002: Asset Management – Management systems – Guidelines for the application of ISO55001

Integrated Product Management

- Consistent with the Asset Management approach, Defence views Product Management as an integrating discipline.
- Product Management functions and activities are to be integrated throughout the Product lifecycle.
- Product Management functions are:
  - Customer Engagement
  - Industry Engagement
  - Financial Management
  - Resource Management
  - Performance Management
  - Support to ADF operations
  - Support to Capability Development
  - Integration Management
  - Enabling Functions:
    - Workforce management
    - Risk Management
    - Quality Management

Source: (PM) 001- CASG Product Management Manual
Integration Management

- IPdM to coordinate delivery of inputs from other suppliers to achieve the performance specified in the agreement with the customer.
- Integration Management is pivotal to ensuring that the efforts of all FIC providers are incorporated in the support of Defence capability.

Source: (PM) 001- CASG Product Management Manual
CLC Project

- A Project is a unique, finite, multidisciplinary and organised endeavour to deliver a Product or Products.
- A Project generally occurs in the early part of the Product Life Cycle although Projects can be established later (eg for Product upgrades).
- A Project has its own life cycle which delivers the Product.

What is Project Management?

- Project Management provides a structured and reliable means to realise the Product.
- Project management is:
  
  * the application of knowledge, skills, tools and techniques to project activities to meet project requirements.*

  - Project management is the management effort to deliver the best balance across these requirements.

### What is Project Management?

Project Management (PM) is achieved through a number of well-defined and proven processes across ten project management knowledge (PMBOK) areas:

- Integration Management
- Scope Management
- Schedule Management
- Cost Management
- Quality Management
- Resource Management
- Communications Management
- Risk Management
- Procurement Management
- Stakeholder Management


### Defence Project Management

- Structured and reliable means to deliver a Product.
- CASG Project Management policy and guidance follows the principles from a number of standards namely:
  - Project Management Institute (PMI) Project Management Body of Knowledge (PMBOK®).
  - Managing Successful Programs (MSP).
IPM Roles in the CLC

• Delivery Group:
  – appoints IPM; and
  – establishes IPMT before Gate 0.

• IPM responsible for:
  – developing PES, IPMP;
  – undertaking initial project planning and coordination;
  – managing ‘program’ of risk reduction activities;
  – coordinating early industry involvement;
  – implementing integrated planning across FIC; and
  – integrating and coordinating delivery of FIC.

Integrated Project Management: dimensions

Consistent with ISO 55000 and PMBOK, Project Management is an integrating discipline which ensures:

• Whole of Life, Joint Force Integration, legislative and regulatory obligations.

• coordinating and integrating FIC.

• integrate the supporting Practices.

Defence materiel or equipment is the result of highly sophisticated engineering effort:
- leading-edge technology;
- novel adaptation of technology;
- significant integration;
- electronics-based and software intensive;
- particular focus on availability, redundancy, endurance, security, and safety; and
- integrates a range engineering disciplines eg mechanical, civil, electrical, aerospace.

These systems must be defined, developed and supported through rigorous formalised methods.
### Systems Engineering Definition

“An interdisciplinary collaborative approach to derive, evolve, and verify a life-cycle balanced system solution which satisfies customer expectations and meets public acceptability.”


Where a system is “a combination of interacting elements organized to achieve one or more stated purposes” ISO/IEC 15288 Systems include: hardware, software, organisation, personnel, collective training systems, facilities, data, support, and operating procedures and organisational policies.

### Systems Engineering

Systems Engineering is a **technical management framework**:

- integrates engineering disciplines
- provides proven structured processes
- enables development and control of a product including:
  - requirements definition,
  - design,
  - verification and validation,
  - maintenance and modification of a Product, and
  - conduct of technical investigations, reviews
- addresses all lifecycle considerations.
Systems Engineering and the CLC

Systems Engineering is valuable to the CLC and obligations of Defence officials:

• trusted method for deriving needs and requirements which are demonstrably traceable to approved guidance
• rigorous consideration of all feasible alternatives to select the best solution
• ensures holistic consideration of all factors
• provides structured assurance approach (e.g. System Review process)
• enables structured identification of system development and technical risks to target risk reduction.

INTEGRATED LOGISTICS SUPPORT
Defence Logistics

• “Defence spends similar amounts each year on sustainment and the acquisition of new equipment. In 2015–16, Defence spent $6.3 billion—21 per cent of its total departmental expenditure—on the sustainment of specialist military equipment”


Defence Logistics

• Defence Logistics supports preparedness of the Australian Defence Organisation (ADO) through acquisition and through-life support of military equipment and supplies.

• Key objective is balancing how:
  – preparedness requirements are met; and
  – while optimising Life-Cycle Costs (LCC).
Integrated Logistics Support (ILS)

- US DoD developed ILS to address availability challenges for complex Materiel Systems and escalating support costs.
  Para 15.4 DEFLOGMAN Part 2 Volume 10 Chapter 15

- ILS is a management function that provides the initial planning, funding, and controls which help to assure that the ultimate consumer (or user) will receive a system that will not only meet performance requirements, but one that can be expeditiously and economically supported throughout its programmed life cycle.
  System Engineering Management, Blanchard and Blyler, 2016

ILS

- disciplined, unified and iterative approach to defining support aspects of Defence systems.
- takes account of all support-related elements including relationships and interdependencies.
- Different schema to ensure all elements addressed.
- Defence Support System Constituent Capabilities:
  – Operating Support.
  – Engineering Support.
  – Maintenance Support.
  – Supply Support.
  – Training Support.
ILS

• Ensure that availability, supportability, and lifecycle cost of capability is considered during design and development (mission and support system).

• ILS practitioners:
  – influence system requirements and design of mission system;
  – provide definition of support elements for capability lifecycle; and
  – contribute to planning and management of support system.

ILS tools and techniques

• ILS uses analytical tools and techniques supported by necessary data:
  – Supportability Analysis (SA) for defining supportability requirements.
  – Logistics Support Analysis (LSA) to optimise Life Cycle Costs (LCC) and system performance.
  – Reliability, Availability, and Maintainability (RAM) modelling and analyses eg to identify system attributes.
  – Life Cycle Costing Analysis (LCCA) overarching methodology for logistics cost effectiveness analysis and financial modelling.
CLC and Capability Management Practices
Dr Mike Ryan & Dr Shari Soutberg

PROCUREMENT AND CONTRACTING

CLC: Tender and Contract Documents

What and Why

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<tr>
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<th>Defence White Paper</th>
<th>DPG</th>
<th>AMS</th>
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<td>Strategic Guidance</td>
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How

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<td>FPS 1</td>
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Proposal = Sponsor's Paper + JCNS + PES

Program Strategy

PES

IPMP

IMS

Project WBS

PES

Tender and Contract Documents

PGPA Act

CPRs

DIP

Smart Buyer

DPPM

Issued by JCA to the CM

Raised within Force Design as Program level direction
Procurement and Contracting

- Materiel acquisition and sustainment contracts worth approximately $12 billion.
- Dependent on sound procurement and contracting practices which:
  - maximises return on investment in capability;
  - delivers on cost and schedule;
  - matches activities to level of risk and complexity to reduce:
    • cost of tendering; and
    • cost of contract management.

Source: Contract Template Selection and Tailoring Guide Version 2.1 April 2016

Key topics for Procurement & Contracting

- Legislative and Policy Context
  • CPRs
  • DPPM
- Core Principles
  • Value for Money
  • Competition etc
- Delegations
  • Commitment
  • Enter into arrangement
- Designing the Procurement
  • Method of Procurement
  • Approach to Market
  • Delivery Model
- Procurement Lifecycle
  • Planning
  • Sourcing
  • Managing
- Contracting Templates
  • ASDEFCON Templates
Defence Proc & Contracting Policy Context

- Defence and its officials operate in an environment of broader legislation and policy:
  - Commonwealth, State and Territory legislation: eg PGPA Act.
  - Commonwealth Policy: eg Commonwealth Procurement Rules (CPRs).
  - Defence Policy: Defence Procurement Policy Manual (DPPM) and Defence Procurement Policy Directives.
- Legislation and policy affect Defence procurement contracts.

Hierarchy of Legislation and Policy

Source: DPPM April 2017
Generic Procurement Life Cycle

The Procurement Life Cycle is scalable and tailorable:

- **Planning**
  - 1. Plan the procurement.
  - 2. Develop ‘Request documentation’ such as RFT.

- **Sourcing**
  - 3. Approach the market.
  - 4. Evaluation.
  - 5. Negotiation and contract signature.

- **Managing**
  - 6. Contract management.
  - 7. Disposal.

Source: DPPM

Procurement Life Cycle

- The Procurement Life Cycle is also scalable and tailorable
- Can be applied to any procurement
- It can be tailored for progressing an major investment proposal project through the CLC or to acquire services within the CLC

Source: DPPM
Relationship to CLC

In context of CLC procurement lifecycle is pivotal to deciding the strategy proposed in the PES for a major acquisition.

- Planning
- Sourcing
- Managing
  - 1. Plan the Procurement
  - 2. Develop Request Documentation eg RFT
  - 3. Approach the Market
  - 4. Evaluation
  - 5. Negotiation and Signature
  - 6. Contract Management
  - 7. Disposal

Relationship to CLC

- The Procurement lifecycle can also be nested within the CLC for example, acquiring risk mitigation studies or other services.
Contracting Templates

- Contracting templates developed by Commonwealth entities to meet:
  - different procurement needs and profiles
  - size, complexity and nature of the procurement activity.
- Templates include:
  - Commonwealth Contracting Suite.
  - The Australian Standard for Defence Contracting (ASDEFCON).
  - Defence Suite of Facilities Contracts
- The focus is on ASDEFCON as used in Capability Management.

Why have ASDEFCON Templates?

- The objectives of ASDEFCON include:
  - Support efficiencies by using common tendering and contracting templates.
  - Standardise and benchmark Defence’s business practices and procedures that:
    - support Commonwealth and Defence policies;
    - reflect ‘best practice’; and
    - support VFM and accountability.
  - Improve relationships with industry by enhancing tendering and contracting templates.
  - Engender professionalism of Defence staff.
  - Lead contracting reform in Defence.

Source: Department of Defence Website: Doing Business with Defence
ASDEFCON Templates

- Defence procurement supported by ASDEFCON suite which is made up of 20 different templates for tendering and contracting including for Materiel:
  - Simple Procurement (of Goods and Services related to materiel)
  - Materiel Acquisition
  - Materiel Support
  - Linked and Combined Materiel Acquisition and Support Contracts
- Associated handbooks and related training are available for some templates.

Source: Department of Defence Website: Doing Business with Defence

Materiel Acquisition Contracting Spectrum

Source: Contract Template Selection and Tailoring Guide Version 2.1 April 2016
ASDEFCON Template Selection

- Template selection is important to making sure that the level of contract management and assurance is commensurate with risk and complexity of the acquisition.
- Need to understand nature of technical requirement (captured in SOW) especially technical complexity.
- Failure to relate tendering contracting effort to technical requirement can result in:
  - excessive unnecessary work; and
  - increased risk.

Source: Contract Template Selection and Tailoring Guide Version 2.1 April 2016
Governance

Public sector governance covers:

‘...the set of responsibilities and practices, policies and procedures, exercised by an agency’s executive, to provide strategic direction, ensure objectives are achieved, manage risks and use resources responsibly and with accountability.’

‘Governance and assurance regimes aim to manage risk in business operations while preserving accountability for performance’.

Source: Building Better Governance, Commonwealth of Australia 2007
Interrelated concepts

- Governance: oversight role and processes by which organisations manage and mitigate risks.
- Compliance ensuring that the organisation meets the requirements imposed by government bodies, regulators, or internal policies.
- Risk management: structured approach to identifying, assessing risks, methods of control and monitoring risk mitigation actions.
- Assurance: measures which demonstrate that the organisation is meeting its obligations (or not).
- Essential to good governance are robust regimes for:
  - Risk Management.
  - Assurance.

Risk Management
Duties with Respect to Risk Management

- PGPA Act seeks to improve the high level accountability of all Commonwealth entities through focusing on their duties, internal controls and the way they engage with, and manage, risk.

- Officers of the Commonwealth must observe their obligations in relation to risk management and risk control ie “duty to establish and maintain systems relating to risk and control”.

- The accountable authority of a Commonwealth entity must establish and maintain:
  - an appropriate system of risk oversight and management for the entity; and
  - an appropriate system of internal control for the entity.

Source: PGPA Section 16

Definitions

- **Risk**: effect of uncertainty on objectives.

- **Risk Management**: coordinated activities to direct and control an organisation with regard to risk.

- **Risk Control**: action to reduce or eliminate threats to organisational objectives

- Risk Controls are based on risk assessments of potential risk factors (can include technical and non-technical aspects eg 17 Smart Buyer categories).

AS/NZS ISO 31000 Risk management pp 1-2
Risk Management in the CLC

General risk management process:

1. Identify the risk 'events' or occurrences.
2. Estimate the likelihood of these happening (probability).
3. Estimate what the impact will be.
4. Figure out the level of risk level and ranking between risk events.
5. Plan what to do to control, reduce, eliminate the risk events.
6. Implement risk management (mitigation, reduction).

Defence Risk Management

“Risk management is to be integrated into all planning, approval, review and implementation processes, at all levels, to ensure that risk is one of the major considerations in decision-making. Risk assessments are to be conducted in all new activities and functions.”

Defence Risk Management

- The Joint Directive emphasises that a key principle applying to all decisions is to accept and treat individual risks based on evidence.
- Evidence-based risk management across the CLC requires a strong risk framework supported by proven methodologies.
Risk Management and the CLC

• Core requirement of CLC is a deliberate approach to risk:
  – Must understand and assess risks.
  – Must have targeted approach to risk management and control.
  – Decisions are made with understanding of risks.
  – Must no longer be risk averse in decision-making.
• Multiple risk frameworks in Defence relevant to CLC include but are not limited to:
  – CLC Risk Mitigation Phase emphasising risk treatment.
  – Smart Buyer Risk Framework (Risk and Drivers Analysis)

Assurance
Meaning of Assurance

- **Assurance:**
  - a positive declaration intended to give confidence; a promise.  
  Source: Oxford Dictionary
  - grounds for justified confidence that a claim has been or will be achieved.  
  Source: ISO/IEC15026-1:2013

- **Compliance Assurance:** measures instituted by a government agency to ensure that the provisions of its regulations are being met.  
  Source: http://www.businessdictionary.com

- **Technical Assurance:** process by which the technical integrity of a product, process, or system is monitored and maintained.  
  Source: http://www.businessdictionary.com

Legislative and Regulatory Obligations

- Assurance practices are to be applied throughout the CLC.
- Application is dictated by Defence frameworks, compliance obligations, and nature of the CLC effort.
- In practical terms compliance with the legislative and regulatory obligations spans the operational, management, and technical aspects of the CLC.
- Sponsors and Managers must understand their obligations and the practices to ensure compliance.
Assurance in Capability Management

- Risk-based decision-making across the CLC requires confidence that:
  - arguments presented are sound and based on evidence;
  - claimed status of capability management is accurate; and
  - outcomes satisfy organisational objectives.
- Undertaking an appropriate Assurance Program supports your obligations as a Commonwealth Officer.
- Assurance activities are conducted across the entire CLC and across various dimensions of capability management (eg technical, safety, financial, seaworthiness) to provide confidence to decision-makers and managers.

Types of Assurance across the CLC

- Contestability.
- Gate Reviews
- Independent Assurance Reviews (IARs).
- Deep Dive Reviews.
- Schedule Compliance Risk Assessment Method (SCRAM).
- Mandated System Reviews.
- Audit.
- Reporting.
- Validation and Verification (V&V).
- Test and Evaluation (T&E).
- Certification.
- QA: Supplier and Product Assurance.
- Engineering Assurance.
Program of assurance activities

- Many different assurance activities across the CLC.
- Program, Product and Project Sponsors should understand and anticipate the range of assurance activities so as to:
  - plan ie schedule and allocate resources;
  - ensure necessary evidence is being collected to support assurance cases; and
  - achieve efficiencies through leveraging activities.
- Assurance activities should be tailored to the particular circumstances and needs.
- Should establish a clear view of Assurance Program and capture this in the IPMP and appropriate subordinate plans.
Use of the word ‘system’

• The word ‘system’ has many contexts:
  – Physical systems such as solar systems, river systems, railway systems, satellite systems, communication systems, information systems, pulley systems, and nervous systems.
  – Philosophical systems, social systems, religious systems, gambling systems, banking systems, and systems of government.
  – More-esoteric examples, such as the consideration of individual and social behaviour as a system of purposeful events.

Use of the word ‘system’

• The common aspect of ‘system’ stems from its early use to refer to:
  the whole (or the set) that results:
    when a number of things have been grouped,
    in a particular manner,
    for a particular reason.
• So, what is a ‘system’ in the context of ‘systems engineering’?
Definition of a system

- In systems engineering, ISO/IEC 15288 therefore defines a system as:

  a combination of interacting elements organized to achieve one or more stated purposes*

---

Definition of a system

- So, a system comprises:
  - system elements,
  - interconnections (interactions) between elements, and
  - an external system boundary.
The mission of the system

- The purpose of the system is called its mission.
  - must be clearly stated by business management and stakeholders.
  - represents the start point of the design process.
  - provides the basis for the ultimate test of the system’s fitness-for-purpose.
- In the broadest sense, the mission of the system is to provide a solution to a business problem.

Types of systems

- There are four main classifications of system:
  - Closed/open systems.
  - Natural/human-made/human-modified systems.
  - Physical/conceptual systems.
  - Precedented/unprecedented.
- A wide variety of combinations of the characteristics can lead to a large number of types of systems, each of which has markedly difficult properties.
- Systems engineering is applied to open, physical systems that are human-made/modified from largely precedent elements.
Definition of a system

- Narrowing the definition of a system has two major implications:
  - The systems elements, interconnections and boundary are not accidental but result from deliberate design (engineering).
  - A system must be managerially and operationally independent (and may well have been procured independently).

A system and its environment
A system and its environment

- System of interest
- Wider system of interest
- Operating environment
- Wider environment

A system and its environment

System as a product

- In a physical sense, the term system is sometimes considered to be synonymous with product—that is, we say that the project is delivering a system, or is delivering a product.
A system as a capability

- Systems are much more than an aggregation of hardware or software products and also include: organisation, personnel, collective training systems, facilities, data, support, and operating procedures and organisational policies.
- A system therefore delivers an operational capability, not just products.

Capability system

- It is common, therefore, particularly in defence environments, to refer to the system at this level as a capability system.
- Each of the elements of a capability system will probably have a different acquisition cycle, since each represents a different type of acquisition.
- Here we focus on the major equipment element so that the descriptions are less cluttered.
- We must remember, however, that all elements are acquired in parallel and must be brought back together prior to introduction into service in order to field an operational capability.
Logical and physical descriptions

• A system can be described in two broad ways:
  – Logical (or functional)—what the system will do, how well it will do it, how it will be tested, under what conditions it will perform, and what other systems will be involved with its operation.
  – Physical—what the system elements are, how they look, and how they are to be manufactured, integrated, and tested.

• Both the logical and physical descriptions of a system comprise a series of statements called requirements.

Logical and physical descriptions

• The two descriptions are valid independent descriptions of a system:
  – We develop the logical description first.
  – How we implement current physical systems should not colour unnecessarily the way in which we might describe future systems.
  – Upper-level trade-offs and feasibility analyses must be conducted at the logical level before deciding on the physical implementation.
  – A logical description is ideally suited to the interface between systems engineering and the business case.
  – The logical description changes slowly; the physical description changes much faster.
Logical and physical descriptions

- In the development of a system, therefore, there are at least two architectural views: a system logical architecture, and a system physical architecture.
- Of course, these two descriptions are of the same system so they must be related.
- We will see later how the logical architecture, as outlined in the requirements breakdown structure (RBS), is mapped onto the physical architecture as represented by the configuration items contained in the work breakdown structure (WBS).

Hierarchical descriptions of a system

- We can consider the system to be a hierarchical composition of system elements (either logical or physical).
### Logical (functional) hierarchy

- In a logical description of a system, the system’s mission is broken down into a hierarchical structure of its major functions—to form a functional hierarchy, or a functional architecture.

![Diagram of functional hierarchy]

- Mission
  - Function 1
    - Function 1.1
    - Function 1.2
    - Function 1.3
  - Function 2
    - Function 2.1
    - Function 2.1

---

### Physical hierarchy

- We use a simple four-layer representation (system, subsystem, assembly, component) which can be more elaborate.

![Diagram of physical hierarchy]

- System
  - Products
  - Subsystems
    - Assemblies
      - Components
        - Subcomponents
          - Parts
        - Subassemblies
          - Subcomponents
            - Parts

Physical hierarchy

- It is common to allow the hierarchical terms to be relative. For example, an aircraft system contains, among others, the engine subsystem, which may consist of assemblies such as fuel tanks, pumps and lines, turbines, compressors, gear boxes, and hydraulic pumps.
- The engine manufacturer may consider the engine to be the system, comprising fuel, power plant, and hydraulic subsystems, and so on.
- However, an implicit part of the definition of a system is that it must be able to stand alone in its own right. An engine is therefore not a system—it is only useful as an element of a system (that is, as a subsystem).

Hierarchy of an SOI

- It is probably better, therefore, to consider an SOI to comprise a combination of interacting system elements, some of which may be systems in their own right.

A system is an integration of a number of co-dependent subsystems that are interconnected permanently to achieve a common purpose. An SoS is an integration of a number of independent systems that are interconnected for a period of time to achieve a common purpose.
System Life Cycle

Generic system life cycle

- Throughout the life of a system there are a number of phases and activities, each of which builds on the results of the preceding phase or activity.
- The sum all these activities is called a system life cycle.
- A generic system life cycle can be divided into four very broad phases.
Pre-acquisition Phase

- The life cycle begins in the Pre-acquisition Phase with an idea for a system being generated as a result of business planning.
- Business needs are confirmed and supported by a business case.
- Ensures that only feasible, cost-effective projects are taken forward to acquisition.

Acquisition Phase

- The Acquisition Phase is focused on bringing the system into being and into service in the organisation.
- The system is defined in terms of:
  - business requirements,
  - stakeholder requirements, and
  - system requirements.
- A contractor is then normally engaged to develop/deliver the system.
Utilization Phase

- The system is operated and supported during the Utilization Phase.
- During utilization, the system may undergo a number of modifications and upgrades to:
  - rectify performance shortfalls,
  - meet changing operational requirements or external environments to enable ongoing support for the system to be maintained, or
  - enhance current performance or reliability.

Retirement Phase

- The system is in service during the Utilization Phase until:
  - the business has no further need for the system, or
  - it no longer can meet the functions required of it by the organisation, or
  - it is no longer cost-effective to keep it in service.
- If the business need for the capability still exists in the organisation, the conclusion of one system life cycle marks the start of another and the process begins again.
Parties involved

- Throughout the system life cycle, there are a number of parties involved.

- The customer organization is managed by:
  - enterprise management who set the direction for the organisation and for
  - business management who are responsible for the activities conducted by
  - the operations element of the organisation which is run by
  - the operators—sometimes called the users.

Parties involved

- The systems used within the organisation are acquired by:
  - the acquisition element (also called the acquirer, or tasking activity) of the organisation under the auspices of
  - a project, which is typically managed by
  - a project manager.

- Project managers are supported by a number of related disciplines including:
  - systems engineering,
  - requirements engineering,
  - specialist engineering disciplines,
  - quality assurance, and
  - integrated logistic support.
Parties involved

- Operators are supported in their operation of the system by the support element of the organisation, which supports, sustains, and maintains the system throughout its life.
- In addition to the operational, acquisition, and support staff, there are many others within the customer organization who have a stake in the successful implementation of the project.
- These stakeholders can include representatives from the management, financial, operations, supply, maintenance, and facilities areas of the organisation.

Parties involved

- The system is obtained from a supplier (also called the performing activity) who may deliver the system off-the-shelf or may develop it, in which case they are often called the developer.
- The supplier (developer) may be an internal part of the customer (acquirer) organisation.
- It is increasingly common these days for the supply or development to be undertaken by an outside organisation called a contractor.
- The relationship between the customer and the contractor is defined by the terms and conditions of the contract.
- Often the contractor is not able to perform all of the work required and devolves packages of work to a number of subcontractors through a number of subcontracts.
Responsibilities of the parties involved

• Responsibility for the various phases of the system life cycle is spread across the enterprise (or organisation) within which the eventual system will operate.

• Note that all parties are involved at all stages in the life cycle, with the roles and responsibilities of each party shifting in emphasis between stages.

Activities in Acquisition and Utilization Phases

• Systems engineering is predominantly related to the Acquisition Phase of the system life cycle and, to a lesser extent, the Utilization Phase.

• For these two major phases, we use the life-cycle activities based on those defined by Blanchard and Fabrycky.

Acquisition Phase

- The Acquisition Phase comprises the four main activities of Conceptual Design, Preliminary Design, Detailed Design and Development, and Construction and/or Production.
- Here we look at each of these activities in a little more detail—we will examine them in much more detail in later weeks.

<table>
<thead>
<tr>
<th>Conceptual Design</th>
<th>Preliminary Design</th>
<th>Detailed Design and Development</th>
<th>Construction and/or Production</th>
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Conceptual Design

- Formal transition from the business world to the project world—from the mission statement to complete logical description of the system-of-interest.
- Ensures proper definition of the system requirements.
- Ensures appropriate engagement with business managers and upper-level stakeholders.
Conceptual Design

- Business Needs and Requirements (BNR) are articulated and confirmed by business management.
- BNR are elaborated by stakeholders at the business operations level into a set of Stakeholder Needs and Requirements (SNR).
- SNR are elaborated by requirements engineers into system requirements in the System Requirement Specification (SyRS).

Conceptual Design

- The BNR, SNR and the SyRS are key elements of what is called the Functional Baseline (FBL).
- Conceptual Design ends with the System Design Review (SDR), which finalizes the initial FBL.
- SDR confirms the BNR, SNR and the SyRS, and provides a formal record of design decisions and design acceptance.
Preliminary Design

- Converts the logical architecture in the initial FBL into description of the physical subsystems (the upper-level physical architecture) that will meet the system requirements.
- Results in the Allocated Baseline (ABL), so-called because the functionality of the system is now allocated to physical building blocks called configuration items (CI), which are described in Development Specifications.
- Ends with a Preliminary Design Review (PDR).

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Detailed Design & Development

- Uses engineering disciplines to develop the individual subsystems, assemblies, and components in the system.
- Results in the Product Baseline (PBL) as the system is now defined by the numerous products (subsystems, assemblies, and components) as well as the materials and processes for manufacturing and construction.
- Ends with Critical Design Review (CDR).

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Construction and/or Development

- Components are produced in accordance with the PBL specifications and the system is ultimately constructed.
- Ends with Formal Qualification Review (FQR), which provides the basis upon which the customer accepts the system from the contractor.
- FQR is informed by the results of acceptance test and evaluation (AT&E)

Utilization and Retirement Phases

- Major activities in Utilization Phase are:
  - Operational Use
  - System Support
- Modifications may be necessary.
- The system life cycle ends with the Retirement Phase.
Development Approaches

- We have presented the life-cycle phases and activities in sequence.
- This assumes the waterfall approach to development.
- There other approaches such as incremental, spiral, and evolutionary acquisition, each of which has strengths and weaknesses.
- For simplicity, we continue to assume the waterfall approach for the majority of the course—a solid understanding of the approach is useful because it helps understand the others, and the others all have the waterfall approach as a fundamental building block.
- We return to the other approaches later.

Introduction to Systems Engineering
What is systems engineering?

• Each definition tends to reflect the particular focus of its source.
• There are, however, a number of common themes which indicate the key tenets of systems engineering:
  – Top-down approach
  – Requirements engineering
  – Life-cycle focus
  – System optimization and balance
  – Integration of specialisations and disciplines
  – Management

Top-down approach

• Traditional engineering disciplines are based on bottom-up approach:
  – We design and build components, integrate them into the next higher level element and so on until we have the system.
  – This is very effective so long as we are trying to solve a particular, well-defined problem.
• Complex problems with many inter-relationships tend not to be suited to bottom-up solutions.
Top-down approach

- Start by looking at the system as a whole to provide a thorough understanding of the system and its environment and interfaces.
- System-level requirements are developed.
- Likely subsystems can then be considered and requirements assigned to individual subsystems, the subsystems further broken down into assemblies, and then into components.
- This process continues until a complete understanding is achieved of the system from top to bottom which allows:
  - Additional (derived requirements) to be developed.
  - Interfaces between subsystems to be identified.
- This approach is well documented in process standards such as ANSI/EIA-632.

Top-down design
Bottom-up integration

- While design is top-down, integration is bottom-up.
- At each stage of the integration, some form of integration testing will be conducted to verify the successful integration.

Requirements engineering

- Complete and accurate definition of requirements is fundamental to project success.
- Original need translates into statements of requirement which form the basis of functional and (eventually) physical design.
- These transitions must be managed by a rigorous process called requirements engineering.
- Once requirements have been collected, the systems engineering process then focuses on the derivation and decomposition of these requirements from the system level right down to the lowest constituent component (sometimes referred to as requirements flowdown).
Requirements engineering

• Requirements traceability is essential:
  – Forward traceability allows design decisions to be traced from any requirement down to a lower level.
  – Backward traceability means that any lower-level requirement is associated with at least one higher-level requirement.
• Traceability assures the customer that all requirements can be accounted for in the design at any stage and that no unnecessary requirements are included.
• Traceability also supports the configuration control (change management) process.
• Requirements traceability is a feature of top-down design, which guarantees that requirements can be satisfied at any stage.

Life-cycle focus

• Systems engineering maintains a life-cycle focus as decisions are made.
• Often, the temptation is to focus on acquisition issues in order to minimise acquisition costs and schedules.
• Given that a system spends a majority of its life in utilisation the full life-cycle cost (LCC) must be considered.
• As a simple example, it is false economy to buy a cheaper car that has very high running costs, if a slightly more expensive car can be acquired which has lower through-life costs (and therefore a lower LCC).
Reduction in overall acquisition schedule

- A reduction in overall acquisition time is possible through solid requirements engineering efforts.
- By getting the requirements right early and then monitor their inclusion into the subsequent design, we can reduce the potential for costly and time-consuming changes later.

System optimisation and balance

- We cover this issue in detail later but basically a collection of optimally-designed subsystems do not necessarily lead to an optimal system.
- Systems engineering is looking for optimal system-level performance.
- This sometimes must force subsystem and component designers down sub-optimal paths.
- Also system engineering recognises that the system must be designed with balance in mind.
  - For example we must balance system performance with other factors such as social, ethical, cultural and psychological effects (and others).
Integration of specializations / disciplines

- Systems engineering integrates a diverse range of technical disciplines and specializations.
- Our aircraft example illustrates this point because it involves more than just engineering disciplines—must also involve finance, legal, environmental specialists and so on.
- Systems engineering defines the tasks that can be completed by these disparate disciplines and specialties and then provides the management to integrate their efforts to produce a system.
- This function is essential because of the complexity of large projects and their contracting mechanisms, and the geographic dispersion of contractor and subcontractor personnel across the country and around the world.

Management

- Systems engineering clearly has a technical role to play but it also has a very important management role.
- There is a very strong link between the necessary functions of project management and systems engineering.
- Systems engineering products ensure project management decisions are informed.
- More on this later.
Conceptual Design

The systems engineering processes begin in earnest with the first activity in the Acquisition Phase—Conceptual Design:

- aims to articulate the needs, to analyse and document the system-level requirements flowing from the needs, and to complete a logical design of the system
- major product is the Initial Functional Baseline (FBL), which provides a system-level logical architecture that is the basis for subsequent lower-level (physical) design
Conceptual Design

• Conceptual Design is critical because:
  – The system definition is expanded from relatively brief business needs into a logical set of system-level requirements that may be hundreds of pages long.
  – All subsequent aspects of the system design will be traced back to the Initial FBL that ends this activity—any errors here will flow down to the remainder of the activities.
  – Conceptual Design is concerned with the transition from the problem domain into the solution domain. It is therefore essential that the output of Conceptual Design adequately represents the business and stakeholder needs and requirements.

Conceptual Design

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- Conceptual Design ends with the System Design Review (SDR), which finalizes the initial FBL.
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Identify major stakeholders

• Since their input to the system life cycle is crucial, careful selection of appropriate stakeholders is fundamental to the success of the project.

• It follows that, if a different set of stakeholders is nominated, the process will most likely end with a different set of system requirements.

Identify major stakeholders

• A stakeholder is commonly defined as someone who has a stake in the project—that is, someone who is affected by the system in some way, or can affect the system in some way.

• In most systems this is not a useful definition since it is often difficult to find someone who is not affected by the system in some way.

• Even in a simple system such as an automatic teller machine (ATM) network for a bank, there may be millions of stakeholders by such a definition.

• In committee-based organizations such as public service organizations, the number of potential stakeholders is almost limitless.
Identify major stakeholders

- Conceptual Design cannot progress with such a definition:
  - There is not sufficient time to engage with that many.
  - It assumes that anyone affected by the system is a source of requirements—even business competitors
  - Conceptual Design would therefore be at the mercy of the anyone who wants to contribute requirements, whether they are useful or not.
  - Stakeholders will not be affected equally and they should not therefore have equal rights in expressing requirements.
- It is also useful to remember that no complex system can be optimum to all parties concerned nor can all functions be optimized.

Identify major stakeholders

- The first step of identifying stakeholders is therefore much more complicated than simply listing all those who could be considered to have a stake in the new system.
- While we must take into account anyone who is affected by the new system, just because they are affected does not necessarily mean that they are stakeholders.
- For example, the armed guards who distribute the cash in an ATM system are clearly important—however, they are not stakeholders but are sources of constraints.
- Similarly, there are a number of parties such as the tellers whose employment may be threatened by the new ATMs (and other competitor banks), who are clearly affected by the system, but they are not necessarily stakeholders.
Identify major stakeholders

- More usefully, a stakeholder an individual who has a right to influence the outcome of the system. Note that a stakeholder is also invariably affected by the system.
- This first act of stakeholder identification is therefore crucial—business management must decide:
  - who are to be considered as stakeholders (those that are to have the right to define the system).
  - what leadership approaches are to be taken to address individuals or groups that may be disenfranchised by the implementation of the new system (such as the bank tellers in our ATM example)—they will certainly be affected by the system but will not be nominated as stakeholders.
Business and project constraints

• Constraints are requirements that are imposed on the system by circumstance, force, or compulsion—they therefore limit absolutely the options open to a designer by imposing immovable boundaries and limits.

• Before focusing on the detail of the desired system, it is essential to identify the business and project constraints that are relevant to the system and its acquisition.

• This analysis provides essential information about the development environment for the system and begins the top-down approach to system development.

Business and project constraints

• Business constraints include any organizational policies, procedures, standards or guidelines that guide system development and procurement, such as:
  – partnering relationships with other companies,
  – use of established life-cycle processes,
  – contracting policies,
  – human resource limitations,
  – budget restrictions, and
  – specific management guidance to the project.
Business and project constraints

- Project constraints include budget and schedule constraints, but also the resource allocations to the project as well as any externally imposed deliverables and acquisition timeframes.

- Many companies have enterprise-wide standards for processes such as quality assurance and systems engineering and these methodologies guide the manner in which projects can operate.

- Additionally, the enterprise may require the project to report progress in a particular way or to implement particular metrics, tools and documentation procedures.
Identify external constraints

- In addition to enterprise-imposed constraints, there are wider external constraints on system development that arise from the requirement for conformance to national and international laws and regulations, compliance with industry-wide standards, as well as ethical and legal considerations.

- Other external constraints include the requirement for interoperability and interfacing to other systems.

- Additionally, projects might be constrained to conform to particular engineering and technical standards; mandated toolsets; metrics; documentation sets and plan templates; technology use; and control and reporting mechanisms.

- Again, an important aspect of top-down design is to understand these constraints before considering lower-level system requirements.
Identify design constraints

- Design constraints include those factors that directly affect the way in which the system design can be conducted. Of course, a number of enterprise, project and external constraints (such as budgets, regulations, and standards) will flow down and be inherited as design constraints.

- Typical design constraints include the state-of-the-art of relevant technologies, the skill sets of available engineers and tradespersons, as well as extant methodologies and tools to assist in the design, development, construction, and production of the system.

- Additionally, bounds such as all-up weight may be a design constraint for an aircraft system if it is to land on certain classes of airfield.

A cautionary note WRT constraints

- Having identified constraints, work should not progress until each constraint is tested and taken on knowingly into the next activity.

- That is, we must convince ourselves that each constraint is actually a constraint and is inviolate.

- It also doesn’t necessarily follow that a current constraint will remain so, or should remain so without question.

- We should therefore consider what can be done to remove the constraint if that would facilitate the progress of the project.

- The cautionary note is therefore that a constraint isn’t so just because some stakeholder or regulator said it is, or because it always has been so in the past.
Define mission, goals and objectives

- Every project should begin with a concise statement of the mission, elaborated by statements of the system-level goals and objectives.

- “A problem is half-solved if properly stated.” John Dewey.
Define mission, goals and objectives

- The mission statement should be quite short and may be expressed in only a few lines, although it should have a word or phrase for every important aspect of the system. While stakeholders often find it difficult to state the mission in a single, short sentence, the project is doomed to failure if the owners cannot describe it succinctly at the outset.

- The mission statement is then expanded and qualified by short declarative statements of the system goals and objectives. Goals are normally relatively broad statements, each of which spawns a number of more-specific objectives (although these are sometimes treated in the reverse order and objectives are considered to lead to goals).

Mission statement for the Aircraft System

- For the ACME Air example, the mission statement for our aircraft might be:

  “… to acquire a medium-sized aircraft that can provide class-leading comfort to passengers between Class X airfields on domestic and international routes, in order to … (profit?)”.

- In this example, the goals and objectives would then need to elaborate on such matters as what is meant by ‘class-leading’ and ‘medium-range’, how many passengers are to be carried, as well as operational issues such as crewing and maintenance.
Define preliminary operational scenarios

- Operational scenarios, or *use cases*, provide valuable guidance to the system designers and form the basis of major events in the Acquisition Phase such as acceptance testing of the system as it is introduced into service.

- Despite any more detailed technical verification and validation procedures, the system’s fitness for purpose is fundamentally related to its ability to perform in accordance with the operational scenarios defined at this stage.

- In many cases it is also useful to define the various modes of operation for the system products under development. Designers need to understand if the system is to exist in a number of different modes even if it is as simple as the difference between the fully operational mode or the training mode.
Measures hierarchy

- Broadly, validation criteria encompass any mechanism by which the customer will measure satisfaction with the products of the Acquisition Phase.
- It is common to develop a hierarchy of measures, such as:
  - critical issues (CI) that relate to the measurement of system goals,
  - critical operational issues (COI) that relate to the measurement of objectives,
  - measures of effectiveness (MOE) that relate to the next level of the requirements hierarchy,
  - measures of performance (MOP) at the next level, and
  - down to verification statements at the lowest level.
For a measure to be relevant, it must be able to be related to one or more requirements. One common way of doing this is to develop a matrix that relates measures to requirements.

In fact, the use of relationship matrices is very common in systems engineering—we have traceability matrices that show inheritance of requirements, we have verification matrices to show how verification means relate to individual requirements or groups of requirements, and we could have matrices to relate measures to requirements.

The use of matrices is common to trace between a hierarchy of requirements, and there is a hierarchy of measures.

Ideally, however, that traceability should be part of the design.
Requirements and measures hierarchies

Requirements Hierarchy

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Measures Hierarchy

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</tr>
<tr>
<td>CI</td>
<td>COI</td>
<td>MOE</td>
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C1. Define business needs and requirements (BNR)

C1.1 Identify major stakeholders and constraints
- C1.1.1 Identify major stakeholders
- C1.1.2 Identify business & project constraints
- C1.1.3 Identify external constraints
- C1.1.4 Identify design constraints

C1.2 Define business needs
- C1.2.1 Develop mission, goals and objectives
- C1.2.2 Define preliminary operational scenarios
- C1.2.3 Define preliminary validation criteria
- C1.2.4 Define preliminary life-cycle concepts

C1.3 Scope system
- C1.3.1 Develop context diagram
- C1.3.2 Define system boundary
- C1.3.3 Define external interfaces
- C1.3.4 Endorse draft business needs

C1.4 Define business requirements
- C1.4.1 Identify available solution classes
- C1.4.2 Confirm compliance with business needs
- C1.4.3 Evaluate available solution classes
- C1.4.4 Select preferred solution class
- C1.4.5 Define business requirements (BRC)

C1.5 Finalise business needs and requirements (BNR)
- C1.5.1 Revise preliminary operational scenarios
- C1.5.2 Revise preliminary life-cycle concepts
- C1.5.3 Revise system scope
- C1.5.4 Revise preliminary validation criteria
- C1.5.5 Endorse business needs and requirements (BNR)

C2. Define stakeholder needs and requirements (BNR)
Define Preliminary Lifecycle Concepts

• Early in the Acquisition Phase, the stakeholders must give some guidance on the lifecycle concepts related to the development, production, testing, distribution, operation, support, training and disposal of the system.

• While the systems engineering procedures that follow will ensure a lifecycle focus, it is important that the stakeholders focus on the major cost drivers that will impact on the supportability of the system. There are a number of lifecycle-related trade-offs at a business-case level.

Define Preliminary Lifecycle Concepts

• For example, consider an inexpensive dashboard-mounted Global Positioning System (GPS) for a large trucking company.

• Since the item is to be procured in large numbers at a low cost, it may be deemed as part of the business case that it would not be cost-effective to implement a repair system for defective items, which would be discarded when broken.

• The consideration doesn’t stop there, however. If that policy was to be adopted, there would still be a need to inspect ‘broken’ items before being discarded to ensure that they were indeed broken, not just subject to problems such as finger-faults or sticking buttons that could be rectified simply. If technical resources are to be applied to inspection, perhaps the additional cost of slightly more detailed training may allow some items to be repaired.
Preliminary Acquisition Concept

• Based on the business operational needs for the proposed system, business management define the proposed acquisition concept.

• Any business needs for acquisition are articulated, such as: budget and schedule, preferred (and perhaps prohibited) supply sources, types of contract desired, relevant existing contractual arrangements, any relevant existing acquisition support arrangements, program/project management considerations, reporting issues, and relationship to other system acquisitions within the organisation.

• This preliminary acquisition concept is continually refined—first, after the feasibility analysis; then, after participants have begun to consider their needs and requirements; and then, at every major review as the design continues.

Preliminary Deployment Concept

• In the Preliminary Deployment Concept, business management outline the issues surrounding the deployment of the system (to the extent that they are concerned with the introduction into service of this system).

• For example, business management may dictate the nature of transition arrangements between an existing and replacement system, since business continuity is at risk during this period.

• Additionally, the Preliminary Deployment Concept may address issues such as transition between facilities, training of operational personnel (and possibly engaging new staff and retiring others), and transition support arrangements.
Preliminary Support Concept

• The Preliminary Support Concept will capture the needs of business management for the support of the system throughout its life cycle. Issues addressed would include relevant support policies and procedures; any relevant existing support arrangements; the support environment; desired maintenance levels and cycles; and the anticipated impact of the proposed system on support facilities, equipment, personnel, and training.

• It should be noted that the consideration of support concepts must be made in the context of achievement of the capability required to meet operational scenarios (which is why the preliminary scenarios are developed first).

Preliminary Retirement Concept

• When considering the retirement aspects of the system during its design, it is useful to undertake three broad tasks: identify the reasons for potential disposal, identify potential disposal methods for the system, which then allows conceptual designers to identify design issues that may arise from the consideration of each method.

• We will discuss the retirement phase later.
Context diagram

- Collectively, these previous few activities are called scoping the system.

- To assist with the scoping process, a tool called a context diagram may be used to illustrate the related systems, relevant regulatory environments, stakeholders, external systems, interfaces, and so on.

- Different systems may of course have significantly different context diagrams.
This is NOT a context diagram

How does this system fit in with the rest of the world?

System Under Consideration

Context diagram

- Police
- Neighbours
- Environment
- Resident
- PSTN
- Power System
- Power Distribution Subsystem
- Power entry panel
- Power grid
- Maintainers?
- Monitoring system

CDD Guide v2.0
Guidance for context diagrams

• Identify all the possible candidate elements for the context diagram (textual list, sticky paper on a board).

• Group similar elements in accordance with their relationship with / impact on / interface with the SOI.

• The SOI is shown as a goose-egg in the centre of the diagram—nothing inside the system is shown.

• The groupings are then drawn as goose-eggs:
  – two overlapping goose-eggs represent an interface,
  – an arrow between illustrates an influence of one group over the other (in the direction of the arrow).

• Move around the boundary verifying each relationship as it is depicted. The diagram is adjusted as necessary and the process continues until the diagram is complete.
Define system boundary

- Definition of the system boundaries is also critical to the success of the fielded system.
- It is essential that these boundaries are defined early in the Acquisition Phase so that it is clear which system elements are under the design control of the project and which are outside the control.
- This is also particularly important to the project manager who is vitally concerned with defining what is to be included in the system as well as what is to be excluded.
System boundary

- The boundary of a system is normally straightforward to describe in physical terms (such as a fence line, or external building walls), but it is often necessary to describe the boundary in conceptual or logical terms as well.

- Additionally, although we traditionally describe the boundary in terms of what is inside the boundary—that is, what is included inside the system—it is often useful to describe what isn’t inside the boundary.

- This is particularly useful when there are a number of elements that may commonly be assumed to be part of the system but are not in this particular case.
Define external interfaces

- Interfaces with existing or future external systems must also be defined as these will place considerable requirements on the system under development.

- While these external systems are not directly related to the project, the success of the fielded system is often determined by its ability to interface to its external environment.

- For example, while it is possible to build a perfectly functional aircraft without consideration of air traffic control regulations, the aircraft would be useless because it would not be allowed to operate.

Consider external interfaces

- The definition of an interface requires considerably more detail than simply identifying and naming the interface. Broadly there are three main steps in interface definition:
  - Interface description. The interface is given a name, short title and identifier. The nature of the interface is described in terms of who, what, when, where, why, how.
  - Interface impact analysis. The interface is analyzed in terms of its impact on the system. In particular, any constraints imposed by the system are identified. A risk analysis is conducted to determine the impact of the interface on the operation and design of the system.
  - Interface control analysis. Each external interface must be analyzed to determine the extent to which it can be controlled so that designers and operators of the system are not at the mercy of its external interfaces.
CLC and Capability Management Practices

Dr Mike Ryan & Dr Shari Soutberg

C1. Define business needs and requirements (BNR)

- C1.1 Identify major stakeholders and constraints
  - C1.1.1 Identify major stakeholders
  - C1.1.2 Identify business & project constraints
  - C1.1.3 Identify external constraints
  - C1.1.4 Identify design constraints

- C1.2 Define business needs
  - C1.2.1 Develop mission, goals and objectives
  - C1.2.2 Define preliminary operational scenarios
  - C1.2.3 Define preliminary validation criteria

- C1.3 Scope system
  - C1.3.1 Develop context diagram
  - C1.3.2 Define system boundary
  - C1.3.3 Define external interfaces

- C1.4 Define business requirements
  - C1.4.1 Identify available solution classes
  - C1.4.2 Confirm compliance with business needs
  - C1.4.3 Evaluate available solution classes
  - C1.4.4 Select preferred solution class
  - C1.4.5 Define business requirements (BRS)

- C1.5 Finalise business needs and requirements (BNR)
  - C1.5.1 Review preliminary operational scenarios
  - C1.5.2 Review preliminary life-cycle concepts
  - C1.5.3 Review system scope
  - C1.5.4 Review preliminary validation criteria
  - C1.5.5 Endorse business needs and requirements (BNR)

C2. Define stakeholder needs and requirements

External interfaces

- Monitoring system
- Resident
- Police
- Neighbours
- Environment
- Monitoring Agent
- Power Grid
- Intruder
- E01
- E02
- E03
- E04
- E05/6
- E07
- E08
- E09
- PSTN
- House System
- Power Distribution Subsystem

- Power entry panel
- Power point
- Resident Monitoring Agent
- Police
- Neighbours
- Environment
System feasibility analysis

• A feasibility analysis should answer questions such as:
  – Is the system really needed?
  – What would be the consequences if the system wasn’t developed?
  – How will the system contribute to business objectives?
  – What critical processes must support the system?
  – What critical processes need not be supported by the system?
  – How will the system affect other systems?
  – What feasible options are there?
  – What likely technology limitations will apply?
  – Is there sufficient budget available?

Feasibility analysis—solution class

• A solution class is a generic solution type, which does not incorporate any specific implementation elements or manufacturer’s solution. Examples include fighter aircraft, airborne radar, ground-based surveillance, space-based communications, ground transportation, and aircraft carrier. (CDD Guide v2.0)

<table>
<thead>
<tr>
<th>Long-range Communications</th>
<th>Surveillance of air-sea gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Cable</td>
<td>• Sky-wave radar</td>
</tr>
<tr>
<td>• Microwave radio relay</td>
<td>• Surface-wave radar</td>
</tr>
<tr>
<td>• HF Communications</td>
<td>• Airborne sensors</td>
</tr>
<tr>
<td>• Satellite</td>
<td>• Satellite sensors</td>
</tr>
</tbody>
</table>
ACME Aircraft feasibility analysis

- ACME wants to service selected short-to-medium domestic and international routes but doesn’t have the airframes to do it. Based on this simple statement of Business Needs, the feasible alternative solution classes might be:
  - lease or buy an existing aircraft, as commercial-off-the-shelf (COTS);
  - lease or buy and modify an existing aircraft (modified COTS);
  - contract to have a new aircraft developed;
  - outsource the operation to another airline; or
  - don’t chase business over these medium routes.
Define business requirements

- The feasibility analysis and selection of the resultant desired solution class may require the draft business needs to be revisited in light of the more-detailed investigations of the feasibility analysis.
- The hierarchical representation of business needs (mission, goals, objectives) is now further elaborated (decomposed and derived) and formalised into a balanced set of business requirements, which are recorded in the BRS.
- The RBS framework is very useful to provide a hierarchical description of the requirement set.

RBS for the security alarm example

1. Deter Unauthorised Entry
   - 1.1 Deter in neighbourhood
   - 1.2 Deter in yard
   - 1.3 Deter in Residence
   - 1.4 Prevent system disabling

2. Detect Entry
   - 2.1 Detect Un/Authorised Entry
   - 2.2 Record Entry Time
   - 2.3 Record Entry Location
   - 2.4 Detection Failure Rate

3. Classify Entry
   - 3.1 Classify Un/Authorised Entry
   - 3.2 Record Classification Details
   - 3.3 Record classification
   - 3.4 False alarm rate
   - 3.5 Adjustable sensitivity

4. Report Unauthorised Entry
   - 4.1 Report Entry Local
   - 4.2 Report Entry Neighbourhood
   - 4.3 Report Entry Agent
   - 4.4 Modify Agent Details

5. Provide Market-leading Alarm
   - 5.1 Suitable for Residences
   - 5.2 Easy to use
   - 5.3 Scalar/modular/upgradable
   - 5.4 Relocatable within Residence
   - 5.5 Sustainable over Life
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Conceptual Design

C1. Define business needs and requirements

C2. Define stakeholder needs and requirements

C3. Define system requirements

C4. Conduct system-level synthesis

C5. Conduct System Design Review (SDR)

To Preliminary Design

Define stakeholder needs and reqts

C1. Define business needs and requirements

C2. Define stakeholder needs and requirements (SNR)

C2.1 Define stakeholders

C2.2 Define stakeholder requirements

C2.2.1 Identify stakeholders

C2.2.2 Conduct trade studies

C2.2.3 Define stakeholder requirements (StRS)

C2.2.4 Define validation criteria

C2.3 Finalise stakeholder needs and requirements (SNR)

C2.3.1 Review operational scenarios

C2.3.2 Review life-cycle concepts

C2.3.3 Review system scope

C2.3.4 Endorse stakeholder needs and requirements (SNR)

C2.4 Define validation criteria

C3. Define system requirements
Define stakeholder needs

C1. Define business needs and requirements

C2. Define stakeholder needs and requirements (SNR)
- C2.1 Define stakeholder needs
  - C2.1.1 Identify stakeholders
  - C2.1.2 Define mission, goals, objectives
  - C2.1.3 Develop operational scenarios
  - C2.1.4 Develop life-cycle concepts
  - C2.1.5 Endorse stakeholder needs

- C2.2 Define stakeholder requirements
  - C2.2.1 Identify trade studies required
  - C2.2.2 Conduct trade studies
  - C2.2.3 Define stakeholder requirements (StRS)
  - C2.2.4 Define validation criteria

- C2.3 Finalise stakeholder needs and requirements (SNR)
  - C2.3.1 Revise operational scenarios
  - C2.3.2 Revise life-cycle concepts
  - C2.3.3 Revise system scope
  - C2.3.4 Endorse stakeholder needs and requirements (SNR)

C3. Define system requirements

Trade studies

C1. Define business needs and requirements

C2. Define stakeholder needs and requirements (SNR)
- C2.1 Define stakeholder needs
  - C2.1.1 Identify stakeholders
  - C2.1.2 Define mission, goals, objectives
  - C2.1.3 Develop operational scenarios
  - C2.1.4 Develop life-cycle concepts
  - C2.1.5 Endorse stakeholder needs

- C2.2 Define stakeholder requirements
  - C2.2.1 Identify trade studies required
  - C2.2.2 Conduct trade studies
  - C2.2.3 Define stakeholder requirements (StRS)
  - C2.2.4 Define validation criteria

- C2.3 Finalise stakeholder needs and requirements (SNR)
  - C2.3.1 Revise operational scenarios
  - C2.3.2 Revise life-cycle concepts
  - C2.3.3 Revise system scope
  - C2.3.4 Endorse stakeholder needs and requirements (SNR)

C3. Define system requirements
Trade studies

- The definition of the scope of the system is greatly assisted by the use of trade-off studies (or trade studies). If we are not careful, the requirements derivation (hierarchical devolution) process will develop an RBS that is far too broad for us to cope with.

- Design is about choice and we should be careful to ensure that we make choices whenever we can.

- Having made a choice of a way ahead, therefore, we are limiting the scope as well as limiting the requirements hierarchy below us.

- Informed choices in design are made through trade studies.

Trade study process

- A generic trade study process might be:
  - Definition of objective and scope for the trade study.
  - Identification of alternative solutions.
  - Nomination of selection criteria.
  - Determination of criteria weighting.
  - Scoring function.
  - Evaluation of alternatives.
  - Sensitivity study.
Define stakeholder requirements

- C1. Define business needs and requirements
- C2. Define stakeholder needs and requirements (SNR)
  - C2.1 Define stakeholder needs
    - C2.1.1 Identify stakeholders
    - C2.1.2 Refine mission, goals, objectives
    - C2.1.3 Develop operational scenarios
    - C2.1.4 Develop life-cycle concepts
    - C2.1.5 Endorse stakeholder needs
  - C2.2 Define stakeholder requirements
    - C2.2.1 Identify trade studies required
    - C2.2.2 Conduct trade studies
    - C2.2.3 Define stakeholder requirements (StRS)
    - C2.2.4 Define validation criteria
    - C2.3 Finalise stakeholder needs and requirements (SNR)
      - C2.3.1 Revise operational scenarios
      - C2.3.2 Revise life-cycle concepts
      - C2.3.3 Revise system scope
      - C2.3.4 Endorse stakeholder needs and requirements (SNR)
  - C3. Define system requirements

Define stakeholder requirements

- A reader of the StRS should be able to understand completely:
  - the likely applications or missions for which the system is intended;
  - the major operational characteristics to be exhibited by the system;
  - the operational constraints that limit the design and development of the system;
  - the external systems and interfaces;
  - the operational and support environment; and
  - the support concept to be employed.
StRS example for ACME Air

• In our aircraft development example, the StRS will contain such statements as:
  – The Aircraft shall be capable of operating from a Class X airport.
  – The Aircraft shall provide class-leading comfort for passengers.
  – The Aircraft shall be turned around to its next flight within 30 minutes.

StRS example for ACME Air

The Aircraft shall provide class-leading comfort for passengers.

• Note that the StRS requirement statements are similar in construction and language to those that will follow in the SyRS, but they do not have to be as precise and the verification requirements can be less stringent.
• That is, for example, class-leading comfort is not directly verifiable, but it is sufficiently bounded for the next level of design (conducted by the system designers) to understand what quantitative statements must be made that, when implemented, will lead to ‘class-leading’ comfort.
Finalise & Endorse SNR

C2. Define stakeholder needs and requirements (SNR)
- C2.1 Define stakeholder needs
  - C2.1.1 Identify stakeholders
  - C2.1.2 Define mission, goals, objectives
  - C2.1.3 Develop operational scenarios
  - C2.1.4 Develop life-cycle concepts
  - C2.1.5 Endorse stakeholder needs
- C2.2 Define stakeholder requirements
  - C2.2.1 Identify trade studies required
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  - C2.3.3 Revise system scope
  - C2.3.4 Endorse stakeholder needs and requirements (SNR)

C3. Define system requirements

Capability system
- Earlier we saw that, because a system is often seen as an operational capability, it is commonly referred to as a capability system comprising the major equipment solution (hardware and software), organization, personnel, collective training, facilities, data, support system (including supplies), and operating procedures and organizational policies.
- At this point in the design, the business owners and stakeholders must agree on how the elements of the capability will be acquired.
- There could be a single SyRS developed for the whole capability system or there could be one SyRS developed for each element of the capability system, or for any combination of elements.
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Capability system

Conceptual Design

C1. Define business needs and requirements
   BNR (PLCD & BRS)

C2. Define stakeholder needs and requirements
   SNR (LCD & SRS)

C3. Define system requirements
   Draft SyRS

C4. Conduct system-level synthesis
   SyRS

C5. Conduct System Design Review (SDR)
   Initial FBL

To Preliminary Design
Define requirements

- C2. Define stakeholder needs and requirements
- C3. Define system requirements
  - C3.1 Establish system requirements framework
  - C3.2 Perform requirements analysis and allocation
    - C3.2.1 Define functional / non-functional requirements
    - C3.2.2 Define performance requirements
    - C3.2.3 Define verification requirements
    - C3.2.4 Assign rationale
  - C3.3 Draft System Requirements Specification (SyRS)
  - C3.4 Define Technical Performance Measures (TPM)
  - C3.5 Conduct System Requirements Review (SRR)
- C4. Conduct system-level synthesis

System Requirements Analysis

- Define Functional Requirements
  - FFBD concept—note: hierarchical nature of the diagram, numbering system, relationships, inputs and outputs
Example functional requirements

Turning around in 30 minutes:

1. Aircraft lands
2. Aircraft taxis from runway to terminal
3. Aircraft turns around in 30 minutes
4. Aircraft taxis from terminal to runway
5. Aircraft takes off

3.0 - Aircraft turns around in 30 minutes
3.1 Unload passengers, freight, luggage (PFL)
3.2 Load PFL
3.3 Conduct refuelling
3.4 Maintain aircraft
3.5 Other turn-around functions

Define performance requirements

C3. Define system requirements
C3.1 Establish system requirements framework
C3.2 Perform requirements analysis and allocation
C3.2.1 Define functional / non-functional requirements
C3.2.2 Define performance requirements
C3.2.3 Define verification requirements
C3.2.4 Assign rationale
C3.3 Draft System Requirements Specification (SyRS)
C3.4 Define Technical Performance Measures (TPM)
C3.5 Conduct System Requirements Review (SRR)

C4. Conduct system-level synthesis
Define performance requirements

- Once the functions have been identified and grouped according to the agreed RBS, the systems engineers and stakeholders must agree on the performance-related parameters that the new system must achieve. Having decided what the system must do, the designer must now determine how well the system is to perform each of those functional requirements. A good discipline is to ensure that, every time a functional requirement is articulated, a corresponding performance statement is made.

- Most of the operational functions will have obvious performance parameters associated with them such as speed, accuracy, endurance, and acceleration. Support and other functions also require parametric definition to define completely the requirement.

Define verification requirements
Define verification requirements

• The definition of requirements is not complete until verification requirements are also included. It is good practice to ensure that, every time a functional/nonfunctional requirement is articulated, a corresponding verification statement is made.

• It is often difficult to write verification requirements for system-level functions, but the discipline of doing so is important since there is little point in stating a requirement for a function without consideration of how the function is to be tested.

• An additional benefit of adhering to the discipline at this stage is that test plans become much easier to write because the tests required at any level can be considered as an aggregation of the verification requirements at that level.

Define verification requirements

• It is not common to include verification statements in the SyRS. In many instances, the function and performance statements are included in the SyRS and the verification requirements are included in a separate document—such as a test concept document, or through a verification cross reference matrix (VCRM).

• This represents the view of the older style of specification. A more modern standard, EIA-632 defines a specification as: ‘A document that contains specified requirements for a product and the means to be used to determine that the product satisfies these requirements’.

• Note, therefore, that the two parts are necessary—that is the functional and performance requirements as well as the means to test them (the verification requirements).
Define verification requirements

- Although verification statements are not common, it is reasonably common to attach a letter after each functional requirement to show the methods that is proposed to be utilised to accomplish verification: Analysis [A]; Demonstration [D]; Inspection [I]; and Test [T].

- While the attachment of a letter to illustrate the verification means, it is much better practice to write a verification statement to make the verification means more specific.

- That is particularly true for the analysis [A] and test [T] verification means because the use of a single letter begs a number of important questions that really should be answered at the time the requirement is written.

Assign rationale

C2. Define stakeholder needs and requirements

C3. Define system requirements

C3.1 Establish system requirements framework

C3.2 Perform requirements analysis and allocation

C3.2.1 Define functional / non-functional requirements

C3.2.2 Define performance requirements

C3.2.3 Define verification requirements

C3.2.4 Assign rationale

C3.3 Draft System Requirements Specification (SyRS)

C3.4 Define Technical Performance Measures (TPM)

C3.5 Conduct System Requirements Review (SRR)

C4. Conduct system-level synthesis

Draft SyRS
Assign rationale

- The rationale explains why each requirement is necessary and the logic behind performance imperatives assigned to the requirement.
- It is also useful to record the rationale behind each requirement, because:
  - The requirement should be able to be justified.
  - It helps explain the requirement which may avoid ambiguity.
  - Communicates intent to lower-level designers.
  - Assists in the tracing required for requirements management.
- Example: Rear Windscreen Design

Analysis and allocation
Analysis and allocation example

• Earlier, in our aircraft development example, we saw that the StRS will contain such statements as:
  – The Aircraft shall be capable of operating from a Class X airport.
  – The Aircraft shall provide class-leading comfort for passengers.
  – The Aircraft shall be turned around to its next flight within 30 minutes.

• From these selected StRS requirements, a number of system requirements will be elaborated (decomposed and derived).

• Note that there is no intention to be complete—the example statements are simply offered as typical of the sort of requirements that would be generated.

Analysis and allocation example

1. Operate from Class X Airports
   1.1 Operate from specified minimum runway length
   1.2 Operate from specified runway surface
   1.3 Operate with specified maximum allowable aircraft weight
   1.4 Operate with specified essential navigation aids
   1.5 Operate with specified essential automatic landing systems
   1.6 Operate with specified essential communications systems

Note that a numbering convention has been added to assist with traceability during later design activities.
Analysis and allocation example

2. Provide class-leading comfort to passengers
   2.1 Provide class-leading seating
   2.2 Provide class-leading entertainment systems
   2.3 Provide class-leading bathroom facilities
   2.4 Provide class-leading catering services

Analysis and allocation example

3. Turn the aircraft around in less than 30 minutes
   3.1 Load passengers, cargo and catering in < 30 minutes
   3.2 Unload passengers, cargo and catering in < 30 minutes
   3.3 Conduct refuelling operations in < 30 minutes
   3.4 Conduct operational maintainability in < 30 minutes
Technical Performance Measures (TPM)

- TPMs are identified early in the system development effort and are continually monitored and tracked throughout the system development as a means of managing the risks associated with system development.

- The first step in identifying TPMs is to identify the quantitative parameters that require tracking throughout the project.

- Throughout the design process, a list of TPMs and associated metrics should be maintained along with the priority, the ‘benchmark’ objective, and the current level of achievement and projected/estimated performance.

- Once the parameters have been identified, they should be prioritized in terms of their importance as viewed by the customer. A second list of TPMs may be established, prioritized and maintained by the contractor.
Technical Performance Measures (TPM)

- IEEE-STD-1220 states that appropriately selected TPMs can be used to:
  - assess conformance to requirements, assess conformance to levels of technical risk,
  - trigger development of recovery plans for identified deficiencies, and
  - examine marginal cost benefits of performance in excess of requirements.

- Bands of acceptable variation from the expected value will also be determined and agreed upon so that unnecessary risk management actions are not instigated at the first sign of a very minor variation. The variation bands will be typically large in the early stages of the design but will become increasingly narrower as the design matures.
System Requirements Reviews (SRR)

- System Requirements Reviews (SRR) may be conducted periodically throughout Conceptual Design to verify and approve versions of system-level requirements.
- The aim of the SRRs is to monitor and approve progressively the system-level requirements that are developed on the way to the Initial FBL.
- Progressive reviews allow the requirements analysis effort to continue to lower levels in the logical hierarchy in the RBS by providing validation of the higher levels of abstraction, providing a firm start point for the subsequent analysis.
- SRRs may or may not be considered formal reviews.
System-level synthesis

- We know that synthesis is another name for evolving design.
- System-level synthesis takes the set of system requirements and determines potential solutions—a broad system-level architecture that is representative of the final system.
- The process of system-level synthesis uses a well-established process of trade-off analysis:
  - Identify the potential solutions to the problem.
  - Weigh up the relative pros and cons of each solution against a set of selection criteria.
  - Select the preferred system-level solution to the problem.
System-level synthesis

- A good example of system-level synthesis is the tendering process adopted by many organisations
- Requirements analysis provides the draft specification that forms a central part of a request for tender or RFT
- Potential contractors respond to the RFT with their proposed system-level solutions
  - These solutions vary in cost and in compliance with the draft specification.
  - Remember the draft specification contains some latitude, which is expressed using words such as mandatory, important and desirable.
- The customer evaluates the responses and selects the preferred system-level solution.

System-level synthesis

- The preferred solution will be selected based on a number of issues including compliance with requirements.
- Following selection, the customer and preferred tenderer will need to meet to massage both the solution and the requirements until a consensus is met.
- This is often called tender negotiation.
- The draft SyRS will be refined at this stage and often changes will need to be made.
System-level synthesis

• Typical changes to the draft SyRS include:
  – Removal of terms such as mandatory, important and desirable.
  – Removal of bands of acceptable performance and replacement with agreed minimum level of acceptable performance.
  – Addition, modification, or deletion of requirements
    • This may involve revisiting the StRS.
    • This will be a test of our traceability.
    • We must re-involve the stakeholders here because systems engineers don’t necessarily own the requirements.

System-level synthesis

• A few words on the refined SyRS:
  – The refined SyRS is perhaps the most important of all systems engineering documents.
  – It is the source of reference for all future work and documentation.
  – If solid, it stands the remaining effort in good stead.
  – Errors, omissions, conflicts and so on will now start flowing into the following systems engineering stages.
  – The later these problems are discovered, the more expensive and less likely the rectification.
  – …
System-level synthesis

- A few words on the refined SyRS:
  - …
  - The specification is traceable back to the StRS.
  - Systems engineers must ensure this traceability and must ensure that achievement of all of the system specification requirements automatically results in satisfaction of the StRS.
  - Sounds obvious, but always check that the sum of the SyRS requirements = the StRS requirements.
  - This is a challenge always faced by systems engineers as the broad StRS statements are translated into a series of more detailed requirements.
System Design Review (SDR)

• At the end of Conceptual Design the System Design Review (SDR) provides the following from a systems engineering perspective:
  – formal confirmation that the logical design meets the business and stakeholder requirements;
  – a formal record of design decisions and acceptance;
  – a formalized communication of the intended design approach to the major players in the design effort;
  – approval of the V&V plans for the system; and
  – approval of the Systems Engineering Management Plan (SEMP) and supporting plans.

System Design Review (SDR)

• In addition to review of the systems engineering effort, a number of review activities will most likely be performed at SDR to support project management:
  – confirmation that the system to be procured aligns with the customer's organizational goals;
  – the Project Management Plan (PMP) is refined;
  – cost estimates are refined;
  – the schedule is refined and is confirmed to be consistent with the cost and risk goals for the project; and
  – confirmation that all required project resources are available.
Preliminary Design

- Preliminary Design starts with the Initial FBL from Conceptual Design and continues to translate system-level requirements into design requirements for the system elements that will combine to form the system.
- Trade-off studies are conducted to assist in the choice of system elements.
- The result of the Preliminary Design effort is the establishment of an Allocated Baseline (ABL), in which requirements are ‘allocated’ to specific physical system elements that combine to form the system.
Preliminary Design

- The contractor is normally responsible for Preliminary Design, who develops the system to meet the requirements of the FBL (normally prepared by the customer).

- Although the customer normally avoids becoming actively involved in design decisions made during Preliminary Design, they remain very interested and their role now increasingly becomes one of monitoring, reviewing and supporting contractor progress.

- In some cases, the customer may opt to add an additional level of rigour to the process by engaging independent systems engineering consultants to provide independent review of the many artefacts produced by contractors during systems development—often called independent verification and validation (IV&V).

Subsystem requirement analysis

Remember our example FFBD for turning around in 30 minutes:
Subsystem requirement analysis

We can now do the lower-level analysis of the required functions:

### Configuration items (CI)

- Each of the major subsystems needs to be considered individually during Preliminary Design.
- Depending on how the designers intend to realise the subsystems, they may be broken down further into configuration items (CIs), which comprise the hardware, software or a combination of both designed to satisfy an allocated group of requirements.
- Sometimes a subsystem will be a single CI, but usually a subsystem will comprise a number of CIs.
- As the name suggests, the configuration of each CI is managed as a separate item for design, development, documentation, construction, review, audit, and test.
- The same CIs may also be used during the Utilization Phase for through-life support although, as we discuss later, the in-service CIs may be different to the development.
CI selection

- The selection and designation of physical design items as CIs is a configuration management function known as configuration identification.

- Configuration management is so critical to systems engineering that we treat it as a separate topic during the section on systems engineering management.

- CIs are a matter of design choice and can vary in size and complexity—MIL-HDBK-61A(SE), Military Handbook—Configuration Management Guidance says that a CI can be anything from from an aircraft, ship, or electronic system to a test meter, or a round of ammunition.

CI selection

- In general, however, items may be identified as CIs because of:
  - Complexity
  - Interfaces
  - Use/function
  - Commonality
  - Provided by a single supplier
  - Criticality
  - Maintenance and documentation needs
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CI selection

• The determination and selection of CIs is a design decision made by the design team (contractor) in their attempt to satisfy the system level requirements in the best possible way.

• The customer sometimes influences the decision, especially if there are mandated solutions or constraints involving customer-furnished equipment that must be used in the design.

• Even if the customer does not influence the decision, the customer needs to be aware of the CI selection process because it impacts on:
  – acquisition activities such as documentation, design reviews, configuration audits and test and evaluation; and
  – operational use and system support activities such as maintenance and modification programs.

Requirements allocation

• We have our subsystems and we have our sets of requirements.

• We now “join the dots” and allocate requirements to subsystems (which represents the translation of functional design into physical design).

• Our requirements set will be larger following our subsystem requirements analysis task but for the sake of the example, we will allocate system-level requirements only.
RBS vs WBS (an aside)

- Early on, we justified the invention of a new term (RBS) by stating that the term was used to differentiate it from a well-known project management term (WBS).
- We are now in a position to investigate the relationship between the RBS and the WBS in order to emphasise the differences between the two structures.
- The concept of the WBS is closely related to the physical structure shown (horizontally) in the allocation matrix.
- WBS documents the work and products necessary to produce the system, which necessarily includes all the CIs listed in our allocation matrix.
RBS vs WBS (an aside)

- In addition to the CIs, the WBS adds additional work including:
  - Design and development work
  - Integration effort
  - Test and evaluation effort
  - And more
- WBS is based more around project management imperatives and concepts.
- To that end, the relationship between WBS and RBS is very similar to the relationship between CI list and RBS.

RBS vs WBS—Aircraft example
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Project (Contract) WBS

Configuration Items (CI)

Enabling Products (EP)

Project RBS

System Requirements

1.
1.1
1.1.1
1.1.2
1.1.3
1.2
1.2.1
1.2.2
1.3
1.3.1
1.3.2
1.3.3
1.3.4

Project Requirements

7.
7.1
7.1.1
7.1.2
7.1.3
7.1.4
7.1.5

Statement of Work (SOW)

System Requirement Specification (SRS)

Requirements Engineering

Logical Architecture

Logical to Physical Translation

StRS

SyRS

Use of architectures

Problem space (in which stakeholders' business exists)

Stakeholder's Operational Environment

Problem Domain

Logical Architecture

Constrains

Influences

Physical Architecture

StRS

SyRS

CIs

Solution space (including available technologies, and types of products and systems)

—stable architectural building blocks

Architectural Family

Solution Domain

Requirements Engineering

Problem Domain

StRS

SyRS

CIs

Architectural Family

StRS

SyRS

CIs

Architectural Family

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SyRS

CIs
Preliminary Design Review (PDR)

- The major PDR task is to investigate each CI.
- Ensure that all system-level requirements have been allocated appropriately.
- Ensure that the system-level requirements have been allocated and derived to sufficient levels of detail to support detailed design and development.
- Ensure that CI to CI (internal) interfaces have been identified and documented.
- Ensure CI to environment (external) interfaces have been addressed.

Preliminary Design Review (PDR)

- PDR should review and approve the documentation set that has been developed to document the allocated baseline.
- This is the baseline that will be used during detailed design and development.
- Successful PDR establishes the allocated baseline and authorizes detailed design against that baseline.
- Not all issues will be resolved during PDR: some action items are to be expected.
- Actions out of PDR should not be “show stoppers” or the show should be stopped until they are addressed.
Preliminary Design Review (PDR)

- PDR could be conducted:
  - on each subsystem or CI (separate review for each CI), or
  - as a system-level review at which all CIs are reviewed
- Approach should be driven by size, complexity and risks associated with the development effort.
- Documentation reviewed includes:
  - Development specifications
  - Interface control documents
  - Draft product specifications (if applicable and available)
Detailed Design and Development

• The Detailed Design and Development activity continues the development effort based on the FBL and ABL developed during Conceptual and Preliminary Design.

• The detailed design effort takes these definitions of the overall system (FBL) and of the major CIs (ABL) and finalizes the design of specific components that make up the CIs (and subsystems).

• The realization and documentation of individual components used to support production is referred to as the Product Baseline (PBL).

| Conceptual Design | Preliminary Design | Detailed Design and Development | Construction and/or Production |

Detailed Design & Development

• The major technical activities undertaken during Detailed Design and Development include:
  – Describing the lower-level assemblies and components making up the CIs (and their interrelationships).
  – Defining the characteristics of those items through specifications and design data.
  – Finalising the design of all interfaces necessary to support system integration.
  – Procuring items COTS or designing them.
  – Developing prototypes or engineering models of the CIs.
  – Conducting a Critical Design Review (CDR) to confirm that design is ready for construction and production.
Integration

• Design has been focusing on developing the lowest level components of the system.

• These components need to be:
  – Procured (in the case of COTS equipment).
  – Procured and modified (for modified COTS).
  – Constructed (in the case of developmental items)

• Integration focuses on combining the individual components to form the next higher-level assembly.

• At each stage of integration, evaluation will take place to verify success.

Integration

• While the design process is top-down, the integration process is bottom-up. At each stage of the integration, some form of integration testing will be conducted to verify the successful integration.
Critical Design Review (CDR)

- Major review of Detailed Design and Development.
- Final review prior to commencement of Construction and/or Production.
- Collection of specifications reviewed and approved establishing the PBL.
- Establishment of the PBL is an effective freezing of design-related activity.
- Final TPM results will be investigated as part of CDR.
- Production Plans will also be approved.
Construction and/or Production

• At the end of Detailed Design and Development, the PBL has been established and the production process is in place and has been proven (most likely with the trial production of selected system elements).

• The system can now move into Construction and/or Production.

<table>
<thead>
<tr>
<th>Conceptual Design</th>
<th>Preliminary Design</th>
<th>Detailed Design and Development</th>
<th>Construction and/or Production</th>
</tr>
</thead>
</table>

Construction and/or Production

• As with all other system requirements, Construction and/or Production requirements need to be considered early in the system development.

• Issues that need to be addressed include:
  – material availability (lead times), ordering, and handling;
  – availability of skill sets (including any training);
  – availability of production tools and equipment;
  – fabrication requirements including production requirements, assembly drawings and instructions;
  – processing and process control;
  – assembly, inspection and test; and
  – packaging, storage, and handling.
The Production Plan

- A Production Plan needs to be produced early in the program and revised continually to take into account special requirements flowing from design.
- The Production Plan will need to be finalised and approved prior to Construction and/or Production (which means that CDR is the latest time for approval).
- The content of the plan will vary depending on the specific requirements of the system.
- Systems engineering process can be used to help develop the plan.

Construction and/or Production

- Other activities
  - Test and Evaluation activities
    - Basically revolve around ensuring system (as constructed) meets requirements.
  - Configuration Audits
    - Part of the Configuration Management effort.
    - Revolve around ensuring items (as built) are in accordance with the appropriate documentation:
      - Physically (Physical Configuration Audit)
      - Functionally (Functional Configuration Audit)
Test Readiness Review (TRR)

- Testing is an expensive and time-consuming exercise involving highly trained personnel, expensive facilities, and specialized test equipment.
- Test Readiness Reviews (TRR) are sometimes contractually required by the customer to demonstrate that the system CIs are ready to enter formal test and evaluation.
- To that end, CI-level TRRs occur during Construction and/or Production and are designed to avoid the unnecessary expense involved with committing T&E resources to a CI or system that is not sufficiently mature to enter testing.
- A system-level TRR may be conducted before commencing major verification activities such as AT&E.

Formal Qualification Review (FQR)

- The Formal Qualification Review (FQR) may be required to verify that the performance of each of the CIs meets all the functional requirements when integrated together into the system.
- The FQR will demonstrate that the integrated system complies with all the specifications generated as part of the project including SyRS, Development Specifications, and interface requirement specifications.
- From this point of view, the FQR could be considered a 'system-level' configuration audit.
- Normally, the FQR would be conducted following the configuration audits and may mark formal system-level acceptance by the customer.
Utilization Phase
(Operational Use and System Support)

- System enters Utilization Phase following successful Construction and/or Production
- Systems engineering involvement is now quite minimal
- Major system activities:
  - Operational Use
  - System Support
  - Operational Test and Evaluation
  - Modifications

<table>
<thead>
<tr>
<th>Pre-acquisition Phase</th>
<th>Acquisition Phase</th>
<th>Utilization Phase</th>
<th>Retirement Phase</th>
</tr>
</thead>
</table>
Operational Use and System Support

• Operational Use
  – Deployment and operation of the system against the original requirements
  – Note that requirements and use of the system may well change as time goes on

• System Support
  – Maintenance and support activities designed during Acquisition Phase
  – Aims to ensure that system is capable of fulfilling operational requirements
  – Support can become challenging as the system ages

Operational Use and System Support

• Modifications
  – May be made early in the Utilization Phase to rectify discrepancies in System performance discovered during Operational Test and Evaluation.
  – Must be made in accordance with sound configuration management practices (introduced in Systems Engineering Management).
  – Main reasons for modifications include:
    • Rectification of system performance problems.
    • Failures identified by the FRACAS process (discussed shortly).
    • New or revised operational requirements.
    • Ensure continued supportability.
Modifications

- Significant modifications can be considered systems in their own right.

FRACAS

- A failure reporting, analysis, and corrective action system (FRACAS) is a closed-loop system designed to continually maintain visibility into system operation and support.
- The FRACAS is put in place to record, analyze and rectify the cause of system failures, especially recurring or related failures.
- The important difference between a maintenance system and a FRACAS is that the maintenance system rectifies the failure and the FRACAS attempts to rectify the cause.
FRACAS

- A successful FRACAS may highlight reliability and maintainability issues as a system proceeds through its life cycle—as it ages, a system normally become less reliable and more difficult to support and maintain.

- The FRACAS is in place to help counter this natural decline in reliability and maintainability.

- A FRACAS based on MIL-STD-2155(AS) has six steps:
  - failure reporting,
  - failure analysis,
  - failure verification,
  - corrective action,
  - failure report and close-out, and
  - identification and control of failed items.

Example FRACAS process

- Testing and operating the system
- Log failure
- Collect data
- Generate failure report
- Repeat and analyze failure
- Review and recommend corrective action
- Carry out corrective action
- Monitor results

MIL-STD-2155(AS)
Retirement Phase

- Final stage in the life cycle.
- Activities include:
  - Transportation
  - Handling
  - Decomposition
  - Processing
- Disposal can be costly and time consuming and the Retirement Concept should be considered early.
- User must ultimately pay for disposal.

Retirement from life cycle

- A system may be retired from a number of life cycles before final disposal at end of life.
Technical reviews and audits

- Technical reviews and audits measure progress and reduce technical risk by:
  - providing a formal evaluation of design maturity
  - measuring and reporting on planned and actual performance
  - clarifying and prioritising design requirements
  - evaluating and establishing the system baseline at discrete points in the design process
  - providing an effective means of formal communication between stakeholders
  - recording design decisions and rationales for later reference
Technical reviews and audits

- Work for both customer and contractor.
- Vital part of systems engineering.
- Range from very informal discussions to formal meetings.
- Aim to determine the ability of the design to meet the necessary requirements.
- Reviews will tend to become more detailed as the design progresses.
- Normally specified (number, content and timing) in contractual documentation.

Technical reviews and audits

- Number of reviews required will depend on:
  - Complexity
  - Size
  - Technical risk
- Reviews must be scheduled at the correct stage in the development:
  - Too early = immature design, unable to determine adequacy
  - Too later = miss opportunities to rectify problems
- Normally relate reviews and audits to documentation release in early stages.
- Seen as a major technical risk monitoring tool.
Technical reviews and audits

- We have already discussed the following reviews and audits discussed in MIL-STD-499B:
  - System Requirements Review
  - System Design Review
  - Preliminary Design Review
  - Critical Design Review
  - Test Readiness Review
  - Functional Configuration Audit
  - Physical Configuration Audit
  - Formal Qualification Review

- Conceptual Design
- Preliminary Design
- Detailed Design & Development
- Construction and/or Production
- Operational Use and System Support

- Feasibility Analysis
- System Requirements Analysis
- System Synthesis & Evaluation
- Subsystem Functional Analysis
- Subsystem Allocation
- Subsystem Synthesis & Evaluation
- Detailed Design
- Requirements
- Designing & Integrating
- System Elements
- System Prototype Development
- Modifications
- Modifications

- System Requirements Review
- Preliminary Design Review
- Critical Design Review
- Functional Configuration Audit
- Physical Configuration Audit
- Formal Qualification Review

- System Level
  - System Requirements
  - System Synthesis & Evaluation
- Subsystem Level
  - Subsystem Functional Analysis
  - Subsystem Allocation
  - Subsystem Synthesis & Evaluation
- Component Level
  - Detailed Design
  - Requirements
  - Designing & Integrating
  - System Elements
  - System Prototype Development
- Modifications
  - Modifications

- System Requirements Review
- Preliminary Design Review
- Critical Design Review
- Functional Configuration Audit
- Physical Configuration Audit
- Formal Qualification Review
Technical review and audit management

- Review and audit requirements can be extensive so management required.
- Requirements must be specified in contract.
- However, requirements must be proportional to size and complexity of the project:
  - Under-reviewing will expose the project to risk.
  - Over-reviewing will needlessly increase cost and schedule without additional benefit.
- Both customer and contractor need to be involved as both parties can add value.
- Results must be documented and action items must be assigned to an individual (unassigned action items = unactioned action items).

Technical Review and Audit Plan (TRAP)

- The principal way of managing the technical review and audit effort is via a Technical Reviews and Audits Plan (TRAP).
- The TRAP documents all formal reviews, detailing the entry criteria that must be met prior to the commencement of the review or audit and the exit criteria that must be demonstrated prior to approval of the review or audit.
- The TRAP is normally drafted and approved during Conceptual Design.
Test and Evaluation

System T&E

- Ensures consistent and coordinated approach to system testing.
- Directs the focus of Test and Evaluation (T&E) effort at different life-cycle stages.
- Aims to progressively test and evaluate the system as it passes through the life cycle.
- Aims to identify problems early to avoid costly and time consuming rectifications later.
- T&E is a major technical risk mitigation measure.
### System T&E

- Testing can be expensive and time-consuming:
  - Specialised test equipment.
  - Highly trained personnel.
  - Expensive operating costs.
  - Facilities.
- A formal plan is usually required to manage the entire T&E effort: Test and Evaluation Master Plan (TEMP).

### Verification and Validation (V&V)

- The entire systems engineering process aims to produce a system that is:
  - *verified* against the documentation produced, and
  - *validated* against the original needs, goals and objectives.
- V&V ensures that we have both:
  - built the system right (verification); and
  - built the right system (validation).
- The T&E effort supports V&V.
T&E categories

• Developmental Test and Evaluation (DT&E):
  – Largely undertaken in the Acquisition Phase.
  – Support design and development effort.
  – Generally undertaken by contractors.
• Acceptance Test and Evaluation (AT&E):
  – Formal acceptance testing on behalf of customer.
  – Between the Acquisition and Utilisation Phases.
• Operational Test and Evaluation (OT&E):
  – Focuses on functional or operational testing of the system.
  – Generally undertaken by users following acceptance.
  – Some OT&E—called Preview T&E (PT&E)—can occur earlier during Acquisition Phase, particularly for large, phased projects.
Developmental Test and Evaluation (DT&E)

- Takes place throughout the Acquisition Phase.
- Aims to highlight design deficiencies early—the earlier a deficiency is noted, the cheaper and easier it is to rectify.
- Used to validate designs and to monitor and minimise design-related risks.
- Covers a broad range of testing from lowest level components to system prototypes very close to final system configuration.
- Responsibility normally lies with the contractor.
- Although a contractor responsibility, customer will normally want visibility into DT&E progress (perhaps through the Technical Review and Audit process).

Acceptance Test and Evaluation (AT&E)

- Normally shared by contractor and customer:
  - customer approves procedures
  - customer and/or contractor conduct testing
  - customer will always observe if not conducting
- Focused on confirming that delivered system meets the system-level requirements contained in the System Specification and the contract (back to the Functional Baseline).
- Discrepancies are documented and rectified.
- On successful conclusion, system is accepted and will formally enter Utilization Phase.
Operational Test and Evaluation (OT&E)

- After AT&E, OT&E is used by the customer to assess the ability of the system to meet the original needs.
- Can be conducted early in Conceptual Design, in which case it is called Preview T&E (PT&E).
- Testing focused on operational functionality rather than design issues.
- Normally, testing agency within the customer’s organisation will be independent from the procuring agency within the customer’s organisation.
- Independence is important to gain an unbiased assessment (sometimes the procuring agency will feel some ownership and responsibility for system performance).

OT&E

- Modifications may be suggested as a result of OT&E.
- OT&E may also be used to assist operators to fine-tune operational procedures relating to system use.
- Must be conducted in as realistic conditions as possible.
- Responsibility of the customer organisation.
Test management

- To allow a coordinated approach to testing, DT&E, AT&E and OT&E will normally be managed by the contractor.
- Coordination ensures minimal impact on schedule and maximum effectiveness.
- Coordination may also save on T&E resources and avoid unnecessary duplication of effort.
Test and Evaluation Master Plan (TEMP)

- Test and Evaluation Master Plan (TEMP) is the major plan for entire T&E effort.
- Required by contract, prepared by contractor and approved by customer.
- Drafted during Conceptual Design and approved by the end of Preliminary Design.
- Should be reviewed at each formal review to ensure that any design changes are reflected in the testing program.
CLC and Capability Management Practices
Dr Mike Ryan & Dr Shari Soutberg

Specification tree

SE Standards Evolution
Integration & Planning

Integration Management

- The Interface Control Document (ICD) will completely define the interfaces between two CIs.
- Interface types include: physical, electronic, electrical, hydraulic, pneumatic, software, and environmental.
- Integration management is all about communications.
- Interface problems are usually blamed on technical difficulties but often result from poor communications between two teams.
- ICD needs to be reviewed regularly if for no other reason than to ensure communications.
- Customer should review ICDs at design reviews.
SE Management Plan (SEMP)

- Systems engineering is such a broad subject area that an overall management plan or approach needs to be developed.
- This plan is called the Systems Engineering Management Plan (SEMP).
- SEMP details:
  - Normally prepared by the contractor.
  - Reviewed and approved by the customer.
- There may be more than one SEMP per system development:
  - Customer.
  - Contractor.
  - Major sub-contractors.
Introduction to Project Management

Introduction

• Project management is still a relatively young, emerging profession.
• While there is some considerable agreement to the tasks that should be conducted, many of the terms are still not standardised.
• We will highlight the major practices and use the most commonly accepted terms.
• In particular, we discuss project management within the framework adopted in the Project Management Body of Knowledge (PMBOK®)*.

What is a project?

• Normally within an organisation there are the people who conduct the normal *operations* of an organisation (the tellers in bank, for example) and those that perform *projects* undertaken to improve the organisation and its services (the project managers who roll out the new ATM network, for example).

• While the distinction between the two is occasionally blurred, operations tend to be ongoing and repetitive, while a project is:

  *A temporary endeavour undertaken to create a unique product, service or result.*


What is a project?

• *Temporary:*
  – A project has an identifiable start and end date.
  – Temporary relates to the activity, not the product.
  – Temporary does not indicate any particular duration—some projects are very short (of the matter of days), others can take decades.

• *Unique:*
  – The unique nature of a project arises because there is always something different about the activities undertaken during a project.
  – For example, building a new house is unique because of different owners, block of land, design, timeframe, etc.
Project size

• A project therefore applies to a wide range of activities undertaken by an organisation over and above its normal operational activities.

• Notice that nothing we have said refers to the size of a project—a project may only involve a few people and a small number of resources, or thousands of people and billions of dollars.

• A project can be of any size—from baking a cake to building the Channel Tunnel—whatever the size, the principles we discuss here are applicable.

• We do need, however, to consider the size of a project (and therefore the amount of management required) at the beginning when we are establishing project processes and procedures.

What is a project?

• Typical projects may be:
  – Developing a new product or service
  – Changing the organisational structure, staffing levels or culture
  – Introducing a new operating procedure into an organisation
  – Designing a new city
  – Modifying an engine to provide greater power
  – Constructing a building or a complex
  – Drilling a well in a third-world village
  – Running for local office

• In short, a project may be any unique, temporary endeavour.
What is a project?

- A project is distinctive because it has:
  - A distinct start and finish
  - A life cycle (a number of distinct phases between the start and end)
  - A budget and an associated cash flow
  - Unique activities
  - Use of resources
  - A single point of responsibility (the project manager)
  - Team roles


What is project management?

- Project management is:

  *the application of knowledge, skills, tools and techniques to project activities to meet the project requirements.*

  * Note: “meet”, not “meet or exceed”.
  * We achieve project management through a number of well-defined processes (the ten PMBOK knowledge areas*) that we discuss in more detail throughout this course.
  * They are introduced here to provide an overview of project management.

What is project management?

Program and portfolio management

- A **program** is defined as a group of related projects managed in a coordinated way to obtain benefits and control not available from managing them individually.
- A **portfolio** is a collection of projects or programs and other work that are grouped together to facilitate effective management of that work to meet strategic business objectives.

Who is the project manager?

- The project manager is the single point of responsibility for a project.
- The project manager integrates and coordinates all the contributions of the project team and guides them successfully to completion.
- Project managers need good:
  - General management and administration skills
  - Leadership skills
  - Planning, problem-solving and decision-making ability
  - Communications (written and verbal) skills
  - Negotiation skills
  - Technical skills

PMBOK knowledge areas

- Integration Management
- Scope Management
- Schedule Management
- Cost Management
- Quality Management
- Resource Management
- Communications Management
- Risk Management
- Procurement Management
- Stakeholder Management
Project Integration Management

- Ensures all project elements are integrated and coordinated and conflicting alternatives and expectations are managed.
- Key is development of the Project Plan.
- Once the plan is in place, the project must be executed in accordance with the plan.
- Since the Project Plan will be subject to changes from time to time and some form of change control is required.

Project Integration Management

1.4 Manage Project Information

.1 Inputs
1. Project management plan
2. Project Documents
3. Deliverables
4. Enterprise environmental considerations
5. Organisational process assets

.2 Tools and Techniques
1. Expert judgement
2. Knowledge management
3. Information management
4. Interpersonal and team skills

.3 Outputs
1. Lessons learned register
2. Project management plan updates
3. Organisational process assets updates

1.5 Monitor and Control Project Work

.1 Inputs
1. Project management plan
2. Project documents
3. Work performance documentation
4. Agreements
5. Enterprise environmental factors
6. Organisational process assets

.2 Tools and Techniques
1. Expert judgement
2. Data analysis
3. Decision making
4. Meetings

.3 Outputs
1. Work performance reports
2. Change requests
3. Project management plan updates
4. Project document updates

1.6 Perform Integrated Change Control

.1 Inputs
1. Project management plan
2. Project documents
3. Work performance reports
4. Change requests
5. Enterprise environmental factors
6. Organisational process assets

.2 Tools and Techniques
1. Expert judgement
2. Change control tools
3. Data analysis
4. Decision making
5. Meetings

.3 Outputs
1. Approved change requests
2. Project management plan updates
3. Project document updates

1.7 Close Project or Phase

.1 Inputs
1. Project charter
2. Project management plan
3. Project documents
4. Accepted deliverables
5. Business documents
6. Agreements
7. Procurement documentation
8. Organisational process assets

.2 Tools and Techniques
1. Expert judgement
2. Data analysis
3. Meetings

.3 Outputs
1. Project document updates
2. Final product, service, or result transition
3. Final report
4. Organisational process assets updates
Project Scope Management

- Ensures all work necessary to complete the project is included in scope.
- Unnecessary work is omitted.
- Scope planning and definition are an important part of scope management.
- Makes use of well known SE tools such as RBS/WBS.
- As with Integration, once plans have been established, they need to be verified.
- This represents formalised approval of the project and its scope by all stakeholders.
- Changes must be managed following approval.
- Remember:
  - Change isn’t necessarily bad but uncontrolled change is.
Project Scope Management

2.4 Create WBS

- Inputs
  1. Project management plan
  2. Project documents
  3. Enterprise environmental factors
  4. Organisational process assets

- Tools and Techniques
  1. Expert judgement
  2. Decomposition

- Outputs
  1. Scope baseline
  2. Project documentation updates

2.5 Validate Scope

- Inputs
  1. Project management plan
  2. Project documents
  3. Verified deliverables
  4. Work performance data

- Tools and Techniques
  1. Inspection
  2. Decision making

- Outputs
  1. Accepted deliverables
  2. Work performance information
  3. Change requests
  4. Project document updates

2.6 Control Scope

- Inputs
  1. Project management plan
  2. Project documents
  3. Work performance data
  4. Organisational process assets

- Tools and Techniques
  1. Data analysis

- Outputs
  1. Work performance information
  2. Change requests
  3. Project management plan updates
  4. Project document updates

Project Schedule Management

- Includes processes required to ensure the timely completion of the project.
- Also called time management:
  - Starts with activity definition where all project activities are identified.
  - The sequence that these activities will be conducted is then identified (including parallel).
  - The duration of each activity is estimated.
  - The schedule results.
- SE is heavily involved with schedule management.
Project Schedule Management

- The schedule then needs to be managed and controlled throughout the project.
- Many computer-aided tools are available to assist (for example, PERT and CPM software).
- Tools don’t manage the schedule, they merely assist the project manager.
- Experience and judgement remain the premier time management tools.

Project Schedule Management

3.4 Estimate Activity Durations

- Inputs
  - 1 Project management plan
  - 2 Project documents
  - 3 Enterprise environmental factors
  - 4 Organisational process assets

- Tools and Techniques
  - 1 Expert judgement
  - 2 Analogous estimating
  - 3 Parametric estimating
  - 4 Three-point estimating
  - 5 Bottom-up estimating
  - 6 Data analysis
  - 7 Decision making
  - 8 Meetings

- Outputs
  - 1 Duration estimates
  - 2 Basis of estimates
  - 3 Project document updates

3.5 Develop Schedule

- Inputs
  - 1 PMP
  - 2 Project documents
  - 3 Agreements
  - 4 Enterprise environmental factors
  - 5 Organisational process assets

- Tools and Techniques
  - 1 Schedule network analysis
  - 2 Critical path method
  - 3 Resource optimization technique
  - 4 Data analysis
  - 5 Leads and lags
  - 6 Schedule compression
  - 7 PMIS
  - 8 Agile release planning

- Outputs
  - 1 Schedule baseline
  - 2 Project schedule
  - 3 Schedule data
  - 4 Project calendars
  - 5 Change requests
  - 6 Change requests
  - 7 Project plan/document updates

3.6 Control Schedule

- Inputs
  - 1 Project management plan
  - 2 Project documents
  - 3 Work performance data
  - 4 Organizational process assets

- Tools and Techniques
  - 1 Data analysis
  - 2 Critical path method
  - 3 PMIS
  - 4 Resource optimization
  - 5 Leads and lags
  - 6 Schedule compression

- Outputs
  - 1 Work performance information
  - 2 Schedule forecasts
  - 3 Change requests
  - 4 Project management plan updates
  - 5 Project document updates

Project Cost Management

- Responsible for ensuring that the project is delivered within the prescribed budget.
- The next step to estimate the costs associated with each of the activities making up the project.
- Can use previous experience, tools, and modelling to assist.
- Cost budgeting involves allocating the budget to individual project activities.
- Cost control then ensures that changes to the cost baseline is positive.
Total Cost of Ownership

- Costing approaches: bottom-up; top-down; or a combination
- Bottom-up:
  - utilises WBS (based on the requirements set)
- Top-down:
  - exemplar solution (eg cost estimate based on existing system/s)
  - Parametric (use a known attribute eg weight of ship, SLOC to develop estimates)
  - Analytical techniques using historical data and application of factors for projections
  - Indexing

Importance of Good Costing Practice

- Supports consideration of Options for Gate decisions
- Fundamental part of the Business Case and Government submissions
- Budgeting
- Particular aspects have proven to be difficult eg estimating developmental and/or integration projects
Costing activities across CLC

- Costing activities and techniques change in type and focus dependent on the phase of the CLC:
  - Pre-Gate 0, 1, 2 activities including risk reduction efforts
  - Acquisition Costs:
    - includes Introduction into Service
  - Operating Costs:
    - Most difficult to estimate
    - Required over LOT of capability
    - Techniques include:
      - Use of historical data
      - Factor against acquisition costs
  - Disposal

Project Cost Management

4.1 Plan cost management
- Inputs
  - Project charter
  - Project management plan
  - Enterprise environmental factors
  - Organisational process assets
- Tools and Techniques
  - Expert judgement
  - Data analysis
  - Meetings
- Outputs
  - Cost management plan

4.2 Estimate Costs
- Inputs
  - Project management plan
  - Project documents
  - Enterprise environmental factors
  - Organisational process assets
- Tools and Techniques
  - Expert judgement
  - Analogous/parametric estimating
  - Three-point estimating
  - Data analysis
  - PMIS
- Outputs
  - Cost estimates
  - Basis of estimates
  - Project document updates

Project Cost Management

4.3 Determine Budget

.1 Inputs
  .1 Project management plan
  .2 Project documents
  .3 Business documents
  .4 Agreements
  .5 Enterprise environmental factors
  .6 Organisational process assets

.2 Tools and Techniques
  .1 Expert judgement
  .2 Cost aggregation
  .3 Data analysis
  .4 Historical information review
  .5 Funding limit reconciliation
  .6 Financing

.3 Outputs
  .1 Cost baseline
  .2 Project funding requirements
  .3 Project document updates

4.4 Control Costs

.1 Inputs
  .1 Project management plan
  .2 Project documents
  .3 Project funding requirements
  .4 Work performance data
  .5 Organisational process assets

.2 Tools and Techniques
  .1 Expert judgement
  .2 Data analysis
  .3 To-complete performance index
  .4 PMIS

.3 Outputs
  .1 Work performance information
  .2 Cost forecasts
  .3 Change requests
  .4 Project management plan updates
  .5 Project document updates


Project Quality Management

- Aims to ensure that the project will satisfy its needs.
- Quality assurance will be dealt with separately later.
- Project Management has an important role to play with respect to quality management.
- Quality planning requires management to determine which quality standards will be applied to the project—for example, the ISO 9000 series (more on this later).
- Once the quality standards have been selected, quality planning against those standards is required.
- Quality assurance (in accordance with the plan) involves planned and systematic activities aimed at enhancing confidence in project quality.
- Quality control is also used to check specific project results.
## Project Management

### 5.1 Plan Quality Management

**Inputs**
- 1. Project charter
- 2. Project management plan
- 3. Project documents
- 4. Enterprise environmental factors
- 5. Organisational process assets

**Tools and Techniques**
- 1. Expert judgement
- 2. Data gathering
- 3. Data analysis
- 4. Decision making
- 5. Data representation
- 6. Test and inspection planning
- 7. Meetings

**Outputs**
- 1. Quality management plan
- 2. Quality metrics
- 3. Project management plan updates
- 4. Project documentation updates

### 5.2 Manage Quality

**Inputs**
- 1. Project management plan
- 2. Project documents
- 3. Organisational process assets

**Tools and Techniques**
- 1. Data gathering
- 2. Data analysis
- 3. Decision making
- 4. Data representation
- 5. Audits
- 6. Design for X
- 7. Problem solving
- 8. Quality improvement methods

**Outputs**
- 1. Quality reports
- 2. Test and evaluation documents
- 3. Change requests
- 4. Project management plan updates
- 5. Project document updates

### 5.3 Control Quality

**Inputs**
- 1. Project management plan
- 2. Project documents
- 3. Approved change requests
- 4. Deliverables
- 5. Work performance data
- 6. Enterprise environmental factors
- 7. Organisational process assets

**Tools and Techniques**
- 1. Data gathering
- 2. Data analysis
- 3. Inspection
- 4. Testing/product evaluations
- 5. Data representation
- 6. Meetings

**Outputs**
- 1. Quality control measurements
- 2. Verified deliverables
- 3. Work performance information
- 4. Change requests
- 5. Project management plan updates
- 6. Project document updates

---

## Project Resource Management

- Aims to make the most effective use of resources involved in the project, particularly people.
- Organisational planning is the initial activity involving:
  - Identifying requirements.
  - Documenting and assigning project roles and responsibilities.
  - Reporting relationships.
- Once the resource requirements have been identified, the staff must be acquired.
- Finally, the team must be developed to enhance the performance of the individual and team.
Project Resource Management

6.1 Plan Resource Management

.1 Inputs
- Project charter
- Project management plan
- Project documents
- Enterprise environmental factors
- Organisational process assets

.2 Tools and Techniques
- Expert judgment
- Data representation
- Organisational theory
- Meetings

.3 Outputs
- Resource management plan
- Team charter
- Project documents updates

6.2 Estimate Activity Resources

.1 Inputs
- Project management plan
- Project documents
- Enterprise environmental factors
- Organisational process assets

.2 Tools and Techniques
- Expert judgment
- Bottom-up estimating
- Analogous estimating
- Parametric estimating
- Data analysis
- PMIS
- Meetings

.3 Outputs
- Resource requirements
- Basis of estimates
- Resource breakdown structure
- Project management plan updates

6.3 Acquire Resources

.1 Inputs
- Project management plan
- Project documents
- Enterprise environmental factors
- Organisational process assets

.2 Tools and Techniques
- Decision making
- Interpersonal and team skills
- Pre-assignment
- Virtual teams

.3 Outputs
- Physical resource assignments
- Project team assignments
- Resource calendars
- Change requests
- Project management plan updates
- Project documents updates
- Enterprise environmental factors updates
- Organisational process assets updates

6.4 Develop Team

.1 Inputs
- Project management plan
- Project documents
- Enterprise environmental factors
- Organisational process assets

.2 Tools and Techniques
- Co-location
- Virtual teams
- Communication technology
- Interpersonal and team skills
- Recognition and rewards
- Training
- Individual and team assessments
- Meetings

.3 Outputs
- Team performance assessments
- Change requests
- Project management plan updates
- Project documents updates
- Enterprise environmental factors updates
- Organisational process assets updates

6.5 Manage Team

.1 Inputs
- Project management plan
- Project documents
- Work performance reports
- Team performance assessments
- Enterprise environmental factors
- Organisational process assets

.2 Tools and Techniques
- Interpersonal and team skills
- PMIS

.3 Outputs
- Change requests
- Project management plan updates
- Project documents updates
- Enterprise environmental factors updates

6.6 Control Resources

.1 Inputs
- Project management plan
- Project documents
- Work performance data
- Agreements
- Organisational process assets

.2 Tools and Techniques
- Data analysis
- Problem solving
- Interpersonal and team skills
- PMIS

.3 Outputs
- Work performance information
- Change requests
- Project management plan updates
- Project documents updates

Communications Management

- Starts with communications planning to determine the overall communications requirements—who needs what, when and how.
- Information is then disseminated in accordance with the findings of the first step.
- Must be done in a timely manner.
- Reporting the performance and status of the project is an important part of communications.
- An important communications aspect is reporting the closure of project phases or the project itself.
Risk Management

- Risk identification:
  - Determine possible risks
  - Document risk characteristics
  - Needs to be performed on a continual basis

- Risk quantification:
  - Evaluates risks and determines interactions
  - Determines likely impact of the risk on the project

- Risk response development:
  - Take advantage of the opportunities
  - Manage the risks to project performance

- Risk response control:
  - responding to changes to the risks

Project Risk Management

8.1 Plan Risk Management
   .1 Inputs
     - Project scope
     - Project management plan
     - Project documents
     - Enterprise environmental factors
     - Organisational process assets
   .2 Tools and Techniques
     - Expert judgment
     - Data analysis
     - Meetings
   .3 Outputs
     - Risk management plan

8.2 Identify Risks
   .1 Inputs
     - Project management plan
     - Project documents
     - Agreements
     - Procurement documentation
     - Enterprise environmental factors
     - Organisational process assets
   .2 Tools and Techniques
     - Expert judgment
     - Data gathering
     - Data analysis
     - Interpersonal and team skills
     - Prompt lists
     - Meetings
   .3 Outputs
     - Risk register
     - Risk reports
     - Project documents updates

8.3 Perform Qualitative Risk Analysis
   .1 Inputs
     - Project management plan
     - Project documents
     - Enterprise environmental factors
     - Organisational process assets
   .2 Tools and Techniques
     - Expert judgment
     - Data gathering
     - Data analysis
     - Interpersonal and team skills
     - Risk categorisation
     - Data representation
     - Meetings
   .3 Outputs
     - Risk register
     - Risk reports
     - Project documents updates

Project Risk Management

8.4 Perform Quantitative Risk Analysis

- Inputs
  1. Project management plan
  2. Project documents
  3. Enterprise environmental factors
  4. Organisational process assets
- Tools and Techniques
  1. Expert judgment
  2. Data gathering
  3. Interpersonal and team skills
  4. Representation of uncertainty
  5. Data analysis
- Outputs
  1. Project documents updates

8.5 Plan Risk Responses

- Inputs
  1. Project management plan
  2. Project documents
  3. Enterprise environmental factors
  4. Organisational process assets
- Tools and Techniques
  1. Expert judgment
  2. Data gathering
  3. Interpersonal and team skills
  4. Strategies for threats
  5. Strategies for opportunities
  6. Contingent response strategies
  7. Strategies for overall project risk
  8. Data analysis
  9. Decision making
- Outputs
  1. Change requests
  2. Project management plan updates
  3. Project document updates

8.6 Implement Risk Responses

- Inputs
  1. Project management plan
  2. Project documents
  3. Organisational process assets
- Tools and Techniques
  1. Expert judgement
  2. Interpersonal and team skills
  3. PMIS
- Outputs
  1. Change requests
  2. Project documents updates

8.7 Monitor Risks

- Inputs
  1. Project management plan
  2. Project documents
  3. Work performance data
  4. Work performance reports
- Tools and Techniques
  1. Data analysis
  2. Audits
  3. Meetings
- Outputs
  1. Work performance information
  2. Change requests
  3. Project management plan updates
  4. Project documents updates
  5. Organisational process assets updates

---

Procurement Management

- Responsible for obtaining materials and services for the project from outside the organisation.
- Planning must be conducted to determine what is required and when.
- Solicitation planning—these requirements must be documented and potential sources identified.
- Solicitation involves obtaining quotes and offers etc.
- Source selection determines the best offer.
- Contract administration—put in place to manage the procurement contract with the source.
- Contract close-out—completion and settlement of the contract.

Project Procurement Management

9.1 Plan Procurements

- Inputs
  - Project charter
  - Business documents
  - Project management plan
  - Project documents
  - Enterprise environmental factors
  - Organisational process assets
- Tools and Techniques
  - Expert judgment
  - Data gathering
  - Data analysis
  - Source selection analysis
  - Meetings
- Outputs
  - Procurement management plan
  - Procurement strategy
  - Bid documents
  - Procurement SOQ
  - Source selection criteria
  - Make-or-buy decisions
  - Independent cost estimates
  - Change requests
  - Project documents updates
  - Org process assets updates

9.2 Conduct Procurements

- Inputs
  - Project management plan
  - Project documents
  - Procurement documents
  - Seller proposals
  - Enterprise environmental factors
  - Organisational process assets
- Tools and Techniques
  - Expert judgment
  - Advertising
  - Bidder conferences
  - Data analysis
  - Interpersonal and team skills
- Outputs
  - Selected sellers
  - Agreements
  - Resource calendars
  - Change requests
  - Project management plan updates
  - Project documents updates
  - Organisational process assets updates

9.3 Control Procurements

- Inputs
  - Project management plan
  - Project documents
  - Procurement documents
  - Agreements
  - Procurement documentation
  - Approved change requests
  - Work performance data
  - Enterprise environmental factors
  - Organisational process assets
- Tools and Techniques
  - Expert judgement
  - Claims administration
  - Data analysis
  - Inspection
  - Audits
- Outputs
  - Closed procurements
  - Work performance information
  - Procurement documents updates
  - Change requests
  - Project management plan updates
  - Project documents updates
  - Organisational process assets updates
Stakeholder Management

- The PMBOK says that stakeholder management involves the processes required to:
  - identify the people, groups, or organizations (the stakeholders) that could impact or be impacted by the project;
  - analyse stakeholder expectations and their impact in the project; and
  - develop appropriate stakeholder management strategies.


Project Stakeholder Management

Project Stakeholder Management

10.3 Manage Stakeholder Engagement

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Tools and Techniques</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Project documents</td>
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<td>3. Interpersonal and team skills</td>
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<td>4. Organizational process assets</td>
<td>4. Ground rules</td>
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<td>5. Meetings</td>
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</table>

10.4 Monitor Stakeholder Engagement

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<th>Tools and Techniques</th>
<th>Outputs</th>
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<td>1. Work performance information</td>
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<td>5. Organizational process assets</td>
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<td>6. Meetings</td>
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Project Stakeholder Management

1. Manage Stakeholder Engagement
2. Monitor Stakeholder Engagement

10.3 Manage Stakeholder Engagement

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10.4 Monitor Stakeholder Engagement

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<td>5. Organizational process assets</td>
<td>5. Interpersonal and team skills</td>
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<td>6. Meetings</td>
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</tbody>
</table>

Project Life Cycle

- Because each project is unique we must be careful to manage it since there is always at least some part of the project that we have never done before.
- To assist in managing projects we normally break the activities up into a number of phases.
- Phases are important because:
  - They allow for finer control and management.
  - Projects are easier to describe and communicate.
  - Decision points at the end of phases allow us the opportunity to review progress and make decisions about future work.
  - Phases of activity can be associated with broader organisational financing and scheduling arrangements.
Project Life Cycle

- Phases normally end with some form of *deliverable*.
- In some respects, then, we can consider a phase as a mini-project that has resources, a beginning and an end, and so on—we can therefore manage it properly.
- The set of all phases is called the project *life cycle*.
- There are a number of project life-cycle models adopted by different organisations. While they are largely very similar, they have slightly different phases, end points, reviews, and so on, depending on the unique needs of the industry and the organisation.
- All project life cycles have a number of common elements.

---

**Resource usage.** At the start, the levels of staffing, finance and other resources are relatively low. As the project progresses, the utilisation increases and then diminishes rapidly as the product is completed and delivered.
CLC and Capability Management Practices

Dr Mike Ryan & Dr Shari Soutberg

Project Life Cycle

The Importance of Project Definition

% of Potential Cost or Efficiency Gains Achieved or Lost

Requirements Identification, Strategy Development, and Initial Risk Assessment

Build and Introduction Into Service

% of Total Project Cost for Typical Project
The Importance of Project Definition

Impact of problem definition (ease of making changes)

Resource levels (cost of making changes)

Typical Project Life Cycles

<table>
<thead>
<tr>
<th>Conceive</th>
<th>Develop</th>
<th>Implement</th>
<th>Terminate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gather data</td>
<td>Appoint team</td>
<td>Set up organisation</td>
<td>Finalise products</td>
</tr>
<tr>
<td>Identify need</td>
<td>Conduct studies</td>
<td>Set up communications</td>
<td>Review and accept</td>
</tr>
<tr>
<td>Establish:</td>
<td>Develop scope</td>
<td>Motivate team</td>
<td>Transfer responsibility</td>
</tr>
<tr>
<td>Goals, objectives</td>
<td>Master plan</td>
<td>Detail technical requirements</td>
<td>Evaluate product</td>
</tr>
<tr>
<td>Basic economics</td>
<td>Budget</td>
<td>Establish</td>
<td>Document results</td>
</tr>
<tr>
<td>Feasibility</td>
<td>Cash flow</td>
<td>Work packages</td>
<td>Release/redirect resources</td>
</tr>
<tr>
<td>Stakeholders</td>
<td>WBS</td>
<td>Detailed schedule</td>
<td>Reassign project team</td>
</tr>
<tr>
<td>Risk level</td>
<td>Policies</td>
<td>Information control systems</td>
<td>Procedure goods and services</td>
</tr>
<tr>
<td>Strategy</td>
<td>Procedures</td>
<td>Procure goods and services</td>
<td>Execute work packages</td>
</tr>
<tr>
<td>Team</td>
<td>Assess risks</td>
<td>Direct/monitor/forecast/control:</td>
<td>Scope</td>
</tr>
<tr>
<td>Estimate resources</td>
<td>Confirm justification</td>
<td>Cost</td>
<td>Quality</td>
</tr>
<tr>
<td>Identify alternatives</td>
<td>Present brief</td>
<td>Time</td>
<td>Time</td>
</tr>
<tr>
<td>Present proposal</td>
<td></td>
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<tr>
<td>Gain approval</td>
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</tbody>
</table>

Simple Project Life-cycle Phases
Typical Project Life Cycles

ACQUISITION PHASE

- Conceptual Design
- Preliminary Design
- Detailed Design and Development
- Construction and/or Production

UTILISATION PHASE

- Operational Use and System Support

System Design and Analysis

Construction and/or Production

Operational Use and System Support

Systems Engineering—Blanchard, et al
### Typical Project Life Cycles

#### Australian Department of Defence

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
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<tbody>
<tr>
<td>Need</td>
<td>Strategy and Concepts Risk Mitigation &amp; Requirements Setting</td>
</tr>
<tr>
<td>Requirements</td>
<td>Acquisition</td>
</tr>
<tr>
<td>Acquisition</td>
<td>In Service</td>
</tr>
<tr>
<td>Disposal</td>
<td></td>
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</tbody>
</table>

**Pre-FPR**

**Post-FPR**

### Typical Project Life Cycles

#### US Department of Defense

<table>
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<th>Phase</th>
<th>Description</th>
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<tbody>
<tr>
<td>Concept and Technology Development</td>
<td>Pre-Systems Acquisition Systems Acquisition (Engineering Development, Demonstration, Production, and Deployment)</td>
</tr>
<tr>
<td>System Development and Demonstration</td>
<td>Production and Deployment</td>
</tr>
<tr>
<td>Support</td>
<td>Sustainment and Maintenance</td>
</tr>
</tbody>
</table>

**US Department of Defense**
Typical Project Life Cycles

Software Development—Waterfall Model

Waterfall—Overlapping builds
Incremental Approach

Iterative Approach
Evolutionary Approach

- Initial Reqs
  - Further Reqs
    - Build 1
      - Build 1 scope
      - Final system scope
    - Build 2
    - Build n
  - Further Reqs

Spiral Development

- Determine objectives, alternatives, constraints
  - Review
  - Plan next phases
- Evaluate alternatives, identify, resolve risks
  - Cumulative cost
  - Operational prototype
  - Prototype
  - Concept of operation
  - Requirements validation
  - Development plan
  - Integration and test plan
  - Requirements plan
  - Life-cycle plan
  - Development
  - Integration and test
  - Design verification and validation
  - Implementation
  - Acceptance test
  - Code
  - Detailed design
  - Software requirements
  - Software product design
  - Simulation, models, benchmarks
  - Integration and test
  - Integration and test plan
  - Requirements plan
  - Life-cycle plan
  - Plan next phases
  - Develop and verify next-level product
Project Scope Management

- Project scope management articulates the processes required to make sure that the project undertakes all of the work required, and no more than the work required, to complete the project.
CLC and Capability Management Practices
Dr Mike Ryan & Dr Shari Soutberg

Project Scope Management

2.1 Plan Scope Management
.1 Inputs
  .1 Project management plan
  .2 Project charter
  .3 Enterprise environmental factors
  .4 Organisational process assets
.2 Tools and Techniques
  .1 Expert judgement
  .2 Meetings
.3 Outputs
  .1 Scope management plan
  .2 Requirements management plan

2.2 Collect Requirements
.1 Inputs
  .1 Scope management plan
  .2 Requirements management plan
  .3 Stakeholder management plan
  .4 Project charter
  .5 Stakeholder register
.2 Tools and Techniques
  .1 Interviews
  .2 Focus groups
  .3 Facilitated workshops
  .4 Group creativity techniques
  .5 Group decision making techniques
  .6 Questionnaires and surveys
  .7 Observations
  .8 Prototypes
  .9 Benchmarking
  .10 Context diagram
.3 Outputs
  .1 Requirements documentation
  .2 Requirements traceability matrix

2.3 Define Scope
.1 Inputs
  .1 Scope management plan
  .2 Project charter
  .3 Requirements documentation
  .4 Organisational process assets
.2 Tools and Techniques
  .1 Expert judgement
  .2 Product analysis
  .3 Alternatives identification
  .4 Facilitated workshops
.3 Outputs
  .1 Project scope statement
  .2 Project documentation updates

2.4 Create WBS
.1 Inputs
  .1 Scope management plan
  .2 Project scope statement
  .3 Requirements documentation
  .4 Enterprise environmental factors
  .5 Organisational process assets
.2 Tools and Techniques
  .1 Decomposition
  .2 Expert judgement
.3 Outputs
  .1 Scope baseline
  .2 Project documentation updates

2.5 Validate Scope
.1 Inputs
  .1 Project management plan
  .2 Requirements documentation
  .3 Requirements traceability matrix
  .4 Verified deliverables
  .5 Work performance data
.2 Tools and Techniques
  .1 Inspection
  .2 Group decision-making techniques
.3 Outputs
  .1 Accepted deliverables
  .2 Change requests
  .3 Work performance information
  .4 Project document updates

2.6 Control Scope
.1 Inputs
  .1 Project management plan
  .2 Requirements documentation
  .3 Requirements traceability matrix
  .4 Work performance data
  .5 Organisational process assets
.2 Tools and Techniques
  .1 Variance analysis
.3 Outputs
  .1 Work performance information
  .2 Change requests
  .3 Project management plan updates
  .4 Project document updates
  .5 Organisational process assets updates

Work Breakdown Structures (WBS)

- A WBS is a deliverable-oriented grouping of project components that provides a hierarchical description of the whole project—if it isn’t in the WBS, it isn’t in the project’s scope.
- The WBS is therefore a graphical overview of the project that helps verify as well as communicate the project scope.
- The WBS is normally presented in chart form—each item is uniquely identified.
- The lowest level of the WBS contains what are normally called work packages.

An example WBS—
US DoD MIL-HDBK-881 format
Work Breakdown Structures (WBS)


Introduction to Program Management
Program Management

A program is a group of related projects managed in a coordinated manner to obtain benefits not available from managing them individually.

Program management is the application of knowledge, skills, tools and techniques to meet program requirements.

Source: PMI website

Program Management

• Who needs to know how Programs work:
  – those responsible for Programs eg Program Sponsors and Managers
  – those who are part of a Program eg Project and Product Managers
CLC Programs

• The common features of Programs:
  – Group of related interdependent Projects, Products and activities that are expected to contribute to an overarching objective.
  – Constituent Products, Projects, and activities are managed mostly separately and will likely be at different phases of the capability lifecycle.
  – The Program authority (Sponsor or Manager) is accountable for the combined outcomes.

Objectives of Programs

• Program objectives in the Defence context are generally of two types:
  – operational outcomes eg joint capability
  – resource commonality eg common systems or resources (eg fuels) which reap acquisition, sustainment and training efficiencies
Program Management in the CLC

• Application of Program Management as described today is important in the CLC for following reasons:
  – managing appropriate groupings of Projects, Products, and activities is often the only way feasible way to identify and achieve shared objectives
  – it is how Defence joint capability will be achieved
  – can significantly enable efficiencies in a resource constrained environment

Role of the Program Sponsor & Manager

• Oversight, monitoring, and decision-making including the authority to reconcile issues between constituent Projects, Product and activities
• Define shared objectives applicable to constituent Projects, Product and activities
• Provide appropriate governance arrangements including clear decision-making and escalation structures
• Establish common business and technical requirements and processes applicable to all constituents of the Program
• Identify and manage risks relevant to achieving Program objectives
Program Management for Joint Capability

- Requires management of four related types of interdependencies between capability systems that are either in Proposal, Project, or Product ‘stage’:
  - Operational (based on CONOPS)
  - Function and Performance
  - Technical requirements: system requirements, system interface requirements (including eg standards and their versions and tailoring)
  - Programmatic/Management (all FIC)

Key Program Management Actions

- **Define** intra- and inter-program interdependencies: (operational, function and performance, technical requirements, programmatic)
- **Plan**: coordinate decisions (incl design and acquisition decisions), milestones, schedules.
- **Governance / Assurance**: Set up appropriate management arrangements (eg Program Steering Group, interface control working groups) to monitor, adjust and report.
- **Manage Risk**: identify, assess and mitigate risks for Programs across Projects and Products. Also identify opportunities.
- **Manage Resources**: Manage resources across the constituent Projects, Products, and activities.
Key Enablers for Program Management

• CPN and JCN: narratives on the expected operational effects of the group of capability systems.
• PIOC: more detailed description of operational relationships between capability systems both within the Program and with other Programs.
• Program Strategy: description of the activities, management arrangements, including integrated schedule across Projects and Products.
• ...
Key Enablers for Program Management

- Capability Integration practice
- System Integration practice
- S/W integration practice
- Configuration Management practice

System of Systems Engineering

- Program Management can be aided by System-of-Systems thinking
- System-of-Systems problems have been described (by DeLaurentis and Maier) as problems which exhibit a number of the following traits:
  - Operational Independence of Elements
  - Managerial Independence of Elements
  - Evolutionary Development
  - Emergent Behaviour
  - Geographical Distribution of Elements
  - Interdisciplinary Study
  - Heterogeneity of Systems
  - Networks of Systems
System of Systems Engineering

• The aims of the Systems Approach and SoSE are to:
  – optimise the outcomes delivered through the new systems (Projects) and legacy (Products) which together satisfy the Program objectives.
  – provide techniques that enable decision-makers to make informed decisions on architectural solutions for System-of-Systems problems across eg technical performance, costs
  – provide a deliberately managed approach to the definition, design and delivery of capability systems in a Program across Projects and Products

SoS Architecture Practice for Programs

• “An architecture is the structure of components, their relationships, and the principles and guidelines governing their design evolution over time” (IEEE 610.12-1990).
• The application of architectures for SoS is directly applicable to CLC Programs.
• SoS (and therefore Program) architectures provide:
  – details on how constituent systems will be used (CONOPS)
  – internal and external operational, functional and technical relationships and dependencies among the constituent systems
  – end-to-end functionality and flows of information and data (and other resources)

Source: Based on SEBoK Architecting approaches for SoS
SoS/Program Architectures

• Provides a common and enduring reference for decisions for Proposals, Projects and Products.

• “From the single-system community's perspective, its part of the SoS capability represents additional obligations, constraints and complexities. Rarely is participation in an SoS seen as a net gain from the viewpoint of single-system stakeholders”
  (Source: Rebovich 2009)

• SEBoK raises the practical problems and potential solutions for situations in which the SoS architecture may be constrained by a reluctance to make changes or invest in the constituent systems, which could be very mature (e.g. in sustainment) or currently productively supporting other uses.
  (Source: SEBoK Architecting approaches for SoS)

I2 Framework (I2F)

• I2F is based on four actions:
  – Use of the I2 Reference Set as an authoritative and comprehensive source of Defence I2 configuration status and requirements.
  – Tailoring of I2 requirements for each Program, Project, and Product.
  – Assurance of tailored I2 requirements by CIT&E (JICA) with focus on Gates 0 to 2.
  – Progressive demonstration of I2 achievement over the CLC assured by CIT&E (JICA and JT&E).
I2 is based on Program, Project and Product Management

I2 Reference Set

- The I2 Reference Set provides:
  - an authoritative and up-to-date source of I2 configuration status and requirements for all joint force efforts.
  - a reliable (configuration managed) basis for analysing and defining joint force relationships, requirements, and risks throughout the CLC.
  - a comprehensive ‘toolkit’ of I2 references from which applicable elements will be drawn for Program, Project, and Product I2 definition.
CLC and Capability Management Practices

Dr Mike Ryan & Dr Shari Soutberg

I2 is Addressed Across the CLC

What and Why

How

Defence White Paper  DPG  AMS  IIP

Force Design

FOE  JCF  AJOC  FIOC

Strategic Guidance

Integrated and Interoperability Reference Set:
- Joint Force
- Supporting Joint Concepts
- Integrating Objectives
- Directed I2 Requirements
- C4ISR Design
- Materiel Standards
- Program and System Architectures
- Product Baselines

PGPA Act

CPRs  DIP

Smartbuyer  DPPM

Issued by JCA to the CM

Program Strategy

JPNS

Combined = Business Case/Proposal/Submission

PES

IPMP

IMS

Tender and Contracting Documents

Issued by JCA to the CM

Pre-Task 2 Risk Identification

Gate 1 Business Case:
- High Level I2
- Needs & Requirements

Gate 2 Business Case:
- More Detailed I2 Needs & Requirements

Gate 3 Business Case:
- Substitution-ready I2 Requirements

CMs

Contract:
- Contract ID Capabilities

Program Execution:
- Program ID Capabilities

In Service ID Capability

Application 3: Reference Set

• Joint Force
• Supporting Joint Concepts
• Integrating Objectives
• Directed I2 Requirements
• C4ISR Design
• Materiel Standards
• Program and System Architectures
• Product Baselines

UNSW
C4ISR Design

- C4ISR Design 2025 v0.6 was been endorsed by the Joint warfare Council as at 24 Nov 16.
- Basis for defining C4ISR requirements, informing capability experimentation, integration, and assuring the joint war-fighting environment through eg test and evaluation.
- C4ISR Design Authority is accountable for defining and assuring the joint war-fighting environment, architecture and setting military I2 requirements.
- ...

C4ISR Design

- ... 
- Defines I2 for Networked Joint Force (NJF) C4 and ISR functions 
- Provides endorsed joint operational, capability and mission/platforms’ systems (interoperability) design patterns and guidance to:
  - enable alignment and integration with existing & future systems
  - trusted, relevant and timely decision quality information
Integrated Logistics Support

Support Elements Addressed through ILS

The support elements are all functions and resources necessary to ensure that each mission system is effectively supported during the in-service phase:

a. engineering support;
b. maintenance support;
c. supply support;
d. training support;
e. packaging, handling, storage and transportation (PHS&T);
f. facilities;
g. support and test equipment (S&TE);
h. personnel;
i. technical data; and
j. computer support.

Source: DEFLOGMAN Part 2 Vol 10 Chapter 3
Support System Constituent Capabilities

- Defence groups the support elements that comprise the Support System through five functional categories (or sub-domains), which are known as the Support System Constituent Capabilities (SSCC):
  - Operating Support
  - Engineering Support
  - Maintenance Support
  - Supply Support
  - Training Support

SSCC Elements

1. **Operating Support Capability.** This capability encompasses the support elements of: operating facilities system operators, support equipment, operator manuals and technical data, operating support procedures, and operating support information systems.

2. **Engineering Support Capability.** Engineering support encompasses the support elements of: engineering facilities, engineering personnel, engineering support and test equipment, engineering technical data, engineering processes, engineering information management system, and software support.
SSCC Elements

3. Maintenance Support Capability. Maintenance support is the capability which includes the support elements necessary to develop, establish and integrate a maintenance support system capable of sustaining a system throughout its life. The capability comprises the elements of: maintenance facilities, maintenance personnel, maintenance support and test equipment, maintenance technical data, maintenance processes, and maintenance information management system.

SSCC Elements

4. Supply Support Capability. Supply support encompasses the following support elements: supply facilities, supply personnel, supply support equipment, supply technical data, supply processes, supply information management system, spares, and packaging.

5. Training Support Capability. The training support capability includes the support elements: training facilities training personnel, training equipment, training materials and other technical data, training processes, and training information management system.
Supportability Analysis (SA)

- The principal analytical tool of ILS, is Supportability Analysis (SA) which is a structured and tailored process of defining Supportability requirements throughout the Materiel System life cycle.
- Supportability significantly influences both Materiel System preparedness, operational and support requirements, and LCC/TCO.
- SA addresses the inter-related issues of Mission System design, Support System development and optimising resources.
- SA provides interaction between the engineering and logistic support processes.

Source: DEFLOGMAN Volume 2 Volume 10 Chapter 15
Logistics Support Analysis (LSA)

- In more detailed and structured applications of SA, the tailored application of DEF(AUST) 5691 is required.
- LSA provides an analytical foundation to achieve Supportability and ILS objectives.
- LSA is the analytical tool that integrates ILS and the engineering functions to ensure that the system design and operational requirements have been properly applied through a single analytical approach.
- LSA is used to optimise LCC and system performance (including reliability and availability) therefore related analyses are RAM and LCCA.

Analyses Related to LSA

- Early LSA is referred to as Front End Logistic Support Analysis (FELSA), which provides analytical support for the investigation of alternate support concepts in the early phases of the CLC.
- LSA has a close relationship with Reliability, Availability and Maintainability (RAM) and Life Cycle Costing Analysis (LCCA).

Source: DMH (LOG) 04-01-002
DMSP (LOG) 04-0-004
Life Cycle Costing Analysis (LCCA)

- LCCA is the identification and analysis of all costs incurred in acquiring, operating and supporting, and disposing of a Materiel System.
- LCCA is used to identify the budget implications of capital investment decisions and the cost impact of various design and support options for Materiel Systems.
- LCCA is a key analytical tool used by ILS personnel, In-Service Support staff, and engineers in the development, production, and through-life support of Materiel Systems.

LCCA

- LCCA is used to identify LCC estimates and cost drivers.
- Each LCC estimate represents a range of plausible costs for an asset (or Materiel System), where the range is influenced by the possible variations of the key cost drivers.
- LCC can be used for comparative assessment of alternative design and support options as part of SE and LSA processes.
- LCCA can be used to improve sustainment by conducting trade-off and sensitivity analysis.

Source: DMH (LOG) 04-01-002
Simulation and Modelling for Support Concepts

Modelling and Simulation

• A model is: a simplified representation of a system:
  – real system,
  – proposed system,
  – futuristic system design,
  – past system, and
  – Phenomenon.

• A simulation is an experimentation with a model of a system as it progresses through time, for the purpose of better understanding and/or improving that system.
Benefits of Modelling and Simulation

• Gain insight into the operation of a system.
• Develop operating or resource policies to improve system performance.
• Test new concepts and/or systems before implementation.
• Gain information without disturbing the actual system.

Modelling for Force Design
Modelling for Force Design

Design a fleet management variant
- Acquisition and retirement decisions
- Operational requirements
- Lives and failure risks
- Lifetime extension and upgrade programs
- Maintenance activities and resources

Modelling for Force Design

Design and compare different variants
CLC and Capability Management Practices

Dr Mike Ryan & Dr Shari Soutberg

LCCA

Lifetime extension decision

LCCA

Effect on acquisition of boosting of the fleet condition
Trade-off analysis

Invest in new maintenance line vs buying a new aircraft

No performance difference between 13 and 14 aircrafts
Model use: Options evaluation

- Fleet capability is the total number of weeks where the fleet size is less than 2.

![95% Conf. Interval for CCSM Fleet Capability](image)

Model use: Options evaluation

- Investigation of options performance over time.

![The Best Case Performance of Option 12 with respect to M1](image)
Model use: Options evaluation

- Investigate and quantify the effects of uncertainty about resource availability, and vulnerability of options to this uncertainty.

Model use: Options comparison and trade-off

- Options are compared with respect to two metrics: fleet capability and the total waiting time for maintenance.

Set of options dominated by Option 2
Waiting Time vs Availability

Model use: baseline comparison

- Options are compared to each other based on four metrics.
ILS Plan (ILSP)

The ILSP should detail:

- Supportability aspects of the Materiel System to be acquired.
- Objectives and goals of the ILS Program.
- Organisation and responsibilities for the ILS Program.
- Methodologies for conducting and managing all ILS activities.
- ILS program WBS and schedule.
- Stakeholders.
- How all the activities will be managed, controlled, scheduled, funded and the allocation of tasks and responsibilities.
- Evaluation activities to validate the accuracy and adequacy of the logistics support.

DMSP-1QMS (LOG) 05-1-009

ILS Plan – LSA Program

- Projects often engage prime contractors to perform Supportability Analysis (SA) and related ILS tasks
- The Contractor’s ILS Plan (called an Integrated Support Plan (ISP) forms a sub-set of the Project’s ILSP.
- The ILSP should describe the LSA program, covering:
  - the opportunities to influence the design of the mission and support system,
  - the scope and LSA strategy, and
  - the tools which will be used to assist in the analysis.

DMSP-1QMS (LOG) 05-1-009
ILS Plan (ILSP)

- The ILSP details how the Project Office ILS Team will:
  - analyse the FIC;
  - define the support solution for solicitation; and
  - deliver the Materiel System support (Support System) including the support element resources and services for sustainment.
- The ILSP should outline the various ILS program activities and the workforce required.
- The ILSP details how each of the defined SSCC will be resourced.

Recap
CLC Overview

- Lifecycle
  - Strategy and Concepts
    - Risk Mitigation and Requirements Setting
    - Acquisition
    - In-Service and Disposal
  - Gate 0
  - Gate 1
  - Gate 2

- Frameworks
  - Force Design Framework
  - Smart Buyer Framework
  - Contestability Framework
  - CLC Management Layers
  - CLC Accountability Model

- Practices: SE, PM, ILS...

CLC: Documents

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<th>How</th>
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Program Strategy

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<td>Project WBS</td>
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Tender and Contracting Docs

PGPA Act

CPRs

Smartbuyer

DIP

DPPM

PES

IPMP

IMS

Issued by JCA in the CM
Applying the CLC: Practices

Legislative, Regulatory, and Policy Context

Defence Behaviours (etc)

CLC Process

Strategy and Concepts → Risk Mitigation and Requirements Setting → Acquisition → In-Service and Disposal

Gate 0 → Gate 1 → Gate 2

Capability Management Practices

Systems Engineering
Product and Project Management
ILS / Logistics
Procurement and Contracting
Assurance and Risk Management
CLC and Capability Management Practices

Dr Mike Ryan & Dr Shari Soutberg

Procurement and Contracting

CLC: Tender and Contracting

- Key outcomes of CLC are to acquire and sustain required capability assets.
- Acquisition and Sustainment of capability assets is achieved through tendering and contracting activities.
- Focus of CLC tendering and source selection is generally between Gate 1 and Gate 2.
- Contract often established shortly after Gate 2.
- Contract Management through Acquisition and In-Service and Disposal Phases.
Procurement and Contracting

- Materiel acquisition and sustainment contracts worth approximately $12 billion.
- CLC dependent on sound procurement and contracting practices which:
  - maximises return on investment in capability;
  - delivers on cost and schedule;
  - matches activities to level of risk and complexity to reduce:
    - cost of tendering; and
    - cost of contract management.

Source: Contract Template Selection and Tailoring Guide Version 2.1 April 2016
Key topics for Procurement & Contracting

- **Legislative and Policy Context**
  - CPRs
  - DPPM

- **Core Principles**
  - Value for Money
  - Competition etc

- **Delegations**
  - Commitment
  - Enter into arrangement

- **Designing the Procurement**
  - Method of Procurement
  - Approach to Market
  - Delivery Model
  - Planning
  - Sourcing
  - Managing

- **Procurement Lifecycle**
  - ASDEFCON Templates

- **Contracting Templates**
Resource Management Framework

• The Commonwealth Resource Management Framework governs:
  – how Defence uses and manage public resources;
  – consists of legislation and policy; and
  – cornerstone of the Framework is the PGPA Act.

Defence Proc & Contracting Policy Context

• Defence and its officials operate in an environment of broader legislation and policy:
  – Commonwealth, State and Territory legislation: eg PGPA Act.
  – Commonwealth Policy: eg Commonwealth Procurement Rules (CPRs).
• Legislation and policy can affect Defence procurement through contracts.

Source: DPPM April 2017
Hierarchy of Legislation and Policy


Commonwealth Procurement Rules (CPRs)

Mandatory Defence Policy

Defence Accountable Authority Instructions (AIIs)

Defence Procurement Policy Manual (DPPM)

CPRs

Defence Directives

Guides and Tools

Defence Complex Procurement Guide

Defence Simple Procurement Process

Better Practice Guides

Contracting Handbook

Templates, tools and resources

Legislation: PGPA Act 2013

• PGPA Act contains provisions dealing with:
  – commitment of relevant money and officials entering into contracts; and
  – ‘contingent liabilities’ eg indemnities, warranties and guarantees.

• Sections 23 and 60 of the PGPA Act are key sections relating to Defence procurement.

Source: DPPM April 2017 Paragraph 21
Legislation: PGPA Act 2013

• The PGPA Framework requires Defence officials to:
  – not be inconsistent with policies of Australian Government;
  – use and manage public resources in an efficient, effective, economical and ethical manner;
  – exercise ‘care and diligence’ in performing their duties;
  – “Act honestly, in good faith and for a proper purpose” performing their duties;
  – not improperly use their position;
  – not improperly use information; and
  – disclose interests in relation to performance of duties.

Source: DPPM April 2017 Paragraph 21

Commonwealth Procurement Rules

• Commonwealth Procurement Rules (CPRs):
  – have effect under the PGPA Act 2013;
  – set out the rules that officials must comply with when they procure goods and services;
  – indicate good practice;
  – are the keystone of the Government's procurement policy framework; and
  – achieving value for money is the core rule.
Defence Procurement Policy Manual

• **Defence** Procurement Policy is in DPPM:
  – promotes responsible and accountable spending by Defence officials when procuring goods and services;
  – assist Defence officials make proper use of public resources (also known as ‘public money’);
  – primary operational instructions to Defence officials tailored to Defence’s particular circumstances;
  – incorporates specific CPRs and additional Defence Procurement Policy Directives for particular circumstances and needs of the Defence; and
  – supports proactive management of risks relating to procurement.

Source: DPPM April 2017

DPPM applicability

• DPPM applies to and must be complied with by all Defence officials.

• Contractors:
  – application of DPPM may be extended to a Contractor through appropriate provisions in contracts, or
  – a Contractor may be prescribed to be a Defence official in accordance with Defence’s Accountable Authority Instructions
  – compliance see paragraph 4.15 of the CPR and the related Note.

• Defence is always under an obligation to ensure that its procurement activities (whether outsourced or not) deliver value for money to the Commonwealth.

Source: DPPM April 2017
Purpose of DPPM

- The purpose of the DPPM is to, inter alia:
  - Assist Defence officials to comply with CPRs and Defence policy when undertaking procurement.
  - Encourage officials to adopt more strategic approaches, commercial expertise and good practice when procuring for Defence.
  - Encourage officials to engage early with Defence industry to stimulate competition and innovation and work with industry to develop better solutions and outcomes for Defence.

Source: DPPM April 2017

Compliance with DPPM, CPRs, Directives

- Officials are not permitted to depart from the mandatory requirements of the PGPA Act, CPR, AAI and FINMAN 2.

- If a Defence official departs from the DPPM in a way that results in a departure from the CPRs, then the official will have contravened the law.

- When considering a possible departure from a Defence Procurement Policy Directive contained in the DPPM, Defence officials should:
  - consider if reasonable and justified;
  - consult their supervisor; and
  - be responsible and accountable for the consequences.
Procurement: Core Principles

CPR Core Principles

- The CPRs have some core principles that Defence officials need to consider when planning and undertaking their procurement activities:
  - Value for Money.
  - Competition.
  - Non-discrimination.
  - Ethical Behaviour: the balance between probity and industry engagement.
  - Risk Management.
**Value for Money**

- ‘Value for Money’ is the core requirement of Commonwealth procurement.
- Procurements should:
  - encourage competition and be non-discriminatory;
  - use public resources in an efficient, effective, economical and ethical manner that is not inconsistent with the policies of the Commonwealth;
  - facilitate accountable and transparent decision making;
  - encourage appropriate engagement with risk; and
  - be commensurate with the scale and scope of the business requirement.

Source: DPPM Chapter 2

**Value for Money**

- Value for money does not automatically mean the lowest price goods or services.
- Must consider the relevant financial and non-financial costs and benefits of each submission, including matters such as:
  - the quality of the goods and services;
  - fitness for purpose of the proposal;
  - potential supplier’s relevant experience and performance history;
  - flexibility of proposal (eg innovation and adaptability over the life cycle);
  - environmental sustainability of eg energy efficiency and environmental impact;
  - whole-of life costs.

Source: DPPM Chapter 2
Competition

- Key element of the Australian Government’s procurement framework.
- Competitive procurement is normally means by which Defence ensures that it is receiving value for money.
- Competition considered most effective motivator for industry to reduce costs and improve performance.
- Competition does not necessarily mean an open tender – more than one supplier can be competitive.
- If open competition is not feasible, Defence officials should explore opportunities for a limited competition subject to relevant CPR.

Source: DPPM Chapter 2

Non-discrimination

- All potential suppliers to government must, subject to CPRs:
  - be treated equitably based on commercial, legal, technical and financial abilities; and
  - not be discriminated against due to their size, degree of foreign affiliation or ownership, location, or the origin of their goods and services.
- Exemptions can be sought:
  - through measures under para 2.6 of CPRs (eg protection of essential security interests);
  - Australian Industry Capability (AIC) policy; and
  - specific Government policy decisions.

Source: DPPM Chapter 2
# Ethical Behaviour

**Section 6 of the CPRs sets out the requirement for Defence officials to properly use and manage public resources.**

**‘Proper’ means:**

- **Efficient:** achievement of the maximum value for the resources used incl selection of the procurement method.
- **Effective:** extent to which intended outcomes or results are achieved incl price, quality and quantity, and the degree to which these contribute to specified outcomes.
- **Economical:** minimising cost, avoiding waste.
- **Ethical:** honesty, integrity, probity, diligence, fairness and consistency incl identifying and manages conflicts of interests, not making improper use of an individual’s position.

Source: DPPM Chapters 2 and 4, Source: CPRs 6.1-6.5

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## Ethical Behaviour

Officials undertaking procurement must act ethically throughout the procurement including:

- recognising and dealing with actual, potential and perceived conflicts of interest;
- dealing with potential suppliers, tenderers and suppliers equitably, including by:
  - seeking appropriate internal or external advice when probity issues arise, and
  - not accepting inappropriate gifts or hospitality;
- carefully considering the use of public resources; and
- complying with all directions including Privacy Act 1988 and the security provisions of the Crimes Act 1914.

*Source: CPR 6.6*
Probity

• Probity is integral to ensuring the defensibility, transparency and success of Defence procurements.

• Defence major capital, ICT and facilities procurements under increasing scrutiny by tenderers, the ANAO, Senate Estimates, other Parliamentary Committees, and media.

• Probity is the evidence of ethical behaviour:
  – complete and confirmed integrity, uprightness and honesty in a particular process.
  – Dept of Finance website lists principles which underpin ethics and probity in Australian Government procurement.

*Source: DPPM para 66 and 67

Probity

• Legislative and policy obligations related to probity include:
  – general duties of officials in Sects 25 to 29 of PGPA Act (due care, diligence, good faith, declaring interests etc);
  – the APS Values and APS Code of Conduct (see Public Service Act 1999, sections 10 and 13);
  – Defence Instruction (General) PERS 25-4 - Notification of Post Separation Employment;
  – Defence Instruction (General) PERS 25-6 - Conflicts of Interest and declarations of interests; and
  – Defence Instruction (General) - PERS 25-7 - Gifts, Hospitality and Sponsorship.

Source: DPPM Chapter 2
Commercial Acumen

- Essentially, Commercial Acumen means:
  - appropriate understanding of how industry is and can be used in Defence business;
  - understanding commercial drivers of industry;
  - how to engage with industry and manage commercial relationships and services; and
  - dealing appropriately with potential suppliers, tenderers and suppliers.

- Effective engagement with and management of the business relationship between Defence and industry is a critical aspect of capability management.

Consistency with Government policies

- Section 21 of the PGPA Act requires the Secretary to govern Defence in a way that is 'not inconsistent with the policies of the Australian Government'.

- This can include Cabinet decisions, or other Government approvals relating to a commitment of relevant money, to the extent that the decision or approval establishes a course or line of action.

- Defence officials exercising delegations (especially for section 23 of PGPA Act) should ensure that they do so consistent with the terms of any Australian Government decisions or approvals relevant to the procurement.

DPPM p6
Procurement-related Delegations

Purpose of Delegations

• Delegations provides authority to exercise a power to take an action and/or make certain decisions in relation to procurement:
  – committing Commonwealth funds (public monies) for the procurement of Goods and/or Services; and
  – establishing an arrangement (eg contract) with a supplier by the physical act of, for example, signing a contract.
• System of delegations reflects various factors including risk, amount being committed (spent) and necessary controls.

DPPM p6
Defence System of Delegations

- Defence system of delegations:
  - A delegation is conferred on or delegated to the Secretary of Defence under PGPA Act in relation to procurement.
  - Defence implements a corresponding system of delegations which confers authority on others in Defence.
- For a Defence official (including a contractor who is prescribed as a Defence official) to exercise a power they are required to have the delegated authority.
- Delegations are described in the Defence Accountable Authority Instructions (AAIs) and issued in Financial Delegations Manual (FINMAN 2).

Reasons for Delegations in Procurement

- In support of Procurement and Contracting activities, Defence has in place delegations to:
  - provide authority to Defence officials to spend money or undertake actions within certain limits;
  - ensure that these activities represent efficient, effective, economical and ethical use of public resources; and
  - provides a risk-based approach to enabling decision-making across Defence with suitable controls.
Procurement and Contracting Delegations

• Under PGPA Act, delegations applying to procurement are:
  – **Commitment Approval** (being able to commit public funds to an activity).
  – **Enter into an Arrangement** (enter into a ‘contract’ including paid contracts, standing offers, non-financial arrangements).

• In addition Defence officials are required to obtain an ‘Endorsement to Proceed’ (EtP) before undertaking certain procurements:
  – all Non-Materiel Procurements with an estimated value at or above $200,000;
  – part of Defence’s internal controls to better ensure the proper use and management of public resources.

Sequence of Exercising Delegations

• For the purposes of section 23(3) of the PGPA Act, delegated Defence officials may approve the commitment of relevant money (**Commitment Approval delegation**).

• This delegation is to be exercised before Commonwealth enters into arrangement that commits money.

• For the purposes of section 23(1) Defence officials may also enter into an arrangement on behalf of the Commonwealth (**Enter into an Arrangement delegation**) which is approved by a Commitment Approval Delegate.
Applicability of Section 23 delegations

- Section 23 PGPA Act delegations apply to all kinds of procurements:
  - both delegations when establishing a contract;
  - both delegations when establishing a standing offer arrangement (by way of a deed);
  - both delegations for each order placed under a standing offer arrangement;
  - both delegations for change to a contract (contract change, amendment or variation etc) if the change involves the commitment of relevant money; and
  - only Enter into an Arrangement delegation if ‘nil-cost’ contract change is required.

Planning the Procurement:

Method of Procurement, Approach to Market and Delivery Model
Considerations for procurement

Three considerations when deciding how to proceed with a procurement:

1. **Method of Procurement** – open or limited tender.
2. **Approach to Market** – which tendering documents to use.
3. **Delivery Model** – type of contract arrangement with supplier.

1. **Method of Procurement**

   • Under the CPRs, there are two main procurement methods:
     
     - **Open tender** – where Defence approaches the open market and invites submissions.
     - **Limited tender** - where Defence approaches only one or more potential suppliers to make submissions.

   • Identifying the procurement method will determine which rules apply.

   • Under the CPR, the **default position** is open tender.

   • Limited tender includes only one supplier (often called a ‘sole source’ procurement).
Method of Procurement

• Selection of a procurement method, either open or limited tender, is dependent on:
  – the nature and structure of the market;
  – the extent of competition (that is, the number of genuinely competitive suppliers); and
  – schedule, cost or other constraints (for example, intellectual property, security etc).

• Very limited circumstances for a limited tender (CPR 10.3):
  – reasons of extreme urgency;
  – unsolicited innovative proposals;
  – no real alternative (such as absence of competition for technical reasons); and
  – additional deliveries of compatible goods and services.

Method of Procurement

• In deciding procurement method Defence officials must ensure:
  – that method is commensurate with the scope, scale, and risk of the procurement and is consistent with VFM; and
  – all procurement method decisions are appropriately documented.

• For procurements valued at or above $200,000, the EtP template is where procurement method decisions are documented.

• Commitment Approval delegate (see section 23(3) PGPA Act) confirms procurement method decision as part of the exercise of their delegation.
Value and Method of Procurement

• Defence has a structured approach to choosing procurement methods based on expected value of a procurement.

• Expected value is maximum value of the proposed contract including total value of the goods and services being procured, options, extensions, renewals, etc over the life of the contract.

• When a procurement is to be conducted in multiple parts the expected value is the maximum value of all of the contracts.

Source: DPPM CPR 9.2 – 9.7

2. Approach to Market

• The type of approach to market includes:
  – request for tender (RFT),
  – request for proposal (RFP),
  – request for quote (RFQ) under a standing offer panel
  – competitive evaluation,
  – some other form of iterative engagement process, and
  – other form of documentation.

• Categorisation of procurement as open or limited tender does not determine what approach to market to use.

• Defence officials should determine the appropriate approach to market strategy during the planning stage of the procurement.
3. Project Delivery Model

• The project delivery model can include prime contract, managing contractor, design and construct contract, alliance contract etc.

• The categorisation of a procurement as an open tender or limited tender does not determine what approach to market to use.

• Defence officials should determine the appropriate approach to market strategy and project delivery model during the planning stage of the procurement.

Procurement Thresholds and Contracting

• The means by which to contract is also dependent on the value, risk, and complexity of the procurement:
  – Under $10,000: Defence Purchasing Card (except for MILIS).
  – Under $200,000: Commonwealth Contracting Suite or if exempt, an endorsed Defence contracting template.
  – Between $200,000 and $1 million: an endorsed Defence contracting template.
  – Above $1 million: an endorsed Defence contracting template for the type of procurement being undertaken.
Implementing Procurement

“Good procurement practice is not about just mechanically applying the CPRs or the additional Defence Procurement Policy Directives in the DPPM. It is about developing a strong understanding of all aspects of the procurement life cycle and using judgement to apply this understanding in each case to deliver the best outcomes. While Defence officials need to comply with the CPRs and the DPPM, officials should design each procurement process in a way that is commensurate with the scope, scale and risk of the relevant procurement.”

Source: DPPM para 90

Smart Buyer
Smart Buyer: designing each procurement

Smart Buyer is a framework to decide the best procurement approach including:

- Method of Procurement.
- Approach to Market.
- Delivery Method.
- Project Management.
- CLC Whole of Life considerations (Acquisition and Sustainment).

Smart Buyer

- Smart Buyer is a decision-making framework that helps develop:
  - Business Case for a proposed investment in capability.
  - Project Execution Strategy (PES).

- Key steps:
  - Understanding the environment/context.
  - Identifying risk and drivers and their impact.
  - Developing a tailored strategy that matches risk and other relevant factors.

Source: Smart Buyer Kick-off Meeting Pack
Smart Buyer: Risks and Drivers to Strategies

**Environment**
- Needs Technology Industry Capability
- Schedule Commercial Project & FIC
- Defence & Program Financial Strategic

**Smart Buyer Decision Framework**
- Environmental Profile
- Implications
- Strategic Analysis
- Informed Decisions
- Tailoring

**Tailored Strategies**
- Asset Management Strategy
- Approvals Strategy
- Acquisition Strategy
- Sustainment Strategy
- Project Management Strategy

**Smart Buyer Products**

- **Risk and drivers analysis:**
  - Explanation of risk, drivers.
  - ‘Heat Map of risk ratings across risk categories.

- **Tailored strategies across:**
  - Approval Strategy eg
    - One or two Minister, NSC.
    - Approval pathway (Gate 1 & 2, Combined, Multiple Gate).
  - Acquisition Strategy.
  - Sustainment Strategy.
  - Project Management Strategy.

Source: Smart Buyer Kick-off Meeting Pack
Smart Buyer – Implementation Steps

- Process steps (scalable):
  – Kick-Off meeting (1.5 hrs).
  – Risk and Drivers workshop (1 day).
  – Strategy Development workshop (1 day).
  – Project team drafts the PES.
  – Red Team Review (1.5 hrs).
  – Approval by Delivery Group Division or Branch Head.

- Facilitated and supported using members of the CASG IAR team who are independent and possess significant experience.

Source: Smart Buyer Kick-off Meeting Pack

Categorisation and Classification
CASG Project Classification and Categorisation

- CASG classifies and categorises Acquisition projects to guide approval, reporting, assurance etc.
- Based on complexity, context, risk CASG determines the classification eg Major Project and category eg ACAT II
- Smart Buyer used to inform, define and tailor the Project

CASG Sustainment Categories Framework

- Sustainment Category (SCAT): four levels of complexity (SCAT I, II, II, and IV), for Sustainment Products within CASG.
- Guides management, reporting, reviews, competencies.
- Sustainment Products assessed and classified based on six sustainment attributes:
  - Sustainment Budget.
  - Management Complexity.
  - Technical Difficulty.
  - Life Cycle Stage.
  - Demand and Availability.
  - Commercial.
Implementing Defence Procurement and Contracting

Generic Life Cycles

Generic lifecycles which can be scaled and applied to CLC dependent on circumstances:

System Lifecycle

1. Plan the Procurement
2. Develop Request Documentation eg RFT
3. Approach the Market
4. Evaluation
5. Negotiation and Signature

Planning | Sourcing | Managing
--- | --- | ---

Project Lifecycle

Conceive | Develop | Implement | Terminate

Source: DPPM
Procurement Life Cycle

• The Procurement Life Cycle is also scalable and tailor able
• Can be applied to ANY procurement
• Following describes how it can be tailored when progressing an investment proposal and project through the CLC

Procurement Life Cycle

• In its most general form it is divided into three phases and seven distinct but interrelated stages:
  – Planning
    1. Plan the procurement.
    2. Develop ‘Request documentation’ eg RFT.
  – Sourcing
    3. Approach the market.
    4. Evaluation.
    5. Negotiation and contract signature.
  – Managing
    7. Disposal.
Relationship to CLC

In context of CLC procurement lifecycle is pivotal to deciding the strategy proposed in the PES for a major acquisition.

- Planning
- Sourcing
- Managing
- Risk Mitigation & Requirements Setting
- Acquisition
- In-Service and Disposal

1. Plan the Procurement
2. Develop Request Documentation eg RFT
3. Approach the Market
4. Evaluation
5. Negotiation and Signature
6. Contract Management
7. Disposal

Relationship to CLC

• The Procurement lifecycle can also be nested within the CLC for example, acquiring risk mitigation studies or other services.
1. Procurement Plan

The **Procurement Plan** will normally cover the following:
- a description of the procurement;
- procurement method (for example, open tender, limited tender) including reasons;
- proposed probity arrangements;
- proposed governance arrangements eg steering committee;
- procurement risk assessment; and
- indicative time-lines and resources (including budgeting of funds to support the procurement).

Source: DPPM April 2017 Paras 96

1. Procurement Plan

- Level of detail in the procurement plan reflects scope, scale and risk of the procurement.
- For less complex procurements, the EtP document may be sufficient to serve as the procurement plan.
- For procurements that are required to be considered by the IC the procurement plan will be informed by the Smart Buyer analysis.

Source: DPPM April 2017 Para 97
2. Request Documentation

• Sets out rules for the procurement describing to potential suppliers:
  – specifics of the procurement;
  – manner in which submissions are to be provided to Defence (eg AusTender); and
  – how submissions will be evaluated.

• Primary information source used by potential suppliers when developing a submission.

DPPM: Paras 98 and 99

2. Request Documentation

• Request documentation normally includes:
  – **Statement of Work**: Requirements incl any essential requirements.
  – **Conditions for Participation**: minimum content and format.
  – **Evaluation Criteria**: including methodology.
  – **Draft Contract**.
2. Request Documentation: SOW

- The SOW should describe:
  - nature, scope and quantity of G&Ss required;
  - requirements including certification, T&E, plans, drawings and training materials;
  - applicable technical specifications (function and performance requirements, rather than specific designs or product descriptions) and related standards;
  - ‘essential requirements’ (in which case, if suppliers are not able to meet the requirements, they will be excluded from consideration); and
  - timeframes expected for the delivery of the required goods, works or services.

2. Request Documentation: Conditions

- Mandatory minimum requirements for supplier submissions to be considered.
- Defence officials should take great care when including conditions for participation, as the CPRs require that Defence reject any submission that does not meet the conditions for participation.
- Conditions for participation are limited to those assuring the legal, financial, technical or commercial capabilities of the supplier to meet the particular requirements of the procurement.
### 2. Request Documentation: Evaluation Criteria

- Evaluation Criteria set the foundation for a fair and equitable assessment of submissions.
- Definition of criteria on the nature of the particular procurement.
- Evaluation of tenderers should be based on a balance of all the criteria, or if a weighting methodology is used, on the relative importance of each criterion.
- If a weighting methodology is used, Defence officials should consider setting this out in the request documentation so that potential suppliers can appropriately focus their responses.

DPPM: Paras 105, 106

### 2. Request Documentation: Rules of the Process

- The request documentation should also set out the rules with regard to:
  - lodgement of submissions (AusTender or other) and closing time for submissions; and
  - answering questions and distributing responses as part of Defence officials responsibilities to be available to answer queries during the period that the tender is open.

DPPM: Paras 107, 108
2. Request Documentation: Draft Contract

- Contains the terms and conditions on which Defence is willing to enter into a contract for the requirement.
- Tenderers to indicate their compliance or non-compliance.
- Defence officials should assess the risk with the tenderers’ non-compliances with the draft contract to enable tenderers to be evaluated against a common baseline.

DPPM: Paras 109

Sourcing: 4. Evaluation

- Evaluation Plan is an internal Defence document that sets out the method for evaluating submissions.
- Defence officials must develop and finalise an Evaluation Plan before an approach is made to the market.
- Depending on complexity may use different evaluation ‘structures’:
  – Steering Committee.
  – Evaluation Board or Team.
  – Subordinate evaluation Working Groups.
- Can also use internal or external advisers or experts to assist with technical requirements, financial viability or price.

DPPM: Para 111

- CPRs require Defence officials to maintain appropriate documentation of the decision making process for each procurement.
- The evaluation report will normally contain:
  - a summary of the evaluation process;
  - a summary of the assessment of each submission;
  - reasons for the exclusion of a submission from further consideration;
  - recommendations concerning the preferred tenderer(s) based on value for money; and
  - details of any issues which need resolution during subsequent contract negotiations.

DPPM: Paras 115-117

Notifying Tenderers

- CPRs require Defence officials to notify affected tenderers promptly of the evaluation outcomes and, if requested, provide a debrief to the tenderers (both successful and unsuccessful tenderers).
- A debrief (verbal or written) should include, as appropriate:
  - explanation of why submission successful or not;
  - areas of weakness or non-compliance in the offer;
  - suggestions for improving future submissions; and
  - if contract already successfully negotiated, the name of successful supplier and total contract price (AusTender in any event, if valued at or above $10,000).
- Defence officials should keep a written record of debriefing.

DPPM: Paras 119-120
5. Negotiation and Award of Contract

• Final stage of procurement process is negotiation and award of the contract with the preferred tenderer.

• During contract negotiations, Defence officials should seek to resolve any issues that were identified during the evaluation.

• At any time during the procurement process, Defence can determine that awarding a contract is not in the public interest but this is a serious step with potential legal and management risks.

• Public interest grounds generally arise in response to new information or unforeseen events.

DPPM: Paras 121-123

Tendering and Contracting Templates
Contracting Templates

- Contracting templates developed by Commonwealth entities to meet:
  - different procurement needs and profiles; and
  - size, complexity and nature of the procurement activity.
- Templates include:
  - Commonwealth Contracting Suite.
  - The Australian Standard for Defence Contracting (ASDEFCON).
  - Defence Suite of Facilities Contracts.
- The focus of the following sections is on ASDEFCON as used in Capability Management.

Contracting Templates

- Defence contracting templates are:
  - drafted and regularly updated; and
  - reflect applicable Commonwealth legislation and policy (including the CPR) and Defence policy.
- Commonwealth, State and Territory legislation and policy often affects procurement and has to be addressed including:
  - Contracting and Legal.
  - Finance.
  - Environment.
  - Work Health and Safety.
  - Security.

DPPM: p35, 36
ASDEFCON Templates

- Defence procurement supported by ASDEFCON suite which is made up of 20 different templates for tendering and contracting.
- Most ASDEFCON templates for tendering are structured to include:
  - a covering letter to tenderers;
  - conditions of tender with response volumes;
  - a draft contract and where appropriate; and
  - a draft statement of work (SOW).
- Associated handbooks and related training are available for some templates.

Source: Department of Defence Website: Doing Business with Defence

Why have ASDEFCON Templates?

- The objectives of ASDEFCON include:
  - Support efficiencies by using common tendering and contracting templates.
  - Standardise and benchmark Defence’s business practices and procedures that:
    - support Commonwealth and Defence policies;
    - reflect ‘best practice’; and
    - support VFM and accountability.
  - Improve relationships with industry by enhancing tendering and contracting templates.
  - Engender professionalism of Defence staff.
  - Lead contracting reform in Defence.

Source: Department of Defence Website: Doing Business with Defence
Tailoring of ASDEFCON Templates

- Defence (and external agencies) can use ASDEFCON templates that suit their circumstances.
- Users are expected to select and tailor the template(s) appropriate to procurement requirements.
- Selecting the right contract template is integral to maximising Defence return on its procurement investment.
- Objectives of ASDEFCON template selection and tailoring are to:
  - enable best value for money to be obtained;
  - ensure sound governance and accountability; and
  - achieve a sensible balance between technical, contractual and managerial risks.

Source: Department of Defence Website: Doing Business with Defence
Source: Contract Template Selection and Tailoring Guide Version 2.1 April 2016

ASDEFCON Template Selection

- SOW captures the scope and nature of the work including the ‘technical requirements’ which are significant drivers of the complexity and risks of the procurement.
- SOW drives template selection.
- Defence Contract Template Selection and Tailoring Guide helps select the best template based on ‘best fit’ with SOW for the procurement’s scope of work.

Source: Contract Template Selection and Tailoring Guide Version 2.1 April 2016
Pivotal Role of SOW in Selection

- SOW details the work to be done by both customer and supplier during the contract eg produce documents, review documents.
- Unnecessary work requirements will increase cost without a commensurate increase in value.
- Insufficient work especially in regard to technical risk may jeopardise outcomes, both resulting in reduced VFM.
- Before selecting a contracting template it is essential to:
  - understand the nature of the activity and the goods and/or services to be acquired ie materiel or a non-materiel; and
  - if it is a procurement or agreement to hire, loan, sale or gift a Defence asset.

Source: Contract Template Selection and Tailoring Guide Version 2.1 April 2016

Five Steps in Template Selection

- **Step 1**: is it a procurement or disposal/transfer of asset; is it a materiel or non-materiel procurement.
- **Step 2**: identifies likely template for a materiel procurement.
- **Step 3**: describes steps for tailoring ASDEFCON templates.
- **Step 4**: describes the options for non-materiel procurements using ASDEFCON, other Defence and Commonwealth templates, and standing offers / panels.
- **Step 5**: describes templates for the disposal or temporary transfer of Defence Assets.

Source: Contract Template Selection and Tailoring Guide Version 2.1 April 2016
Materiel Procurement

- Materiel procurements include goods and services for ‘military purposes’.
- ‘Goods’ include major platforms, such as ships, vehicles and aircraft through to consumables, such as oil, and nuts and bolts used on materiel systems.
- ‘Services’ related to materiel include:
  - services applied directly (‘physically’) to the materiel eg maintenance and supply activities (‘Materiel Support Services’), and
  - services ‘related’ to the materiel, such as reliability analysis, maintenance or inventory requirements determination (‘Indirect Materiel Services’).

Source: Contract Template Selection and Tailoring Guide Version 2.1 April 2016

Non-Materiel Procurement

- Non-materiel procurements include all other goods and services such as:
  - infrastructure,
  - commercial ICT goods and services,
  - office supplies,
  - domestic trade services,
  - gardening,
  - food, printing services,
  - consultancy services not related to materiel systems

Source: Contract Template Selection and Tailoring Guide Version 2.1 April 2016
Choosing the right ASDEFCON Template

- **SOW**
  - **Understand technical complexity**
  - **Materiel**
  - **Non-Materiel**
    - **Goods**
    - **Services**
      - **Acquisition Templates**
      - **Support Templates**
      - **Select Template based on complexity**

Acquisition Contracting Spectrum

- **ASDEFCON (Strategic Materiel)**
- **ASDEFCON (Complex Materiel)**
  - Volume 2
- **ASDEFCON (Complex Materiel)**
  - Volume 1
- **ASDEFCON Standing Offers**
- **Simple Procurement**

Source: Contract Template Selection and Tailoring Guide Version 2.1 April 2016
Range of ASDEFCON Templates

- **Simple** Procurement of Goods and Repair / Maintenance Services Procurement or disposal/transfer of asset.
- **Materiel Acquisition**: selection of appropriate Materiel Acquisition Templates:
  - ASDEFCON (Strategic Materiel).
  - ASDEFCON (Complex Materiel) Volume 2.
  - ASDEFCON (Complex Materiel) Volume 1.
  - ASDEFCON Standing Offers.
  - Simple Procurement of Goods.

Source: Contract Template Selection and Tailoring Guide Version 2.1 April 2016

Range of ASDEFCON Templates

- **Materiel Support**: Materiel Support Templates:
  - ASDEFCON (Support).
  - ASDEFCON (Support Short).
  - ASDEFCON Standing Offers.
  - Simple Procurement of Repair / Maintenance Services.
- **Linked and Combined** Materiel Acquisition and Support Contracts:
  - Most materiel acquisitions will require follow-on support for the materiel so be arranged in a single procurement.
  - ASDEFCON Linkages Modules are designed to help ‘link’ draft contracts based on the ASDEFCON templates for acquisition and support released under a single RFT.

Source: Contract Template Selection and Tailoring Guide Version 2.1 April 2016
## Contents of ASDEFCON Templates


## Contents of ASDEFCON Strategic Materiel

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Part 3 - Statement of Work

The SOW makes statements such as:

“The Contractor shall perform all activities necessary to manage, design, develop, construct, integrate, test, deliver, install and obtain Certification and Acceptance of the Supplies by the Commonwealth in accordance with the Contract.”

“The Contractor shall allocate the requirements for the Materiel System defined in the FPS at Annex A to the SOW into a System Specification (SS) for the Mission System and a Support System Specification (SSSPEC) for the Support System.”

Source: ASDEFCON (Strategic Materiel) template Section 2
Part 3 - Data Item Descriptions (DID)

- A Data Item Description (DID) is a document defining the information or data deliverables required of a tenderer or contractor.

- Within a solicitation or contract:
  - each DID is uniquely numbered to identify the ‘data item’
  - format is defined eg DID preparation instructions including a table of contents and descriptions of each section
  - specific required content eg “the Tender Lifecycle Cost Model shall provide sufficient detail to enable the Commonwealth to understand the LCC model developed by the tenderer”

Source: ASDEFCON (Strategic Materiel)

Part 3 - Data Item Descriptions (DID)

- Specific DIDs to be provided are selected from lists:
  - Tender Document Requirements List (TDRL) or
  - Contract Data Requirements List (CDRL)

- Tender or Contract Data requirements are core or optional

- Example from ASDEFCON SM TDRL:
  - A-1 Executive Summary (Core)
  - A-2 Tenderer’s Profile (Core)
  - A-3 Schedule of Proposed Subcontractors (Core)
  - A-4 Statement of Non-Compliance (Core)
  - E-1 Project Strategy (Core)

- Under the CDRL, these plans and documents may not be required to be delivered until some time after Effective Date.
Part 3 - Data Item Descriptions (DID)

• The SOW specifies that the Contractor shall produce, update and deliver all data items to the Commonwealth in accordance with the CDRL contained in the SOW.

• Annex C to the Draft Statement of Work (V3.1) provides the comprehensive list of possible Data Items.

• For each Data Item the Commonwealth Representative will then:
  – Review;
  – Approve or not Approve;
  – Accept or reject; or
  – Consider a Contract Change Proposal (CCP) for Approval.

Source: ASDEFCON (Strategic Materiel)

Part 3: Mandated System Review Checklists

• MSR Checklist sets out Commonwealth’s requirements and minimum expectations for the various reviews throughout the contract.

• MSR checklists includes ‘exit criteria’ for assessing review completion.

• Examples of these reviews:
  – Integrated Baseline Review (IBR).
  – System Requirements Review (SRR).
  – System Definition Review (SDR).

• Need to determine to what extent the System Reviews are to be applied depending on the nature of the work (SOW, complexity).

Source: ASDEFCON (Strategic Materiel)
Part 3: Mandated System Review Checklists

Important reviews concerning the built system:

• **Functional Configuration Audit (FCA):** to demonstrate that the item’s actual performance complies with all elements of its specification (applicable to the Mission System and Support System).

• **Physical Configuration Audit (PCA):** to examine formally the as-built version of a Configuration Item against its design documentation in order to establish the Product Baseline.

• **Test Readiness Review (TRR):** relates to a specific V&V phase for a Configuration Item, group of Configuration Items, subsystem, component (including SSCC) or system (including Mission Systems, Support System or combination thereof).

• **System Acceptance Audit (SAA):** objectives are to demonstrate that Mission Support System elements meet required criteria, is safe and suitable for service to enable Mission System Acceptance to be achieved, and can be effectively operated.

• **Transition Requirements Review (TXRR):** objectives are to demonstrate that the requirements for the transfer of materiel Supplies and processes from the Contractor (Acquisition) to the Contractor (Support) and to Commonwealth support organisations have been identified and clearly defined.

Source: ASDEFCON (Strategic Materiel)
Tailoring the ASDEFCON Template

- Template
  - Work to be done
    - SOW
      - CoA requirements standards for work
      - allocate work responsibilities to CoA & Contractor
  - Information to be provided by Tenderer/Contractor
    - TDRL/CDRL
      - List of Data Requirements: Data Items
  - Reviews to be conducted during contract
    - MSR
      - Mandated, Highly Desirable

RISK MANAGEMENT AND ASSURANCE
Governance

Public sector governance covers:

‘...the set of responsibilities and practices, policies and procedures, exercised by an agency’s executive, to provide strategic direction, ensure objectives are achieved, manage risks and use resources responsibly and with accountability.’

‘Governance and assurance regimes aim to manage risk in business operations while preserving accountability for performance’.

Source: Building Better Governance, Commonwealth of Australia 2007

Interrelated concepts

- Governance: oversight role and processes by which organisations manage and mitigate risks.
- Compliance ensuring that the organisation meets the requirements imposed by government bodies, regulators, or internal policies.
- Risk management: structured approach to identifying, assessing risks, methods of control and monitoring risk mitigation actions.
- Assurance: measures which demonstrate that the organisation is meeting its obligations (or not).
- Essential to good governance are robust regimes for:
  - Risk Management.
  - Assurance.
Duties with Respect to Risk Management

• The PGPA Act seeks to improve the high level accountability of all Commonwealth entities through focusing on their duties, internal controls and the way they engage with, and manage, risk.

• Officers of the Commonwealth must observe their obligations in relation to risk management and risk control ie “duty to establish and maintain systems relating to risk and control”.

• The accountable authority of a Commonwealth entity must establish and maintain:
  – an appropriate system of risk oversight and management for the entity; and
  – an appropriate system of internal control for the entity.

Source: PGPA Section 16
Definitions

- **Risk**: effect of uncertainty on objectives.
- **Risk Management**: coordinated activities to direct and control an organisation with regard to risk.
- **Risk Control**: action to reduce or eliminate threats to organisational objectives
- **Risk Controls** are based on risk assessments of potential risk factors (can include technical and non-technical aspects eg 17 Smart Buyer categories)

AS/NZS ISO 31000 Risk management pp 1-2

Risk Management Process

Risk Management in the CLC

General risk management process:

1. Identify the risk ‘events’ or occurrences.
2. Estimate the likelihood of these happening (probability).
3. Estimate what the impact will be.
4. Figure out the level of risk level and ranking between risk events.
5. Plan what to do to control, reduce, eliminate the risk events.
6. Implement risk management (mitigation, reduction).

Controlling Risk – Technical

- Technical Hierarchy of Controls for a system can help inform how to undertake risk control for the CLC.
- Use different ways to control the risk depending on what is possible, cost and the impact.
Controlling CLC Risk – Categories

**Acquisition**

- Requirements
- Technology
- Schedule
- Commercial
- Project Integration
- Defence Integration
- Financial
- Strategic
- Industry

**Sustainment**

- In-service Requirements
- Obsolescence
- Commercial
- FIC
- Financial
- Strategic
- Operational
- Industry

Controlling CLC Risk – Acquisition Categories

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>Risk Event</th>
<th>Treatment/ Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirements</td>
<td>Requirements incomplete</td>
<td>Additional requirements development</td>
</tr>
<tr>
<td></td>
<td>Not verifiable</td>
<td>Technical trial to determine constraints</td>
</tr>
<tr>
<td></td>
<td>Ambiguous</td>
<td>Peer review</td>
</tr>
<tr>
<td>Technology</td>
<td>Not mature</td>
<td>Develop technology further, trial</td>
</tr>
<tr>
<td></td>
<td>Unproven</td>
<td>Field in increments</td>
</tr>
<tr>
<td>Schedule</td>
<td>Schedule not achievable</td>
<td>Redevelop WBS and schedule</td>
</tr>
<tr>
<td>Commercial</td>
<td>Limited competition in market</td>
<td>Contract with appropriate performance incentives</td>
</tr>
<tr>
<td>Project Integration</td>
<td>Related Projects misaligned</td>
<td>Establish Prime System Integrator to manage interdependencies</td>
</tr>
<tr>
<td>Defence Integration</td>
<td>FIC delivery misaligned</td>
<td>Establish Steering and review group</td>
</tr>
<tr>
<td>Financial</td>
<td>Schedule slippage affects milestone achievement</td>
<td>Establish Program level so that flexibility to accommodate changes</td>
</tr>
<tr>
<td>Strategic</td>
<td>Changing threat situation</td>
<td>Ensure growth in system requirements and capabilities</td>
</tr>
<tr>
<td>Industry</td>
<td>Industry not investing in field</td>
<td>Funding to establish industry capability</td>
</tr>
</tbody>
</table>
Implementing Risk Mitigation

Expectations of Risk Approach to CLC

• A structured and deliberate approach to risk management processes supports PGPA duties through:
  • reducing and controlling risk; and
  • enabling informed decision-making.

• Clear understanding and consideration of risks in decision-making.

• Conscious risk reduction mindset throughout the CLC (not just to Gate 2).

• Targeted risk control actions focused on identified risks.
Risk Management and the CLC

- Core requirement of CLC is a deliberate approach to risk:
  - Must understand and assess risks.
  - Must have targeted approach to risk management and control.
  - Decisions are made with understanding of risks.
  - Must no longer be risk averse in decision-making.
- Multiple risk frameworks in Defence relevant to CLC include but are not limited to:
  - CLC Risk Mitigation Phase emphasising risk treatment.
  - Smart Buyer Risk Framework (Risk and Drivers Analysis)
Meaning of Assurance

• **Assurance**:
  – a positive declaration intended to give confidence; a promise. Source: Oxford Dictionary
  – grounds for justified confidence that a claim has been or will be achieved. Source: ISO/IEC15026-1:2013

• **Compliance Assurance**: measures instituted by a government agency to ensure that the provisions of its regulations are being met. Source: http://www.businessdictionary.com

• **Technical Assurance**: process by which the technical integrity of a product, process, or system is monitored and maintained. Source: http://www.businessdictionary.com

Description of Assurance Cases

• “Reasoned, auditable artefact created that supports the contention that its top-level claim (or set of claims), is satisfied, including systematic argumentation and its underlying evidence and explicit assumptions that support the claim(s)”

  AS4360 (Risk Management)

• Assurance Cases contain the following:
  – one or more claims about properties;
  – arguments that logically link the evidence and any assumptions to the claim(s);
  – a body of evidence and possibly assumptions supporting the arguments for the claim(s);
  – justification of the choice of top-level claim and the method of reasoning.

  Source ISO/IEC 15026-1:2013(en)
Assurance in the CLC

• An important element of risk-based decision-making across the CLC, is confidence that:
  • arguments presented are sound and based on evidence;
  • claimed status of capability management is accurate; and
  • outcomes satisfy organisational objectives.

• **Assurance activities** are conducted across the entire CLC and across various dimensions of capability management (e.g., technical, safety, financial, seaworthiness) to provide confidence to decision-makers and managers.

• Assurance outcomes provides evidence-based arguments for action.

Types of Assurance Across the CLC

• Contestability
• Gate Reviews / IAR
• Deep Dive Reviews
• SCRAM
• Major System Reviews
• Audit
• Reporting
• V&V
• T&E
• Certification
• I2 Assurance
• Quality Assurance: Supplier and Product Assurance
• Engineering Assurance
Contestability Framework

- Key assurance activity during Investment Approval Pathway
- Reviews force design outputs and all Gate submissions to ensure:
  - alignment with strategic resource and capability guidance; and
  - an acceptable basis for decision making.
- Checks that plans to proceed to next gate can be executed.
- Reviews risk assessments and treatment strategies.
- Reviews cost and schedule estimates.
- Participates in independent assurance reviews and ‘deep dives’.

Review Panels

The reporting framework is augmented by two additional independent assurance mechanisms which review the health of a Program, Product or project:

- **Gate Reviews.** The Capability Manager or Program Sponsor and/or the Delivery Group initiate an independently chaired review panel before all gates and critical milestones.

- **In Depth Reviews.** The Program Sponsor, VCDF or DepSec Strategic Policy and Intelligence or Delivery Group Head, may also initiate an independently chaired In Depth Review as a result of a significant trigger or particular concern.
Program-level Health Checks

- Program-level health checks are the responsibility of the Program Sponsor and are conducted on a regular basis.
- Health checks support progress reporting to the Capability Manager, members of the Program Steering Group and other key stakeholders, typically on a tri-annual basis.
- This reporting methodology is standardised across the Integrated Investment Program to minimise or eliminate the need for additional performance reporting.

Deep Dive Reviews

- Deep Dive is a review activity led by Force Design Division:
  - supported by the Program Sponsor and Contestability Division (as appropriate);
  - scheduled in the Force Design Forward Work Plan;
  - focuses on a Program, cross-Program or Capability Stream; and
  - revisits assumptions and analyse the status of existing, planned and future capabilities and transitional aspects within the scope of the activity.
Independent Assurance Reviews (IAR)

- IARs are the Group Level component of CASG’s assurance framework (Program/Project Quality Reviews).
- They provide reliable advice regarding the continuing viability of capability investment decisions as well as the health and outlook of programs, acquisition projects and sustainment products.
- The IAR uses a specifically chartered Board with distinct skills and experience to examine the current state of a program, project or product.

Source: CASG Business Framework 2017

Independent Assurance Reviews (IAR)

- The IAR Chair makes recommendations to the relevant CASG Senior Executive and Capability Manager regarding the health and outlook of the activities reviewed and identifies actions to improve performance.
- Reviews occur in the lead up to key project milestones or annually.
- Sustainment reviews occur in the lead up to major events in the product life cycle, such as mid-life upgrades or periodically, one to three years.

Source: CASG Business Framework 2017
The Schedule Compliance Risk Methodology (SCRAM) is a structured approach to identifying projects risks and issues which have origins in technical or engineering factors eg requirements definition, system design, development, production, and system integration and test including specific aspects software development.

- Understand the impact on project outcomes with focus on schedule.
- Providing evidence and recommendations for treatment of risks and remediation of issues.

When Can SCRAM be Applied?

- Projections of schedule outcomes at any point in the CLC which need to factor in system and software development and system integration activities.
- To provide evidence for Smart Buyer risk-profiling especially for technical implementation risk up to Gate 2.
- To assess project health from Gate 0 through to Acceptance.
- To provide ‘due diligence’ assessments during management handovers.
- To identify sources of technical implementation risk.
- To assist in determination of practical risk mitigation actions.
Technical Regulation

- Technical Regulation
  Technical regulation provides confidence to Capability Managers about the safety and technical integrity of their systems and equipment. This includes fitness for service, safety and environmental compliance.

- The following references govern technical regulation within Defence and apply in conjunction with applicable laws and regulations.

  • Seaworthiness:
    - Defence Seaworthiness Management System Manual (DSwMS) (Jun 17)
    - N4 Library
  
  • Airworthiness:
    - Defence Aviation Safety Regulation (DASR) introduced in 2016 and replaced the Military Operational and Technical Airworthiness Regulations
  
  • Land Technical Regulation
  
  • Explosive Ordnance Regulation
    - DI (G) LOG 4-1-006 - Safety of Explosive Ordnance
Audit

- Auditing is a cornerstone of good public sector governance.
- Objective assessments of whether public resources are managed responsibly and effectively to achieve intended results, auditors help public sector organizations achieve accountability and integrity, improve operations, and instill confidence among citizens and stakeholders.

Range of Audits

In quality management there are three main categories of audits, which depend on the relationship between the auditor and the person being audited: first-party, second-party, and third-party audits.

• Third-Party Audits: A third-party audit occurs when an organisation engages an independent party to perform an audit. This can be used when the organisation wishes to create a quality management system (QMS) that conforms to a standard set of requirements, such as ISO 9001, and to verify that outcome.
• …
Range of Audits

• …

• **Second-party audit:** when an organisation performs an audit of a supplier to ensure that they are meeting the requirements specified in the contract or other agreement. All or part of the contract or agreement can be audited. It is important to understand that a second-party audit is between the customer and the supplier and has nothing to do with becoming certified.

• **First-Party Audits:** are often called **internal audits.** This is when someone from the organisation itself audits a process or set of processes in the quality management system to ensure it meets that required. The audit is on behalf of the organization and not a customer or certification body.

ANAO

• Relevant activities of ANAO:
  – Performance audits of Australian Government programs and entities;
  – Assurance reviews of Australian Government entities.

• ANAO Auditors use tools such as financial audits, performance audits, investigations, and advisory services to fulfill each of these roles.
Mandated System Reviews

- The Mandated System Reviews (MSRs) are based on System Engineering reviews which provide assurance on achievement of progress for contracted work. This is inherently represents a form of **Assurance Case** for each logical step in system development, production and delivery.

- Pivotal System Reviews which are undertaken for most materiel acquisitions include:
  - Integrated Baseline Review (IBR).
  - System Requirements Review (SRR).
  - System Definition Review (SDR).
  - Preliminary Design Review (PDR).
  - Detailed Design Review (DDR).

Source: ASDEFCON (Strategic Materiel)
T&E Categories

• Developmental Test and Evaluation (DT&E)
  – Largely undertaken in the Acquisition Phase.
  – Support design and development effort.
  – Generally undertaken by contractors.
• Acceptance Test and Evaluation (AT&E)
  – Formal acceptance testing on behalf of customer.
  – Between the Acquisition and Utilisation Phases.
• Operational Test and Evaluation (OT&E)
  – Focuses on functional or operational testing of the system
  – Generally undertaken by users following acceptance.
  – Some OT&E (called Preview T&E) can occur earlier during Acquisition Phase, particularly for large, phased projects.

Verification and Validation (V&V)

• The entire systems engineering process aims to produce a system that is:
  – verified against the documentation produced (MOPs); and
  – validated against the original needs, goals and objectives (MOEs).
• V&V ensures that we have both:
  – built the system right (verification); and
  – and built the right system (validation).
• The T&E effort supports V&V.
**Methods of V&V**

- T&E
- Demonstration
- Experiment
- Analysis
- Modelling
- Simulation
- Inspection/examination
- Similarity
- Certification
- Implication

---

Program of assurance activities

- Many different assurance activities across the CLC
- Program, Product and Project Sponsors should understand and anticipate the range of assurance activities so as to:
  - plan ie schedule and allocate resources;
  - ensure necessary evidence is being collected to support assurance cases; and
  - achieve efficiencies through leveraging activities.
- Assurance activities should be tailored to the particular circumstances and needs.
- Should establish a clear view of Assurance Program and capture this in the IPMP and appropriate subordinate plans.
Implementing the CLC

- CLC artefacts and documents are pivotal to implementing the CLC:
  - provide the basis for decision making;
  - provide basis for agreement on plans and actions; and
  - provide evidence for management and assurance.
- Different documents relate to different accepts of the CLC.
- Following slides are provided for reference reflecting latest known guidance with focus on new documents (to Gate 2).
- Next section will use the example introduced on Day 1 as the basis to describe the new CLC artefacts and documents to Gate 2 with respect to their development and use.
- The example will step us through the key CLC artefacts and documents leading up to Gate 2.
Meaning of Artefact

- An artefact may be defined as an object that has been intentionally made or produced for a certain purpose.

  Source: Stanford Encyclopedia of Philosophy

- In software development, artefact can refer to tangible products associated with the software development including requirements, models, design documents, as well as project plans, business cases, and risk assessments. Artefacts help describe the development as well as the function, architecture, and design of the software.

- We will use artefact as any means of communicating information associated with the CLC including documents, models, plans, architectures, and proposals.
Scope of Artefacts Being Covered

- Many artefacts are created through the CLC from early FSR Narratives through to project closure and materiel disposal documentation.
- This course focuses on those CLC artefacts:
  - which have been identified as core to the CLC; and
  - which are to be developed by Capability Managers and Delivery Groups.
- Key CLC artefacts can be divided into two broad categories:
  - **Program** for proposals or as common references for subordinate projects/products.
  - **Project/Product** for proposals.
Key CLC Artefacts

• Program-reference:
  – Capability Program Narrative (CPN).
  – Program Strategy.
  – Program Integrating Operational Concept (PIOC).

• …

Key CLC Artefacts

• …

• Proposal Artefacts at Program, Project, or Product level:
  – Joint Capability Narrative (JCN).
  – Project Execution Strategy (PES).
  – Business Case which supports Proposals & Submissions.
  – Capability Definition Documents (CDD).
    • Operational Concept Document (OCD).
    • Function and Performance Specification (FPS).
    • Test and Evaluation Master Plan (TEMP).
Programs: Key Points

Program

A program is a group of related projects managed in a coordinated manner to obtain benefits not available from managing them individually. Program management is the application of knowledge, skills, tools and techniques to meet program requirements.

Source: PMI website

A Program, in the context of managing Defence capability, is defined as a group of related Projects, Products, and activities that are managed in a coordinated way to optimise capability outcomes within allocated resources.

Objectives of Programs

- Program objectives in the Defence context are generally of two types:
  - **Operational outcomes** eg joint capability.
  - **Resource commonality** eg common systems or resources (eg fuels) which reap acquisition, sustainment and training efficiencies.

Benefits of Programs for CLC

There are four areas of benefit for introducing a Program layer as part of the CLC:

- Aids prioritisation of the Integrated Investment Program.
  - groups investment proposals which can better show how government directed outcomes will be/ have been delivered.
- Realisation of Joint Force outcomes:
  - managing across projects which deliver integrated and interoperable capability systems.
- Improved acquisition and sustainment of **similar or common** capability systems.
- More aligned and efficient management of **related capability systems** in a resource constrained environment.
Program

Program is made up of Products, Projects, and Activities which:
- deliver a capability outcome;
- have relationships; and
- likely need to be synchronised or coordinated.
Program Artefacts as a Common Reference

- Program-level artefacts provide an overarching reference for constituent projects and products.
- Common reference information spanning business and technical requirements, design and management implementation aspects applicable to all constituent elements.
- Efficient: Each subordinate artefact leverages the parent artefact so that only the essential ‘delta’ is developed.
- Aligned: Related Projects and Products reference common program information to enable aligned and, where appropriate, joint force outcomes.

Program Layer as ‘Umbrella’ Reference

Efficient: Each subordinate artefact leverages the parent artefact so that only the essential ‘delta’ is developed.

Aligned: Related Projects and Products reference common program information to enable joint force outcomes.
Role of the Program Sponsor

- Oversight, monitoring, and decision-making including the authority to reconcile issues between constituent Projects, Product and activities.
- Define shared objectives across Projects/Products and identifies and manage risks relevant to Program objectives.
- Establish and authorise common reference information spanning business and technical requirements, design and management implementation aspects applicable to all constituent systems.
- Provides appropriate governance arrangements including clear decision-making and escalation structures.
- Reporting performance of Programs for Capability Stream Leads to prioritise.

Contestability at Program-level

- Contestability is performed at Program level to assure government and senior stakeholders that Programs are aligned with strategic guidance and resource allocation.
- Contestability is conducted as part of the review of the CPN and JCN.
- The level of contestability should be proportionate to the risk presented by a Program with additional depth of review being possible.
Architecture Practice for Programs

• “An architecture is the structure of components, their relationships, and the principles and guidelines governing their design evolution over time” (IEEE 610.12-1990).

• Can use architectures for CLC SoS and Programs to provides a common and enduring reference for decisions for Proposals, Projects and Products.

• Architectures can describe:
  – how constituent systems are used (CONOPS);
  – operational, functional and technical relationships and dependencies between constituent systems; and
  – end-to-end functionality and flows of information and data (and other resources).

Source: Based on SEBoK Architecting approaches for SoS

I2 Framework (I2F)

I2 Reference Set

I2 Implementation

I2 Assurance, Approval

Joint Force Guidance

I2 Framework (I2F)
Program CLC Artefacts

<table>
<thead>
<tr>
<th>Artefact</th>
<th>Description</th>
<th>Developed by</th>
<th>Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPN:</td>
<td>Narrative which inform required capability of the subject group of capability systems</td>
<td>Force Design Division</td>
<td>Force Design Division</td>
</tr>
<tr>
<td>PIOC:</td>
<td>Operational and other features of the capability grouping both within the Program and relationships with other Programs</td>
<td>Program Sponsor</td>
<td>Program Sponsor/Endorsed by Joint Capability Authority</td>
</tr>
<tr>
<td>Program Strategy:</td>
<td>Activities, management arrangements, including integrated schedule across related Projects and Products within the Program</td>
<td>Program Sponsor</td>
<td>Program Sponsor</td>
</tr>
<tr>
<td>Program Architectures:</td>
<td>Program features using Defence Architecture Framework (DAF) conventions</td>
<td>Program Sponsor/C4ISR Design Authority</td>
<td>Program Sponsor/C4ISR Design Authority</td>
</tr>
</tbody>
</table>
CLC and Capability Management Practices
Dr Mike Ryan & Dr Shari Soutberg

Case Study: Capability Program - IAMD

Capability Streams (to prioritise over multiple domains)

Source: Interim CLC Manual

Background to IAMD

- Combination of ADF systems for defence against air and missile threats such as:
  - ballistic missiles;
  - airbreathing threats (cruise missiles); and
  - long-range rockets, artillery and mortars.
- Requires integrated operations between all three Services, support from Government Agencies, and integrated, where appropriate, with allied and coalition forces.
CLC and Capability Management Practices
Dr Mike Ryan & Dr Shari Soutberg

Capability Program Narrative (CPN)

Program Layer as ‘Umbrella’ Reference

- Force Design Division develops
- Definition of the expected capability outcome for each of the 40 Programs
- Provides the ‘umbrella’ or common reference for each of its constituents Projects and Products
Capability Program Narrative (CPN)

• Raised by Force Design Division as enduring Program-level direction including concepts and requirements.
• Articulates ‘What’ and ‘Why’.
• Provides the CM with a synopsis of:
  – operational environment,
  – constraints,
  – governance,
  – Joint Force needs, and
  – sustainment arrangements and priorities where relevant.
• Distils strategic and conceptual guidance into actionable deliverable terms.
• Contestability reviews the strategic fit of the CPN.

Possible IAMD CPN – key points

• Narrative or vision of what IAMD is and how it will operate to address the threat.
• A narrative of:
  – IAMD operational context including threats;
  – what the Program is trying to achieve operationally;
  – constituent capabilities and how they will need to work collectively;
  – interoperability, integration and commonality constraints internal and external to the Program:
    • materiel solutions; and
    • support arrangements.
Possible IAMD CPN – key points

- eg: Increasingly sophisticated air and missile threat to deployed forces:
  - globally and within our region; and
  - likelihood that it will increase in years ahead.
- eg: Require modern and integrated ground-based air defence system:
  - integration of offensive and defensive operations against air-breathing and missile threats, to counter an enemy’s ability to degrade or disrupt our operations and projection of combat power in a contested environment; and
  - fuse and share information to enhance accuracy and speed of ADF's systems response to threats.

Possible IAMD CPN – key points

- eg: Flexibility for further enhancement to handle more complex threats and to integrate new technologies as they emerge.
- eg: IAMD is a shared responsibility that will require integrated operations between all three Services, supported by Government Agencies, and integrated, where appropriate, with allied and coalition forces.
- eg: Must include:
  - expanded access to air and space situational awareness information, including through space-based systems;
  - ground-based active electronically scanned array radars;
  - consider integrating CEA phased array radar in a ground-based role; and
  - meet defined sovereign capabilities (including support).
Elements of IAMD

- Includes:
  - Upgrade of the ADF’s existing air-defence systems, including C4I systems and sensors.
  - Joint Battle Management System to better coordinate and synchronise ADF operations.
  - Future ground-based air-defence system
    - short-range man-portable surface to air system; and
    - medium-range surface-to-air missile system.
- First two IAMD projects:
  - Land19 Phase 7B: Army’s Ground Based Air Defence missile system comprising Radar plus Missile.
  - AIR 6500: Upgrade or replacement of the ADF’s existing air defence systems.
Program Layer as ‘Umbrella’ Reference

Program Integrating Operational Concept (PIOC)

Program Strategy

Program 1
- VCDF is the Joint Force Authority
- Areas within VCDF assist in the development of the PIOC:
  - Joint Integration and Capability Assurance (JICA) and
  - C4ISR Design Authority

PIOC

- Who develops it?
  - developed at the discretion of the Program Sponsor; and
  - requires endorsement from the JFA.
- When is it developed?
  - when a Program is established and then maintained.
- What is its intent?
  - primary co-ordination document to manage intra and inter-Program linkages;
  - provide uniform, consistent overarching design direction to constituent, related Programs, Projects, & Products; and
  - reduce the level of detail required in documentation.
- Support provided by VCDF Group.
What is in the PIOC?

- Clear Program boundary definition and content that reflects Concept of Operations (CONOPS) – how IAMD operations would be conducted based on scenarios.

- Definition of Program intra- and interdependencies where they can be defined: Operational, System, and programming

- Traceability of Integration and Interoperability (I2) requirements to higher level guidance including Joint Supporting Concept, IOC Integrating Objectives, directed I2 requirements from JCA eg Mode 5 IFF and Link 16

- Identification of operational dependencies including definition of Information Exchange Requirements (IERs)
**What is in the PIOC?**

Target Program operational, functional and performance attributes and constraints (incl COIs, MOEs, MOPs) sufficient to define:

- overall Program attributes;
- interdependencies in terms of exchange of services, physical assets and information:
  - between constituent systems, and
  - external to Program;
- interface requirements of constituent systems; and
- ‘Umbrella’ requirements for Project and Program OCD’s and Program T&E activities.

- Critical Operational Issues (COIs)
- Measures of Effectiveness (MOEs)
- Measures of Performance (MOPs)

---

**I2 Framework (I2F)**

**I2 Reference Set**

- **AUTHORISED REQUIREMENTS**
  - Joint Force Outcomes
  - Supporting Joint Concepts
  - Integrating Joint Objectives
  - Directed I2 requirements

- **AUTHORISED REFERENCE DESIGNS**

- **Required Practices**
  - Demonstrated Traceability
  - Use of Standards
  - Consultation
  - Established A Agreements
  - Tailored Assurance Pathways
  - Configuration Control of I2 info

**STRATEGIC & OPERATIONAL GUIDANCE**

**DCAP OUTCOMES**

**EXTERNAL OBLIGATIONS AND AGREEMENTS**

**PROGRAM**

- drives Program I2 requirements
- Systems incl Interface Specifications
- Agreed requirements fed back into Reference Set

**PROJECT**

- Decide Project I2 requirements
- Systems incl Interface Specifications

**PRODUCT**

- Define Product I2 Reference and Baseline

**I2 Implementation**

- I2 Framework (I2F)

**I2 Assurance, Approval**

- Assure and approve Investment Proposals for compliance with Reference Set requirements
- Assure Program, Project and Product Realisation for I2 compliance with approved requirements
- Assure ongoing in-service I2 compliance of Products against approved I2 requirements
Program Assurance Strategy

• Program T&E is achieved through coordination of T&E activities for constituent Projects and Products

PIOC is ‘umbrella’ reference document

• Provides design guidance in the form of:
  – the Program’s needs derived from relevant operational scenarios;
  – Program-level operational architectures, as derived from joint war fighting architectures developed by the C4ISR Design Authority;
  – relevant process and technical standards to be adopted across the Program eg Technical Data Links Interoperability (Multiple Standards and Bearers: Link 16, JREAP and Link 22); and
  – realisation of the Joint Force including US Interoperability requirements.
Requirements: related systems

- Programs help drive common, compatible requirements for related systems:
  - common standards;
  - agreed requirements for related systems (interface); and
  - specifications for common systems used in different operational contexts.

Requirements for interfacing systems

- Joint Force requires coordination and consistency across requirements development efforts for each capability component.
- Must 'design' for I2 and flexibility.
Requirements for common systems

- Specifications for common systems used in different operational contexts must be reconciled to cater for different operational and technical situations.
- Eg Ingress Protection – dust and water.

Pilot Model-based PIOC

- Model-based PIOC is being piloted.
- The aim of the model is to provide a single repository:
  - to capture a program’s operational concept,
  - program management artefacts, and
  - allow each stakeholder to interrogate the model to extract the information relevant to their role.
- Significant alignment with architecture approach to defining program and system features: Defence Architecture Framework (DAF) applies.
Pilot Model-based PIOC

• Expectations from model-based PIOC:
  – common reference for related projects;
  – define project dependencies and associated risks;
  – identify integration and interoperability (I2) risks and mitigation actions;
  – support integrated program-level capability design;
  – support visualisation of program dependencies;
  – reduce documentation;
  – reduce project management effort;
  – improve FIC decision making; and
  – support procurement efficiencies.

Pilot model-based PIOC

• The model is also expected to improve:
  – requirements specification and allocation to subsystems;
  – early identification of requirements and traceability;
  – system design integrity including definition of boundaries;
  – documentation burden;
  – operational description of program: mission, relevant policies and doctrine, scenarios, needs and constraints;
  – integrating objectives including the COI, MOE and MOP;
  – architectures and standards; and
  – a functional description of each of the capability system components: FIC overview; Schedule; Dependencies; Risks.
Integration and Interoperability

- Key CLC requirement is realisation of the Joint Force.
- The PIOC structure contains information on all related projects and products and the relationship to the program which are relevant to delivering the Joint Force.
- Relationships including interdependencies which reflect Integration and Interoperability can be defined using dependency analyses such as SCMILE (Sensing, Command and control, physical Mobility, Information mobility, Logistics (and supply, sustainment and support), Engagement/effects) services analysis. This information could be used to conduct sensitivity to change analysis.

Program Strategy
Program Layer as ‘Umbrella’ Reference

---

Program Strategy

- **Who develops it?**
  - The **Program Sponsor** on behalf of the CM based on the CPN.

- **When is it developed?**
  - When a **Program is established** and then maintained.

- **What is its intent?**
  - To maintain a pipeline of proposals, Programs and activities.
  - To ensure that known Program gaps and opportunities are managed and prioritised to meet Program capability outcomes and preparedness objectives.
Program Strategy

Why is it produced?

- To describe how the Program outcomes as articulated in the CPN will be achieved.
- To be the primary document that defines the intent for leading, managing and developing capabilities to satisfy Program outcomes.
- The Program Strategy and PIOC help the CM (through the Program Sponsor) coordinate the activities of the CM, Delivery and Enabling Groups for Proposals, Projects and Products that make up the Program.

What is in the Program Strategy?

- How the Program is aligned to CPN, Capability Stream requirements and Defence strategic direction.
- An integrated planning view of the Projects and Products within the Program, including FIC.
- How the Program will develop, deliver, transition and sustain agreed capabilities.
- Coordination of sustainment for all Products to maximise the aggregate of capability output across the Program.
- Program-level industry opportunities and constraints.
- Risks, issues, gaps including risk mitigation and acceptance for both acquisition and sustainment.
IAMD Program: Project elements

AIR 6500
Phase 1

- Upgraded or Replaced C4I
- Ground Based Sensors

- IOC FY22/23
- FOC FY28/29

AIR 6500
Phase 2
Gate 0 – Feb 20
Gate 1&2 – Apr 22

- Medium-Range Ground Based Air and Missile Defence Effector

- IOC FY25/26
- FOC FY28/29

Land19
Phase 7B

- Short-Range Ground Based Air and Missile Defence Effector

- IOC 2023
- FOC 2025

Contributing Projects: SEA4000, SEA5000, AIR5077, AIR6000…

Overlapping FIC requirements and planning
- Common training and workforce
- Coordinated Sustainment

IAMD Program Strategy

- “The critical issue is that an IAMD Program cannot be built purely bottom-up if it is to be both effective and affordable; a top-down direction and focus is essential. There is a need for an IAM Program Roadmap, that is a Directive and not only a recommendation.”

Reference: Williams Foundation Integrated Air and Missile Defence Study 2017
Program Strategy Content

- Identifies applicable Govt direction, strategic guidance (DWP, IIP), narratives eg JCN, CPN.
- Defined outcomes and outputs (including priorities).
- Resource, funding, FIC allocation requirements & priorities.
- Key risks, risk mgmt actions incl escalation approach.
- Identification of all constituent Proposals, Projects, Products, relationships/dependencies across operational, technical and programmatic aspects including:
  - schedule and delivery milestones;
  - activities (eg interface definition);
  - resourcing including budget and workforce; and
  - FIC elements.
- Linkages and critical dependencies with other Programs
- Stakeholders, Governance and Management forums.
- Requirements (incl stds) for Integration and Interoperability.
- Program-level assurance program including T&E concept.
- Activities to transition into service and sustainment.
- Development gaps and opportunities to inform Force Design.
- Information management incl Program architecture info.
- 12-month (rolling) Plan: review points, milestones.
- Key Performance Metrics.

Source: Defence Program Strategy Guide
PS Reviews

Reviews of PS:

– Program Sponsor is responsible for conducting periodic reviews of the Program Strategy to identify and mitigate risk within the Program.
– IC may direct that Contestability conducts a review.
CLC and Capability Management Practices

Dr Mike Ryan & Dr Shari Soutberg

Proposal Artefacts

<table>
<thead>
<tr>
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<td>DIP</td>
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<tr>
<td>Concepts</td>
<td>DPPM</td>
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Issued by JCA to the CM

CPN

JCN

Program Strategy

JCNS

Proposal = Sponsor's Paper/ JCNS + PES

OCD

Project

WBS

FPS 1

FPS 2

Tender and Contract Documents

PES

IPMP

IMS

CLC Case Study
CLC Proposal Case Study

- Aspects of CLC re-design have been implemented in successful projects.
- This Case Study based on an actual Defence project that has used elements of CLC approach.
- We will look at how CLC may have been applied for an actual project focussing on S&C and RM&RS Phases:
  - approach to be adopted;
  - activities to be undertaken; and
  - documents to be produced.

SEA 1448 Ph4A Project: ESM

- Electronic Support Measures (ESM)
  - used on RAN ships to detect and identify (classify) adversary’s radars
  - a bit like a music recognition app
- Comprises antenna and processing equipment
- Integrates and displays on the Combat System
SEA 1448 Ph4A Project: Key Factors

- ESM system to be installed on multiple existing platforms across 3 different classes of ship.
- Installation has to be synchronised with availability of platforms.
- Different installation requirements dependent on class:
  - physical installation differences; and
  - differences in RF ‘noise’ situation.
- Multiple vendors to create the system.
- Multiple contractors to install the systems on ships.
- Time pressure to enable deployment of vessels with this capability.

Implementing the CLC (eg)
CLC and Capability Management Practices

Dr Mike Ryan & Dr Shari Soutberg

Case Study: SEA 1448 Phase 4A

We will look at the case study in terms of what would have been done and produced under the CLC touching on:

• CLC process, frameworks and management constructs eg Programs, Smart Buyer etc.
• Enabling Practices:
  – Systems Engineering.
  – Project Management.
  – ILS.
  – Procurement and Contracting.
• Then we will look at it in terms of artefacts and documents to be developed

Joint Capability Narrative (JCN)
JCN

• Who develops it?
  – Force Design Division (Force Options and Plans Branch).
• When is it developed?
  – when a capability need or enabling gap or opportunity identified.
• Why is it produced?
  – used to task appropriate CM to develop a more detailed JCNS; and
  – prepared as the rationale for an investment proposal.

JCN

• What is in a JCN?
  – Provides a conceptual framework for a defined gap or opportunity and ensures joint needs are clearly aligned with strategic guidance.
  – Articulates gaps, risks, issues or opportunities and the CM's plan to meet the problem posed.
  – Articulates time, resource constraints and strategic considerations.
Identifying a Capability Gap

- Defence Capability Assessment Program (DCAP) produces recommended and prioritised capability investment.
- In the case of the ESM, Navy recognised a vulnerability for their platforms.
- If conducted under CLC:
  - CM can indicate a capability gap; and
  - Capability Gap can have it considered as part of DCAP.

JCN to JCNS Pathway

- Pathways:
  - JCN is presented to Joint Warfare Council (JWC) if risk, cost or complexity is of concern; and
  - generally directs the CM to nominate a Program Sponsor to develop a JCNS.
JCN

- In the absence of JCN, use FSR Narratives and IIP funding profiles as reference.
- Contestability reviews the JCN as one of the Force Design outputs.
- JCNs are still being developed.

Joint Capability Needs Statement (JCNS)
Proposition Artefacts

**What and Why**

- Defence White Paper
- DPG
- AMS
- IIP
- Force Design
  - FOE
  - JCF
  - AJOC
  - EJOC
- Concepts
- Issued by JCA to the CM

**How**

- PGPA Act
- CPRs
- DIP
- Smart Buyer
- DPPM
- Program Strategy
- Proposal – Sponsor’s Paper/JCNS/PES
- Tender and Contract Documents

**JCNS**

- **Who develops it?**
  - Program Sponsor as tasked by CM through a tasking statement.
- **When is it developed?**
  - when a capability need or enabling gap or opportunity identified through a JCN and the CM assigns a Program Sponsor; and
- **Why is it produced?**
  - an agreed statement of military or enabler need, which determines the capability required to deliver on strategic guidance.

Source: Update Interim CLC Manual
JCNS

• What is in it?
  – high level statement of an identified and bounded capability need and available option sets;
  – represents a defined and bounded system solution to the capability gap;
  – system need described as a hierarchical structure of objectives including FIC to address the gaps and opportunities posed in the JCN;
  – describes CM’s plan to meet the problem posed by the JCN;
  – contribution to joint capability with FIC integration issues highlighted and interdependencies defined; and
  – JCNS must clearly reflect but not repeat JCN, CPN.

Source: Update Interim CLC Manual

JCNS

• Who reviews and/or approves the JCNS?
  – Contestability Division reviews the Gate 0 submission including the JCNS to test if consistent with strategic guidance;
  – presented at Gate 0 for approval by IC (at the same time as the Business Case); and
  – Defence Committee (DC) reviews JCNS only for most complex, politically sensitive, novel and/or high risk proposals, especially where they diverge from established policy and endorses further development of selected options.

Source: Update Interim CLC Manual
Contestability and the JCNS

- Contestability Division can assist in the development of the JCNS prior to Gate 0.
- Contestability reviews the JCNS prior to Smart Buyer workshops.
- JCNS is assessed by Contestability Division for Gate 0 to check if it:
  - aligns with Strategic Guidance aligns with resourcing provisions; and
  - can be delivered within resourcing direction.

Strategic Guidance and the JCNS

- In the absence of the JCN and CPN, the JCNS must clearly link to (but not repeat) most recent strategic guidance:
  - FSR Narratives.
  - Defence White Paper 16.
  - Force Structure Review.
  - Defence Planning Guidance (DPG).
  - Australian Military Strategy (AMS).
  - relevant Strategic Policy and Joint Concepts.
  - IIP funding profiles.
Key Features Required of the JCNS

- Strategic **Alignment** and Program Coherence.
- **Justification**: evidence supported by logic, traceability.
- **Prioritisation of Needs** in plain English.
- Consideration of **Joint Force, Integration and Interoperability**.
- Consideration of all FIC.
- **Scheduling issues**.
- **Systems approach**:
  - structured derivation of requirements,
  - recognition of SoS, and
  - clear bounding of the system need to reflect capability gap or opportunity.

Possible Content of the ESM JCNS

- Description of the need which addresses the gaps posed in the JCN.
- **Hierarchy** (priority) of capabilities eg ability to detect and classify radars.
- Characteristics for the ES system eg frequency spectrum of interest.
- Joint integration and FIC integration issues eg use a common system on multiple classes.
- Relationships with other projects or programs eg major ship programs.
Project Execution Strategy (PES)
Strategy and Concepts Phase: Contestability

**Gate 0**
- **Output:** Joint Capability Narrative (JCN)
- CM assigned
- **Output:** Joint Capability Needs Statement (JCNS)

**Gate 1**
- Delivery Group assigned
- IPM assigned and IPMT initiated
- **Output:** Project Execution Strategy

**Gate 2**

Smart Buyer Framework

**Need**
- Risk/Driver Profile
- Analysis/Tailoring
- Strategy

**JCNS**
- Requirements
- Technology
- Schedule
- Commercial
- Project Integration
- Defence Integration
- Financial
- Strategic
- In-Service
- Obsolescence

**PES**
- Approvals Strategy
- Project Mgt Strategy
- Acquisition Strategy
- Sustainment Strategy
PES Overview

• High level, risk based tailored strategy to support Investment Committee decision making with respect to a proposal.
• The PES consists of four strategies developed using the Smart Buyer Decision Making Framework:
  – Approval Strategy.
  – Project Management Strategy.
  – Acquisition Strategy.
  – Sustainment Strategy.

PES – Key Points

• Who develops it?
  – Delivery Group in close consultation with CM
• When is it developed?
  – prior to Gate 0 and evolves after that, and
  – remains relevant until project closure but may be updated as Project progresses.
• Why is it produced?
  – IC for decision making for the project at Gates 0, 1 and 2 of the CLC; and
  – FIC providers as a common reference for defining their activities.
### PES – Key Points

<table>
<thead>
<tr>
<th>What is its purpose?</th>
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<tbody>
<tr>
<td>– recommended implementation strategy for realising the capability need;</td>
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<tr>
<td>– sets broad direction for the entire project;</td>
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<tr>
<td>– high-level, tailored statement of strategy alternatives and recommended approach for the project; and</td>
</tr>
<tr>
<td>– shapes development of subordinate project plans including Integrated Project Management Plan (IPMP).</td>
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<table>
<thead>
<tr>
<th>Features in its development:</th>
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<tbody>
<tr>
<td>– developed and tailored as per Smart Buyer principles and informed by context, risks and drivers; and</td>
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<tr>
<td>– developed in accordance with an asset management approach (whole of life, TCO, all FIC).</td>
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</table>

### PES– Key Points

<table>
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<tr>
<th>What is in it?</th>
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<tbody>
<tr>
<td>– Project considerations and analysis eg risks, drivers;</td>
</tr>
<tr>
<td>– Acquisition and Sustainment Strategies;</td>
</tr>
<tr>
<td>– Approvals Strategy and Pathway; and</td>
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<tr>
<td>– PM approach and project activities.</td>
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<thead>
<tr>
<th>Review and Approval:</th>
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<tbody>
<tr>
<td>– Gate 0 approval constitutes formal endorsement of the PES and the elements contained within it.</td>
</tr>
<tr>
<td>– Reviewed and revalidated at each subsequent CLC approval.</td>
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</table>
PES Development

**Purpose:** To present the recommended implementation strategy for realising the capability need.

**Developed using Smart Buyer workshops:**
- Kick-off.
- Environmental scan.
- Risk and Drivers.
- Strategy.

**Produced by:** the Program/Project Sponsor and Integrated Project Manager (IPM) as members of the Integrated Project Management Team (IPMT/IPT).

PES Development

**Presented at Gates:** Evolving PES presented in conjunction with Business Case/ Proposal/ Submission and the JCNS.

**Includes** certain areas of discussion:
- Key Project Factors, Risks and Drivers.
- Preferred Acquisition, Sustainment and Approval Strategies.
- Proposed Information Gathering Activities (including risk reduction activities).
- FIC Integration.
- Necessary resources and schedule.
PES: two key activities

- Risks and Drivers Analysis.

- Strategy Development:
  - whole of life view;
  - proposed activities to next Gate;
    - risk reduction work;
    - funding required; and
    - expected outcomes.

- To undertake these activities you need to understand the operational, technical, commercial, project management and support factors.

Smart Buyer ‘Risk and Drivers’ Categories

- Acquisition
  - Requirements
  - Technology
  - Schedule
  - Commercial
  - Project Integration
  - Defence Integration
  - Financial
  - Strategic
  - Industry

- Sustainment
  - In-Service Requirements
  - Obsolescence
  - Commercial
  - FIC
  - Financial
  - Strategic
  - Operational
  - Industry

For each Project/Proposal these are rated as High, Medium-High, Medium-Low or Low
PES: understand the solution context

For the ESM case study need to understand:

- **Operational factors** eg:
  - operational imperative to deliver capability
  - availability of platforms
- **Technical factors** eg:
  - solution will be based on a number of subsystems
  - technical risks
- **Support factors**:
  - sovereign support capability
  - opportunities for efficiencies
- **Commercial and Project Management factors** eg:
  - ability to leverage off other acquisition activities

PES: ESM context

- Electronic Support Measures system is based on integration of a number of sub-systems.
- Installation on different classes of ships.
- Some of the sub-systems are still under development.
- Sub-systems developed by different vendors.
Case Study: ESM Risks and Drivers

• Technical:
  – Installation/Platform Integration complexity.
  – Different parts of the system being developed to different timelines.
  – Structural and other issues unknown (antenna mast).
  – Combat system integration (software & hardware issues).

• Project Management
  – Upgrade cycle that was set by Anti-Ship Missile Defence (ASMD) Program Risks identified included:
    • Two programs (ASMD and ES) out of sync.
    • Time pressures.
    • Overseas design and production of significant part of system with local platform installation.

Case Study: ESM Risks and Drivers

• Commercial:
  – Multiple interdependent vendors (Saab, Excelis, BAE, CEA).
  – Continuity of vendor workforce through the different phases of the Defence approval lifecycle.
  – Price and Schedule unclear.

• T&E:
  – ANZAC (HMAS Perth) at Pacific Missile Range Facility (PMRF) for missile firings.
### Case Study: Risk Reduction Activities

Targeted and funded risk reduction activities:

- **Technical**:
  - Measurement of RF Environment.
  - Ship Survey.
  - Requirements Validation workshop.
  - Product Maturity Roadmap / System development timeline.
  - Combat System Integration workshops.

- **Implementation**:
  - Opportunities: Remove and install equipment.
  - Fitted For But Not With (FFBNW).
  - System Integration Lab.
  - Continuity of Workforce.

### Key Discussion Areas for PES

1. **Project Summary**: background including relationship between this proposal and other Projects or Products.
2. **Project Factors**: key risks, drivers and other factors that will shape the PES.
3. **Acquisition Strategy**: describes the Acquisition Strategy alternatives and rationale for the preferred Strategy.
4. **Sustainment Strategy**: describes the Sustainment Strategy alternatives and rationale for the preferred Strategy.
5. **Approval Strategy**: with respect to Gates and Government approvals.
6. **Project Management Strategy**: Overview as basis for Integrated Project Management Plan (IPMP) and Integrated Master Schedule (IMS)
1. Project Summary

- Relationships with other Programs, Projects and Products.
- How long the capability is expected to be in service (Life of Type).
- High-level view of the resources and the years of the expenditure.
- Key schedule dates including approval schedule (consideration at Gates) and introduction into service timeline (IOC and FOC).
- Governance ie CM, Program Sponsor, Program Manager, Project Sponsor, Delivery Division/Group.

2. Project Factors

- The Project Risk and Drivers profile for a project/proposal is determined in accordance with the Smart Buyer Decision Making Framework and categories.
- The profile provided in the PES includes potential actions in response to key risk or drivers.
- Project risk profile reflecting residual risk.
- Potential actions can suggest particular strategies and/or inform implementation plans.
Examples: Factors that Shape Strategies

- Factors that shape strategies include but are not limited to:
  - Risk and Driver profile (including extent of risk mitigation activities).
  - Acquisition and support budget limitations.
  - Competitive environment and leverage for Commonwealth.
  - Reduced Defence workforce.
  - Planned Withdrawal Date (PWD) of current assets.
  - Costs of tendering for industry and Commonwealth.
  - Extant source selection outcomes for similar systems.
  - Australian industry participation.
  - Schedule certainty.

3. Acquisition Strategy

- The PES will include assessment of the advantages and disadvantages for each of the strategy alternatives considered.
- Examples of Acquisition Strategies include but are not limited to:
  - Fast to Contract drawing on Maximum (Open) Competition.
  - Early down-selection.
  - Staged Acquisition.
Case Study: ESM Acquisition Strategy

- **Procurement method:** Open and Limited Tender.
- **Approach to Market method:**
  - AWD used RFT.
  - SEA 1448 limited RFT.
- **Project Delivery Model:**
  - Prime System Integrator (PSI): Commonwealth.
  - System and Installation Contractors.
- **Contracting Template:**
  - ASDEFCON Complex (plus some elements (including DIDs) from Strategic Materiel).
  - No FMS needed in this case – commercial buy OK.

4. Sustainment Strategy

- **Examples of Sustainment Strategies** include but are not limited to:
  - In-house/Outsource Hybrid.
  - Maximum Outsourced Support Solution.
- **Areas of consideration for Sustainment Strategies** include but are not limited to:
  - cost and ability to support preparedness requirements;
  - necessary engineering support;
  - different levels of maintenance;
  - supply support (including stores and distribution); and
  - training support.
Case Study: Sustainment Strategy

- Prime support ‘agent’ was JEDS for all subsystem elements of the ES system.
- SAAB in-service support contractor for combat system elements of the ES system.
- Integration facility to support system development.
- Training: Train the trainer ie vendors trained Navy to deliver operator and maintainer training.
- Sparing and Maintenance: Contractor Managed Commonwealth Asset (CMCA) (eg warehouse) responsibility assigned to JEDS for sparing, repair and helpdesk etc.

5. Approvals Strategy

- Risk-Based Approach to Defence Investment Approvals Framework considers four categories of risk:
  - Finance.
  - Requirements.
  - Technical and Integration.
  - Industrial and Strategic.
- Example of Approval Strategy for simple project with no significant risks or decisions required from Government:
  - can proceed directly from Gate 0 to Gate 2; and
  - can be approved by Minister for Defence and Minister for Finance, rather than going to NSC.
Case Study: Approvals Strategy

- Common ES system for RAN – AWD, ANZAC, LHD, Subs.
- Under the CLC, SEA 1448 Phase 4A could have potentially had approval at Gate 0 to seek next approval to acquire at Gate 2.
- Government approval documented in Project Direction.

6. Project Management Strategy

- Project Management as integrating discipline address all FIC:
  - Delivery.
  - Coordination.
  - Integration
- Overview provides basis for IPMP and IMS.
- Key information gathering activities (including risk mitigation activities).
- Resources (including enabling budget for delivery groups).
- Governance bodies, roles and responsibilities.
- Schedule.
Case Study: PM for SEA1448 Ph4A

Factors to be considered:
- System development and production vendors and locations
- Access to platforms for integration.
- Multiple stakeholder engagement.
- IPMT composition eg structural, RF, SW integration expertise.
- IPM to manage significant Risk Reduction activities.

Case Study: PM for SEA1448 Ph4A

- Navy to:
  – provide x platforms on an agreed timeline;
  – provide y crews for training; and
  – other sea assets for test program eg other vessels to test ES system performance.
- DSTG to:
  – provide advice on the maturity of the technology by a certain date; and
  – help develop the test program and analyse the results.
- Airforce to provide test assets for sea trials.
- Joint Organisations (JEWOSU) to provide test libraries and operational libraries.
Integrated Project Management Plan (IPMP)

IPMP provides guidance for subordinate plans including:

- **Project Management** Planning Guidance.
- **Engineering Planning** Guidance (for Systems Engineering Management Plan (SEMP)).
- **Sustainment** Planning Guidance.
- **Commercial** Planning Guidance.
- **Acceptance into Operational Service** Planning Guidance.
- **Project Office Management**.
Case Study: SE considerations

- **Systems Engineering** implications:
  - Requirements for installation and use on different classes need to be defined and, where necessary, reconciled.
  - Analysis and integration of technical issues across different engineering disciplines eg physical mounting of antenna on mast, radio frequency (RF) interference with other emitters.
  - Integration with shipboard systems needs to be defined and planned eg power, combat system.
  - Integration has to be staged.

---

Case Study: SE considerations

Systems Engineering activities of V&V and T&E are critical to delivering a fully operational system:

- Multiple system development activities, integration and multiple stakeholders, so accurate, common and agreed documentation is essential.
- Clear adherence of solution to documented needs and requirements is essential:
  - *verified* against the documentation produced; and
  - *validated* against the original needs, goals and objectives.
- The T&E effort supporting V&V:
  - needs to be carefully planned and implemented; and
  - incremental approach building up ‘objective quality evidence’ that the subsystems, then system, meets requirements.
CLC and Capability Management Practices

Dr Mike Ryan & Dr Shari Soutberg

Business Case

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Program Strategy

Project = Sponsor’s Paper JCNS+PES

Proposal Artefacts

Portfolio

Program

Product

- OCD
- FPS 1
- FPS 2

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- JCNS
- JCN

Tender and Contract Documents

PGPA Act

CPRs

Smart Buyer

DPPM
CLC Business Case – Overview

- Clearly defines the gap or opportunity – bounding the problem.
- Describes how the option set for closing the gap, has been narrowed, including removal of infeasible solutions.
- Contains a preliminary assessment of the financial resources that the Investment Committee is prepared to commit in order to acquire and sustain the capability.
- CM develops the Gate 0 Business Case supported by the Delivery Group and manages its progression to the IC.

CLC Business Case – Overview

- Investment Proposal is a proposal to expend funds on a Project or Program. It is articulated by a Business Case consisting of a Submission, JCNS and a PES.
- Purpose of the Business Case is to provide a sufficient argument for the Investment Proposal and a strategy for its implementation.
- Business Case is the decision document presented at CLC gates, based upon the Five Case Model, with Strategic, Economic, Commercial, Financial and Management Cases.
- Business Case is presented at Gate 0 and presented with Submissions at Gates 1 and 2.
CLC Business Case

- "Business Case presents an argument which demonstrates that the benefits or outcomes are worth the commitment of the planned resources (funds, people, time)".
  - Defence CLC Seminar Feb 2017

- The Business Case details how capability options fit within both the Program and the Capability Stream.
- Highlights the strategic logic of options and risks to the Program and Capability Stream if capabilities are not developed.
- Ensures future requirements do not extend beyond strategic need.

Summary of Five ‘Cases’

- **Strategic Case**: Proposal aligns with strategic intent and priorities.
- **Economic Case**: Consideration of options and value proposition for the proposed investment is sound.
- **Financial Case**: Resourcing provisions are addressed.
- **Commercial Case**: Requirements, execution strategy including acquisition and sustainment strategy, risk.
- **Management Case**: Management arrangements.
Case Study: Business Cases

• Strategic Case:
  – Proposal aligns with strategic intent and priorities.
  – Contained in JCNS.

• Economic Case:
  – Options and value proposition for the proposed investment are sound.
  – Spend $10m to protect $1bn.
  – Need to be able to use the asset in the necessary environments ie can’t be constrained.
  – Standardised ES system across fleet so economies of scale for acquisitions, training, support.

Case Study: Business Cases

• Financial Case:
  – Resourcing provisions are addressed including:
  – costings defined:
    • estimates for risk reduction;
    • outcomes of risk reduction effort enabled better quotes (uncertainty increases costs);
    • estimates for acquisition and support; and
    • phasings and currencies defined.
  – workforce requirements and timings defined;
  – savings achieved by reducing support costs eg training, maintenance.
Case Study: Business Cases

**Commercial Case:**
- can leverage off other competitions (RFTs) and contracts to reduce cost of tendering; and
- installation through ANZAC Alliance using existing contracts with BAE (installation) and SAAB (combat system integration).

**Management Case:**
- Prime System Integrator – overarching manager.
- MEWSPO has expertise in EW so case for system SPO management argued.
- Defined engagement between AWD Project, ASMD Project and SEA 1448 Phase 4A through formal documented ‘Project Agreements’.

Proposal Artefacts

<table>
<thead>
<tr>
<th>What and Why</th>
<th>How</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defence White Paper</td>
<td>PGPA Act</td>
</tr>
<tr>
<td>Strategic Guidance</td>
<td>CRPs</td>
</tr>
<tr>
<td>Force Design</td>
<td>DIP</td>
</tr>
<tr>
<td>FOE, JCF, AJOC, EJOC Concepts</td>
<td>Smart Buyer</td>
</tr>
<tr>
<td>CPN (raised within Force Design via Program level direction)</td>
<td>DPPM</td>
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<tr>
<td>CPN</td>
<td>Program Strategy</td>
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<tr>
<td>JCNS</td>
<td>PES</td>
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<td>OCD</td>
<td>Project WBS</td>
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<td>FPS 1</td>
<td>IPS</td>
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<tr>
<td>FPS 2</td>
<td>IMS</td>
</tr>
<tr>
<td>Issued by JCA to the CM</td>
<td>Issued by JCA to the CM</td>
</tr>
</tbody>
</table>

Tender and Contract Documents
Gate 0 Business Case

- Gate 0 Business Case is presented to the Investment Committee by the Capability Manager to inform an investment decision and identifies a set of feasible and achievable options.
- The purpose of the Gate 0 Business Case is to provide a sufficient argument for the Investment Proposal and a strategy for its implementation.
- Level of detail in the Gate 0 Business Case is determined by the level of complexity of the proposal.

Gate 1 Submission

- Decision making at Gate 1 is based around the government submission.
- The Submission is prepared by CM and summarises the Business Case which:
  - focuses on the risk treatment activities that have taken place since Gate 0;
  - describes progress in reducing options;
  - defines the requirements statement; and
  - outlines the plan and risk mitigation activities to progress to Gate 2.
Gate 1 Submission

- The Business Case and Submission includes:
  - assessment of risk;
  - initial independently tested cost and schedule estimates;
  - TEMP; and
  - IPMP and stage plan to progress to Gate 2.

Gate 2 Submission

- Decision making at Gate 2 is based around a single Gate 2 Business Case, which forms the basis of the proposal to government for approval.
- The CM is responsible for producing the Gate 2 submission which is informed by the Business Case signed off jointly by the CM and the Delivery Group.
- The submission is reviewed by Contestability Division and any contestability advice on outstanding issues is embedded into the submission.
- The Business Case includes detail within which the IPMT is authorised to negotiate a contract post Gate 2.
Gate 2 Submission

The final submission and business case includes:

1. Residual risk and mitigation plans for that risk.
2. Confirmation that investment satisfies Defence policy and priorities, and is value for money.
3. Schedule, whole of life costing and approval limit.
4. Updated TEMP.
5. Analysis of preferred contractor and summary of intended contractual terms.

Better Business Case Framework
Better Business Case (BBC)

- Defence CLC Business Case development is based on the Better Business Case (BBC) framework as described on the NZ Treasury website (http://www.treasury.govt.nz).
- BBC is a systematic method which is used to develop business cases for programmes or projects.
- The benefits of BBC are that each of the key aspects of a robust investment proposal are explicitly and systematically addressed through five distinct cases.

Source: http://www.treasury.govt.nz/statesector/investmentmanagement/plan/bbc/framework

Better Business Case

- **Strategic Case** provides a compelling case for change and ensures a strategic fit and meets business needs.
- **Economic Case** demonstrates that the preferred option provides value for money.
- **Financial Case** confirms that the proposal is affordable within available funding.
- **Commercial Case** confirms that the proposal and its various elements are commercially viable.
- **Management Case** demonstrates that the proposal is achievable and can be successfully delivered.

Source: http://www.treasury.govt.nz/statesector/investmentmanagement/plan/bbc/framework
Better Business Case

The five Better Business Case components have been applied to the structure adopted for CLC Business Case:

• **Strategic Case:** Presents the argument that proposal aligns with strategic (capability and business) intent and is consistent with priorities. It includes the description of strategic risks, issues, and constraints relevant to the proposal. This case is satisfied by the JCNS.

• **Economic Case:** Presents the argument on the method, considerations, and rationale used to select the options. This case is also satisfied by the JCNS.

Source: Defence VCDF website

Better Business Case

• **Financial, Commercial and Management Cases** are addressed through:
  
  – Proposal of detailed risk-based tailored PES.
  
  – Proposal of resources needed timeframes and outcomes required to reach the next Gate. This aspect is also captured in the PES.

Source: Defence VCDF website
Strategic Case – JCNS

• Argument that proposal aligns with strategic (capability and business) intent and is consistent with priorities:
  – A short statement of decisions being sought from VCDF.
  – If Project is already in the IIP then the need is reconfirmed if there has been change to the strategic landscape, otherwise just restated.
  – Capability Need and the Investment Proposal is justified within context of Defence strategic landscape and identified Portfolio and Program priorities.
  – ...

Source: Defence VCDF website

Strategic Case – JCNS

• Argument that proposal aligns with strategic (capability and business) intent and is consistent with priorities:
  – ...
  – Scope of Capability Need is agreed in terms of capability objectives, outcomes, and requirements.
  – Proposal fits in with other relevant strategic ‘business’ intentions eg ICT roadmap.
  – Value Proposition: the overall Investment Proposal, as known at the time, represents value to Defence outcomes relative to other investments.

Source: Defence VCDF website
Strategic Case – JCNS

• Description of strategic risks, issues, and constraints relevant to the proposal:
  – Is the expected financial allocation to get to the next Gate affordable and consistent with Defence priorities (informed by Smart Buyer Risk Analysis, Joint Capability Needs Statement and Program Strategy).
  – Consistent with due-diligence obligations identify risks, issues and opportunities for the overall proposal.
  – Constraints that will impact option selection and implementation e.g. enablers, resources.
  – Dependencies and potential impacts on other parts of Defence, industry etc.
  – Stakeholders are identified and key interests understood.

Source: Defence VCDF website

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Economic Case – JCNS

• Presents the argument on the method, considerations, and rationale used to select the options:
  – Critical Success Factors which have been used to evaluate the options including key factors.
  – Value proposition of each option (value for money if information available).
  – Supplier capacity and capability (market analysis).
  – Potential affordability and achievability.
  – For a direct to Gate 2 proposal, the options considered, the short-listing, and rationale for the preferred option/s. The Value Proposition of each option is described.
  – Where options require further development the argument is presented here for a Gate 1 decision.

Source: Defence VCDF website
Financial, Commercial, Mgt Cases – PES

• Proposal of detailed risk-based tailored PES based on Smart Buyer Framework for preferred option/s:
  – Tailored approval Pathway for Gates, decision delegations, time-bounding and plan (to next Gate).
  – Tailored Acquisition and Sustainment Strategy including Industry Engagement and solicitation method.
  – Risk Reduction activities that address program and project risks consistent with the IC’s risk appetite.
  – …

Source: Defence VCDF website

Financial, Commercial, Mgt Cases – PES

• Proposal of detailed risk-based tailored PES based on Smart Buyer Framework for preferred option/s:
  – …
  – Sufficient documentation (tailored Information requirements).
  – Cost and Schedule estimates (broad for overall investment and accurate for work to next Gate).
  – Project execution workforce.
  – Management of Project/Program dependencies.
  – Governance and Assurance approach.

Source: Defence VCDF website
Financial, Commercial, Mgt Cases – PES

Proposal of resources needed, timeframes and outcomes required to reach the next Gate:

• Resources required to reach the next Gate based on the PES are justified and available for implementation including cost of risk reduction activities and all other project costs to reach the next Gate.

• Agreement to schedule to next Gate.

• Project delivery Workforce.

• Specific information needed for decisions on proposal including: Guidance from VCDF on escalation criteria and thresholds for return to IC.

Source: Defence VCDF website

Integrated Project Management Plan (IPMP)
Integrated Project Management Plan

- The IPMP is the detailed plan to introduce the capability into service.
- The IPMP evolves into an Integrated Product Management Plan as the capability approaches introduction into service and transitions into product management under the appropriate Program.


IPMP – Key Points

- Details activities and resources needed to satisfy the selected strategy documented in the PES.
- Demonstrates that the selected strategy described can be implemented within budget, schedule, quality and risk.
- Provides the basis for subordinate plans eg Systems Engineering Management Plan (SEMP).
- Includes the Integrated Master Schedule (IMS).

Source: IPMP Guide
IPMP – Key Points

- High-level definition of products, activities (including sequencing and dependencies) and resources needed to implement the PES.
- Used as a common reference (enabling shared understanding and coordinated realisation) by:
  - Sponsor.
  - FIC Providers.
  - CASG Line Management.
  - Project Office staff.
- Demonstrates the feasibility of the selected strategy ie:
  - can be implemented within budget, schedule, quality (incl scope) constraints; and
  - the risks are manageable and acceptable.

Source: IPMP Guide

IPMP – Key Points

- Basis for coordinated realisation of the capability identifying deliverables, schedule, dependencies and risks.
- Defines the major management control/decision points (i.e. stages) within the project.
- Defines major products and outcomes within each stage and activities and resources required to produce them at an acceptable level of risk.

Source: IPMP Guide
IPMP – Key Points

- Sufficient detail to enable management and be easily understood by key stakeholders:
  - understand each of the products required (including intermediate products);
  - the dependencies between FIC elements and between FIC providers;
  - who is to provide each product;
  - when and where each product is to be provided; and
  - the quality attributes of each product.

- Includes the IMS which is the highest level definition of schedule detailing activity timings, dependencies, and necessary resources.

Source: IPMP Guide

FIC Integration as Part of the IPMP

- Coordination and integration of FIC elements ensures a seamless transition into service of the capability and achieve IOC and FOC on time and on budget.
- Dependencies between FIC activities and deliverables become milestones in the IPMP and IMS against which each FIC provider can report progress.

Source: IPMP Guide
**FIC Providers as Part of the IPT**

- The FIC provider’s role is to cooperatively participate in the IPT for the joint planning and realisation of the capability in accordance with the Project Directive.
- FIC Providers are expected to:
  - Manage their respective tasks, milestone achievement, financial expenditure, contracting and procurement under their respective management and business processes.
  - Regularly status their work and provide the IPM and Sponsor early warning of any issues including proposed corrective actions.
  - Use an escalation process to the appropriate steering group for issues that exceed the level of experience or authority of the IPM or FIC provider.

Source: IPMP Guide

**Integrated Project Manager (IPM)**

- The IPM is expected to:
  - Work with FIC providers to identify FIC element deliverables for the project (i.e. what, where and when).
  - Identify dependencies among FIC elements (e.g. flowdown of requirements).
  - Gain the commitment of each FIC Element provider to deliverables and timeframes for which they are responsible.
  - ...

Source: IPMP Guide
Integrated Project Manager (IPM)

- The IPM is expected to:
  - ...  
  - Meet regularly with all FIC providers and required enablers in the spirit of open and collaborative communications to consider integration risks and issues.
  - Continually assess the impact of baseline milestone movements on the project’s IOC and FOC milestones for all FIC providers.
  - Escalate issues to the Sponsor or Steering Group as appropriate.

Source: IPMP Guide

Integrated Project Team (IPT)

- The IPT coordinates the FIC elements required to realise the capability.
- Following Gate 0 approval, Projects may be overseen by a Capability Program Steering Group (CPSG) which enables joint consideration and decision-making of FIC.
- An IPM designate and minimum support resources (eg commercial manager and engineering resources) can be appointed prior to Gate 0 to support Gate 0 documentation.
- IPT is to be established including Program and Project Sponsor, Integrated Project Manager (IPM) and FIC representatives in accordance with governance model.

Source: IPMP Guide
IPMP Structure

Section 1. Project Summary
Section 2. IPMP Authority
Section 3. IPMP Maintenance
Section 4. Project Execution Strategy Summary
Section 5. Project Management Approach

...
Section 1. Project Summary

- IIP Value
- Project Staffing
- Schedule Summary
  - Gate 0
  - Gate 1
  - Gate 2
  - Prime Contract Effective Date
  - Initial Operating Capability (IOC)
  - Final Operating Capability (FOC)
- Capability Manager, Program Sponsor, Program Manager, Project Sponsor, User Representatives, Delivery Group.

Source: IPMP Template

Section 2. IPMP Authority

- Identify authority of PES ie when PES approved, relevant Gate etc.
- Confirm traceability of IPMP to the strategies identified in the PES and the need to maintain control over this relationship including approval and management arrangement of deviation.
- Identify FIC providers and key responsibilities.
- Identify consultation in development of this plan.

Source: IPMP Template
Section 3. IPMP Maintenance

- Identify the revision expectations for the IPMP eg following key milestones eg following solicitation outcomes

Source: IPMP Template

Section 4. PES Summary

- **Scope**
- **FIC** summarise the FIC elements, capability baselines and broad responsibilities to be coordinated to realise the capability.
- **Major Factors** factors influencing the PES and the PM approach:
  - Acquisition Strategy.
  - Sustainment Strategy.
  - Transition to Sustainment.
  - Acceptance into Service.
  - Closure.

Source: IPMP Template
Section 5. Project Management Approach

5.1 Governance
5.2 Assurance
5.3 Major Activities
5.4 Budget
5.5 Coordination and Control
5.6 Stakeholders
5.7 Engineering Approach
5.8 Sustainment Approach
5.9 Commercial Approach
5.10 Project Office Management

Source: IPMP Template

Annex A: PM Planning Guidance

A.1 Project Governance
A.2 Project Assurance
A.3 Stage / Detailed Planning
A.4 Project Work Breakdown Structure
A.5 Integrated Master Schedule
A.6 Integrated Project Team
A.7 Battle Rhythm
A.8 Risk and Contingency Management
A.9 Issue Management
A.10 Stakeholder Management
A.11 Transition to Sustainment
A.12 Acceptance into Operational Service
A.13 Project Closure

Source: IPMP Template
Annex B: Engineering Planning Guidance

- Consult with the CASG Engineering and Technical COE to define an engineering approach appropriate for the Project.
- Areas to be defined:
  - B.1 Technical Objectives
  - B.2 Engineering Organisation and Responsibilities
  - B.3 Technical Risks and Mitigations
  - B.4 Technical Activities

Source: IPMP Template

Annex C: Sustainment Planning Guidance

- Consult with the CASG Materiel Logistics COE to define a sustainment approach appropriate for the Project.
- Areas to be defined:
  - C.1 Sustainment Objectives.
  - C.2 Sustainment Organisation and Responsibilities.
  - C.3 Sustainment Risks and Mitigations.
  - C.4 Sustainment Activities.

Source: IPMP Template
Annex D: Commercial Planning Guidance

- Consult with the CASG COE to define a commercial approach appropriate for the Project.
- Areas to be defined:
  - D.1 Commercial Objectives.
  - D.2 Commercial Organisation and Responsibilities.
  - D.3 Commercial Risks and Mitigations.
  - D.4 Commercial Activities.

Source: IPMP Template

Annex E: Acceptance into Operational Service Planning Guidance

- This Annex should be prepared in close consultation with, or by, the CM Representatives and Sponsor.
- Areas to be defined:
  - E.1 Capability Baselines.
  - E.2 Basis of Provisioning
  - E.3 Facility and Training Area Needs

Source: IPMP Template
Annex F: Project Office Management

- Consult with the CASG Program Management COE to define a project office management approach appropriate for the Project.

- Areas to be defined:
  - F.1 Organisation
  - F.2 Roles and Responsibilities
  - F.3 Decision Making Processes
  - F.4 Configuration and Data Management
  - F.5 Quality Management
  - F.6 Security
  - F.7 Work Health & Safety and Environment Management

Source: IPMP Template
Needs and Requirements Artefacts

What and Why

- Defence White Paper
- Strategic Guidance
- Force Design
- FP 1
- FP 2
- OCD
- Project Strategy
- Project WBS
- Tender and Contract Documents

How

- PGPA Act
- CPRs
- DIP
- Smart Buyer
- DPPM
- Issued by JCA to the CM

Capability Definition Documents (CDD)

- The **Operational Concept Document (OCD)** is the capstone document that captures the scope of, and intent for, the proposed Capability.
- The **Function and Performance Specification (FPS)** specifies the formal requirements for the Materiel System and provides the basis for design and qualification testing of the system.
- The **T&E Master Plan (TEMP)** considers T&E requirements within the life-cycle management of the Capability System. The TEMP is elaborated further by the contractor in the V&V Plan.
CLC Needs and Requirements Hierarchy

Program 1
- Program Strategy
- Program Integrating Operational Concept (PIOC)

Project 1
- JCNS 1
- IPMP
- OCD
- FPS
- TEMP

Project 2
- JCNS 2
- IPMP
- OCD
- FPS
- TEMP

Product 3
- JCNS 3
- IPMP
- OCD
- FPS
- TEMP

Program Level Supports Sufficiency Goal

Program 1
- Program Strategy
- Program Integrating Operational Concept (PIOC)

Project 1
- JCNS 1
- IPMP
- OCD
- FPS
- TEMP

Project 2
- JCNS 2
- IPMP
- OCD
- FPS
- TEMP

Product 3
- JCNS 3
- IPMP
- OCD
- FPS
- TEMP

Requirements development practices using Program-level needs and requirements information supports FPR and CLC expectations of sufficiency through use of common references and re-use.
Needs and Requirements Re-use

Program Integrating Operational Concept (PIOC)

Sections 1-4

Sections 5-6

OCD

FPS

TEMP

Re-use

Re-use

Re-use

Needs and Requirements Re-use

Needs and Requirements developed specifically for Project

Transformation of Operational Needs

Warfighter Domain
Well Understood by Warfighters

Operational Needs

Transformation

OCD
Understood by all parties

Specification

documented in FPS

Implementation Domain
Well Understood by Acquirers & Developers

Specifications

T&E expectations
documented in TCD

Transformation
documented in OCD
CLC and Capability Management Practices

Dr Mike Ryan & Dr Shari Soutberg

OCD, FPS, TEMP Relationship

Needs Hierarchy
- Mission
- Level 1
- Level 2
- Level 3

Measures Hierarchy
- CI
- COI
- MOE
- MOP
- TPM

Prepared by Stakeholders (CM)

OCD, FPS, TEMP Relationship

Needs Hierarchy
- Mission
- Level 1
- Level 2
- Level 3
- Level 4
- Level n

Measures Hierarchy
- CI
- COI
- MOE
- MOP
- TPM

Augmented/prepared by Acquirer (CASG)
OCD, FPS, TEMP Relationship

Needs Hierarchy

- Mission
- Level 1
  - Level 2
    - Level 3
      - Level 4
        - Level n

Measures Hierarchy

- CI
  - COI
  - MOE
  - MOP
  - TPM

OCD
- Communicates the solution-independent needs of the warfighter to all stakeholders, including acquirers and developers, in a language that all parties can understand.
- Describes capability from an operational perspective.
- Facilitates an understanding of the overall system goals for the materiel system.
- Details missions and scenarios associated with operations and support of the Materiel System.
- Provides a reference for determining ‘fitness for purpose’.
- Provides a justifiable basis for the formal requirements for the Materiel System, as captured in the FPS.
- Details the FIC needed to realise the Capability System in operational service.
OCD Template

0. EXECUTIVE SUMMARY
  0.1 Identification and Justification
  0.2 Key Boundary Issues
  0.3 Project Schedule
  0.4 Capability System Mission and Critical Operational Issues
  0.5 Existing Capability Description
  0.6 Materiel System Solution-class
  0.7 Fundamental Inputs to Capability

1. SCOPE
  1.1 Capability Identification
  1.2 Document Purpose & Intended Audience
  1.3 Justification for Capability
  1.4 System Boundary and Acquisition Assumptions
  1.5 Key Timeframes for Capability

2. DEFINITIONS AND REFERENCED DOCUMENTS
  2.1 Referenced Documents
  2.2 Glossary of Terms

3. SOLUTION-DEPENDENT CAPABILITY NEEDS
  3.1 Mission Overview
  3.2 Operational Policies and Doctrine
  3.3 Capability System End-user classes
  3.4 Summary of Operational Scenarios
  3.4.1 Common Scenario Attributes
  3.4.2 Scenario 1 - Scenario Title
  3.4.2.1 Summary of Situation
  3.4.2.2 Summary of Military Response
  3.4.2.3 Summary of Operational Needs
  3.4.3 Scenario 2 - Scenario Title
  3.4.4 Scenario N - Scenario Title
  3.5 Summary of Consolidated Operational Needs
  3.6 Solution-class-Independent Constraints

4. EXISTING SYSTEM
  4.1 Existing System Overview
  4.2 Existing System Operational Capability Comparison
  4.3 Existing System Internal Shortcomings
  4.4 Existing System Planned or Active Upgrades
  4.5 Existing System Internal User classes
  4.6 Existing System Internal Functionality
  4.7 Summary of Existing System Internal Scenarios

5. SYSTEM SOLUTION-CLASS DESCRIPTION
  5.1 Materiel System Description
  5.2 Mission System Architecture
  5.3 Materiel System Interfaces
  5.4 Materiel System Internal User classes
  5.5 Materiel System Functionality and Performance
  5.6 Materiel System Support Concepts and Requirements
  5.7 Materiel System Constraints
  5.8 Materiel System Evolution and Technology Forecast
  5.9 Summary of Materiel System Internal Scenarios
  5.9.1 Internal Scenario 1 - ‘A Typical Day’s Operation’
  5.9.1.1 Summary of Situation
  5.9.1.2 Summary of Process Flows and Interactions
  5.9.1.3 Summary of Materiel System Requirements
  5.9.2 Internal Scenario 2 - Scenario Title
  5.9.3 Internal Scenario N - Scenario Title
OCD Template

6. CONSOLIDATED FUNDAMENTAL INPUTS TO CAPABILITY (FIC) REQUIREMENTS
6.1 FIC Related Guidance
6.2 Major Systems FIC Element Requirements
6.3 Facilities and Training Areas FIC Element Requirements
6.4 Support FIC Element Requirements
6.5 Supplies FIC Element Requirements
6.6 Organisation FIC Element Requirements
6.7 Command and Management FIC Element Requirements
6.8 Personnel FIC Element Requirements
6.9 Collective Training FIC Element Requirements
6.10 Industry FIC Elements Requirements
6.11 FIC Impacts on Supporting Capabilities
6.12 Summary of Overall FIC Responsibilities
6.13 FIC Development Forecast

A. ANNEX A - EXTERNAL SCENARIOS
A.1 Capability System Operational Scenarios
A.1.1 Common Scenario Attributes
A.1.2 Scenario 1 - Scenario Title
A.1.2.1 Scenario 1 - Situation Requiring ADF Action
A.1.2.2 Scenario 1 - Military Response
A.1.2.3 Scenario 1 - Operational Needs
A.1.3 Operational Scenario 2 - Scenario Title
A.1.4 Operational Scenario N - Scenario Title
A.2 Consolidated Operational Needs

B. ANNEX B - EXISTING SYSTEM INTERNAL SCENARIOS
B.1 Internal Scenario 1 - 'A Typical Day’s Operation'
B.1.1 Internal Scenario 1 - Situation
B.1.2 Internal Scenario 1 - Details of Process Flows and Interactions
B.1.3 Internal Scenario 1 - Identified Shortcomings
B.2 Internal Scenario 2 - Scenario Title
B.3 Internal Scenario N - Scenario Title

C. ANNEX C - MATERIEL SYSTEM INTERNAL SCENARIOS
C.1 Internal Scenario 1 - 'A Typical Day’s Operation'
C.1.1 Internal Scenario 1 - Situation
C.1.2 Internal Scenario 1 - Details of Process Flows and Interactions
C.1.3 Internal Scenario 1 - Materiel System Requirements
C.2 Internal Scenario 2 - Scenario Title
C.3 Internal Scenario N - Scenario Title
C.4 Consolidated Materiel System Functionality and Performance
FPS

- Specifies formal requirements for the Materiel System.
- Provides the basis for design and qualification testing of the system.
- Provides the vehicle for the capture of formal, verifiable and unambiguous requirements, ‘distilled’ from the OCD.
- Is intentionally written using formal language, with all requirements in the FPS traceable to needs in the OCD.
- Addresses the total Materiel System, but will later be developed into a Mission System specification and a Support System specification, usually by a prime contractor or prime system integrator.
- FPS requirements may also need to be decomposed and/or allocated for the purposes of individual acquisition contracts.

FPS Template

Section 1 – Scope
1.1 – Identification
1.2 – System Overview
1.3 – Document Overview

Section 2 – Applicable Documents

Section 3 – Requirements
3.1 – Missions
3.2 – System Boundaries and Context
3.3 – Required States and Modes
3.4 – System Capability Requirements
3.5 – Availability
3.6 – Reliability
3.7 – Maintainability
3.8 – Deployability
3.9 – Transportability
3.10 – Environmental Conditions
3.11 – Electromagnetic Radiation
3.12 – Architecture, Growth and Expansion
3.13 – Safety
3.14 – Environmental Impact Requirements
3.15 – Useability and Human Factors
3.16 – Security and Privacy
3.17 – Adaptation Requirements
3.18 – Design and Implementation Constraints
3.19 – System Interface Requirements

Section 4 – Precedence and Criticality of Requirements

Section 5 – Verification

Section 6 – Requirements Traceability

Section 7 – Notes
SECTION I - SYSTEM DESCRIPTION
1.1 Mission Description
1.1.1 Operational Need
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CDD Guide v2.2
Develop OCD, FPS, and TEMP

1. Define Capability System context and background
2. Define Capability System needs (independent of Solution class)
3. Describe relevant existing system capability
4. Define Material System & FIC requirements (dependent on Solution class)
5. Maintain OCD, FPS & TEMP over life of Capability System

CDD Guide v2.0
OCD Section

Develop OCD, FPS, and TEMP

OCD Section
1 to 3
4
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1. Define Capability System context and background
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What do we need?
What do we have?
What can we do?
Is everything still OK?
Define CS Context and Background

Define Capability System Needs
Describe Existing System Capability

Define Materiel System Requirements
CLC and Capability Management Practices

Dr Mike Ryan & Dr Shari Soutberg

Selected Important Activities

1.2 Identify Stakeholders

- Identify Capability
- Identify Stakeholders
- Identify operational and functional objectives
- Identify key stakeholders, e.g., Capability Owners
- Identify System Boundaries, e.g., independent
- Identify Mission Class, e.g., minor
- Identify mission critical/essential
documentation
- Identify internal/external
- Identify Capabilities
- Identify classic:
- Establish and maintain Glossary and list of Referenced Documents
- Selected Important Activities
1.2 Identify Stakeholders

- Strictly speaking a stakeholder could be defined as someone who has a stake in the project—that is, someone who is affected by the system in some way, or can affect the system in some way.

- More usefully, a stakeholder is defined as someone (or some organisation) who has a right to influence the outcome of the system, rather than someone who is simply affected by the system.

Even our better definition does not assist us to identify our stakeholders automatically. If a stakeholder has a right to influence the requirements, we need to identify what or who gives them that right. Even then, we need to examine candidate stakeholders more carefully. For example:

- Do all stakeholders have equal rights?
- If not, who decides which have higher priority?
- What do we do if stakeholders do not agree?
- If a group of people is considered to be a stakeholder, do they all have a voice, or is a spokesperson to be elected/nominated?
- How do we discount requirements collected from a stakeholder who is clearly confused and whose contributions are unenlightening?
1.4 Identify CS Boundaries

Context Diagrams

- To assist with bounding the system, a tool called a context diagram may be used to illustrate the related systems, relevant regulatory environments, stakeholders, external systems, interfaces, and so on.
- Different systems may of course have significantly different context diagrams.
This is NOT a Context Diagram

How does this system fit in with the rest of the world?

- System Under Consideration
- Power entry panel
- Power point
- Power Distribution Subsystem
- Intruder
- Resident
- Monitoring system
- PSTN
- Police
- Neighbours
- Environment
- House System
- Alarm System
Consider External Interfaces

- Interfaces with existing or future external systems must also be defined as these will place considerable requirements on the system under development.

- While these external systems are not directly related to the system, the success of the fielded system is often determined by its ability to interface to its external environment.

- For example, while it is possible to build a perfectly functional aircraft without consideration of air traffic control regulations, the aircraft would be useless because it would not be allowed to operate.

Consider External Interfaces

- The definition of an interface requires considerably more detail than simply identifying and naming the interface. Broadly there are three main steps in interface definition:
  - **Interface Description.** The interface is given a name, short title and identifier. The nature of the interface is described in terms of who, what, when, where, why, how.
  - **Interface Impact Analysis.** The interface is analysed in terms of its impact on the system. In particular, any constraints imposed by the system are identified. A risk analysis is conducted to determine the impact of the interface on the operation and design of the system.
  - **Interface Control Analysis.** Each external interface must be analysed to determine the extent to which it can be controlled so that designers and operators of the system are not at the mercy of its external interfaces.
Consider External Interfaces

• Once it has been defined, each interface has to be documented and managed. Interface management is very important because systems (and the projects that deliver them, for that matter) often live or die by their interfaces. This is even more evident in modern systems where the sheer number of interfaces and their complexity are a significant source of risk in system development.

• The definition of a system’s external interfaces assists in defining the system’s scope—interface management is therefore an important part of the scope management activities undertaken by the project manager. It is highly likely that the scope of a system would be affected should there be a change to any aspect of a system’s external interfaces throughout its development.
1.6 Identify Mission Objectives

- Identify Capability
- Identify System (solution-class-independent)
- Identify Stakeholders
- Identify Capability Rationale
- Identify Capability System Boundaries
- Identify Key Timeframes

- Identify Primary and Secondary Mission Objectives
- Identify Operational Policies and Doctrine

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Identify Mission (and Operational Needs)

- Because the user has most probably stated the mission for the system in a fairly general way, every project should begin with a concise statement of the mission, elaborated by statements of the system-level needs.

- The mission statement is then expanded and qualified by short declarative statements of the system operational needs (best expressed in a functional hierarchy).

- Level 1 Operational Needs are normally relatively broad, each of which spawns a number of more-specific Level 2 Operational Needs, each of which spawns a number of more-specific Level 3 Operational Needs, and so on.

- Level 3 or 4 is sufficient for the OCD—lower level needs spawn system requirements in the FPS (and subsequently in the SS and then the SSS).
Secondary Missions

- Secondary mission objectives can be considered on the assumption that the Capability System will eventually be in place. These secondary objectives take advantage of the existence of this Capability System, given that, without it, they would have to be satisfied in another way.

- For example, an air-to-air refueller platform may have a secondary mission objective as a communications relay. If the refuelling role did not exist, the communications-relay capability may be achieved by some other means, such as a suitably equipped unmanned aerial vehicle.

1.7 Identify Policies and Doctrine
1.7 Identify Policies and Doctrine

- Identify operational and policies such as:
  - international treaties;
  - agreements regarding operation in international waters or airspace;
  - compliance with environmental, heritage, and land rights legislation;
  - compliance with spectrum management regulations;
  - doctrine relating to the primary and secondary missions; and
  - interoperability requirements, which may be considered here, but are usually considered as part of the derivation of the operational needs and solution-class requirements.

- We discuss these in more detail later as enterprise constraints.

18 Glossary and Referenced Documents
1.8 Glossary and Referenced Documents

- The aim of this step is to initially create and then maintain a glossary of defined terms and acronyms, and a list of referenced documents. The set of terms used in each of the OCD, FPS and TEMP may not always overlap, but wherever common terms and documents are referenced, the terminology and references should be the same.

- A project-wide integrated dictionary should be established, consisting of both a glossary of terms and acronyms and a list of referenced documents. A filtered set of this dictionary should be incorporated into the OCD and other CDD, as applicable.
2.1 Identify all End-user Classes

- The aim of this step is to identify all the End-user classes (End-users that has a common set of needs) in conjunction with establishing the scenarios for the Capability System.

- This step is typically iterative because the identification of an End-user class may require additional operational scenarios (next step) in which they appear, and vice-versa.

- The set of End-user classes should identify the people who are external to the 'black box' Capability System and who are the End-users of the system products or capabilities.

- The roles and needs of people inside the Capability System (Internal Users), such as operators, maintainers and trainers, is addressed later (in Section 5.4), during preparation of the internal, solution-class-dependent description.
2.2 Select Operational Scenarios

- Once the mission and high-level operational needs have been articulated, the top-down process is continued through an examination of the range of operational scenarios that the stakeholders propose for the system.

- The examination begins with a description of the general operational environment for the system to identify all of the environmental factors that may have an effect on the operation of the system.

- Specific operational scenarios are then described in users’ language to depict the full range of circumstances under which the system is required to operate.

- It is not necessary to describe every possible scenario, but all types of operation must be represented. Scenarios also need to represent all stakeholder perspectives.
2.2 Select Operational Scenarios

• These scenarios, or use cases, provide valuable guidance to the system designers and form the basis of major events in the Acquisition Phase such as acceptance testing of the system as it is introduced into service.

• Despite any more detailed technical verification and validation procedures, the system’s fitness for purpose is fundamentally related to its ability to perform in accordance with the operational scenarios defined at this stage.

• In many cases it is also useful to define the various modes of operation for the system products under development. Designers need to understand if the system is to exist in a number of different modes even if it is as simple as the difference between the fully operational mode or the training mode.

2.2 Select Operational Scenarios

• Complex systems may have their requirements stated in a number of modes. For example, a modern fighter aircraft may have modes defined for air-to-air combat, ground attack, reconnaissance, naval operations, non-tactical flights, and so on. Each mode must be associated with the particular conditions (mission, operational, environmental, configurational, and so on) that define it.

• In our aircraft example, a number of modes may be defined for international and domestic operation including taxi, take-off, cruise, approach, landing, turn-around, and so on. Modes may also be defined for maintenance and for administrative movement of the aircraft.
2.2 Select Operational Scenarios

- Users tend to think in terms of the systems operation to suit their purposes—care has to be taken to define exception conditions.

- For example, a pilot of a combat aircraft will naturally describe a number of modes and states during which adversary aircraft are engaged and destroyed, but will need some prompting to describe what happens when the pilot’s aircraft is hit and the pilot must eject.

- At every stage in each scenario, we must ask the question “What could go wrong here?”

DefineCapabilitySystemConstraints
Project and Enterprise Constraints

• Before focusing on the detail of the desired system, it is essential to identify the project and enterprise constraints that are relevant to the system and its acquisition. This analysis provides essential information about the development environment for the system and begins the top-down approach to system development.

• Enterprise constraints include any organizational policies, procedures, standards or guidelines that guide system development and procurement. These constraints can include partnering relationships with other companies, contracting policies and so on.

Project and Enterprise Constraints

• Project constraints include the resource allocations to the project as well as any externally imposed deliverables and acquisition timeframes.

• Many companies have enterprise-wide standards for processes such as quality assurance and systems engineering and these methodologies guide the manner in which projects can operate.

• Additionally, the enterprise may require the project to report progress in a particular way or to implement particular metrics, tools and documentation procedures.
Identify External Constraints

• In addition to enterprise-imposed constraints, there are wider external constraints on system development that arise from the requirement for conformance to national and international laws and regulations, compliance with industry-wide standards, as well as ethical and legal considerations.

• Other external constraints include the requirement for interoperability and the capabilities required for interfacing to other systems.

• Again, an important aspect of top-down design is to understand these constraints before considering lower-level system requirements.

Identify External Constraints

• External constraints could include:
  – Business environment. The system will no doubt be affected by changes in the broader business and economic environment, particularly those related to cost, pricing, availability, and licensing.
  – Conformance to laws and regulations. Conformance to laws is binding within a national or international legal construct; regulations are normally provided by governing bodies within the application domain of the development.
  – Compliance with standards. Industry standards provide similar constraints to laws and regulations, except that compliance with any particular standard may be at the discretion of the developer, unless the standard is mandated by the enterprise or by the contract.
Identify External Constraints

• External constraints could include:
  – ...
  – Ethical considerations and social responsibility. System developers have a moral and ethical responsibility to the owners and users of the system, as well as to the community.
  – Interoperability and or interfacing requirements. Since it is rare that a system would stand alone, interoperability and interface considerations must be taken into account during development.
  – Operating environment. The system will have to exist within an operational environment that will provide constraints in terms of temperature, humidity, and radiation as well as robustness to shock.

Identify Design Constraints

• Design constraints include those factors that directly affect the way in which the system design can be conducted. Of course, a number of enterprise, project and external constraints (such as budgets, regulations, and standards) will flow down and be inherited as design constraints.

• Typical design constraints include the state-of-the-art of relevant technologies, the skill sets of available engineers and tradespersons, as well as extant methodologies and tools to assist in the design, development, construction, and production of the system.

• Additionally, bounds such as all-up weight may be a design constraint for an aircraft system if it is to land on certain classes of airfield.
Overview of CLC Artefact Development

- Artefacts are developed over the CLC to perform a number of functions:
  - Recording evidence and decisions.
  - Supports considered analysis and records rationale.
  - Allows demonstration of traceability.
  - Supporting risk reduction.
  - Establishes authority and certainty.
  - Provides continuity of position, expectations, and agreed outcomes.
  - Bounds the scope and enabling parameters.
CLC and Capability Management Practices

Dr Mike Ryan & Dr Shari Soutberg

Information Development over CLC

<table>
<thead>
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<th>Gate 0</th>
<th>Gate 1</th>
<th>Gate 2</th>
<th>AIOS</th>
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<td>• Capability Need</td>
<td>Business Case</td>
<td>Business Case</td>
<td>Business Case</td>
<td>Acceptance Case</td>
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<tr>
<td>• Strategy (tailored)</td>
<td>Risk Reduction Activities</td>
<td>Risk Reduction Activities</td>
<td>Risk Reduction Activities</td>
<td>Acquisition activities</td>
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<tr>
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<tr>
<td>• Controllability</td>
<td>• Options</td>
<td>• Early analysis of solution space</td>
<td>• Risk Reduction Studies (technical risk)</td>
<td></td>
</tr>
</tbody>
</table>

- Sufficient Definition to:
  a. identify solution class options for further risk reduction
  b. meet risk appetite
  c. Refine Business Case and inform decision points to Gate 0

- Sufficient Definition to:
  a. refine options for further risk reduction post Gate 1
  b. meet risk appetite
  c. Refine Business Case and inform decision points to Gate 1

- Sufficient Definition to:
  a. understand risks (eg platform survey, initial design, T&Cs)
  b. Down-select (with competitive tension) between solutions/vendors
  c. meet risk appetite
  d. Refine Business Case and inform decision points to Gate 2

- Sufficient Definition to:
  a. achieve acceptance of CS (whole FIC)
  b. enable sustainment
  c. meet risk appetite

Sustainment activities

- Sufficient Definition to:
  a. negotiate and enter contracts
  b. demonstrate achievement of contracts at completion
  c. meet risk appetite
  d. Develop Acceptance Case at AIOS
  e. Ensure adherence to government direction and inform assurance points

- Sufficient Definition to:
  a. achieve acceptance of CS (whole FIC)
  b. enable sustainment
  c. meet risk appetite

Sufficient Definition to:

- Gate 0
- Gate 1
- Gate 2
- AIOS

Risk Reduction Activities

Requirement

Options

Strategy

Resourcing

Risks

Value Proposition already established or partly Proposal as part of Portfolio and Program

Force Design

Early analysis of solution space

Reducing Uncertainty

CLC and Capability Management Practices

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