Capability Life Cycle (CLC) Management

Dr Mike Ryan
&
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Your Presenters

Associate Professor Mike Ryan is the Director of the UNSW Capability System Centre. He holds BE, MEngSc and PhD degrees in electrical engineering from the University of New South Wales. He is a Fellow of Engineers Australia (FIEAust), a Chartered Professional Engineer (CPEng) in three colleges (electrical, ITEE and systems engineering), a Senior Member of IEEE (SMIEEE), a Fellow of the International Council on Systems Engineering (INCOSE), and a Fellow of the Institute of Managers and Leaders (FIML). Since 1981, he has held a number of positions in communications and systems engineering and in management and project management. Since 1998, he has been with the School of Engineering and Information Technology, University of New South Wales, Canberra where he is currently the Director of the Capability Systems Centre. His research and teaching interests are in communications and information systems, requirements engineering, systems engineering, project management, and technology management. He is the Editor-in-Chief of an international journal, and is the Co-Chair of the Requirements Working Group INCOSE. He is the author or co-author of twelve books, three book chapters, and over 250 technical papers and reports. (m.ryan@adfa.edu.au)

Dr Shari Soutberg has over 30 years experience in Defence, with a focus on materiel acquisition, sustainment, organisational improvement and reform. Shari is currently an Industry Fellow at the UNSW Capability System Centre. Significant activities include development of a framework for delivery of joint force outcomes and training courses on capability development practices applicable to Defence. Prior to this, Shari was the acting Chief Systems Engineer for CASG and a member of the First Principles Review (FPR) Capability Lifecycle (CLC) team which developed capability management reform initiatives. As Director Systems Engineering and later Director Materiel Engineering in CASG, Shari led the development and implementation of Defence engineering policy and guidance, including fundamental changes arising from the WHS Act 2011. Shari provided stewardship of the Defence Engineering and Technical Job Family through establishing learning and development structures. She also supported Defence corporate engineering and technical workforce planning including industrial relations engagement. Whilst in the Office of the Parliamentary Secretary for Defence Industry, Shari was a significant contributor to the Defence Industry Policy leading to the role of Director Industry Policy. After joining the Department of Defence, Shari worked on maritime platforms and equipment and as a project manager for naval projects. Shari has a Bachelor of Engineering (Electrical), Masters of Management Economics, and a Doctor of Philosophy which addressed requirements development in Defence capability management. (s.soutberg@adfa.edu.au)

Books

1. M. Ryan, *Battlefield Command Systems*, Brassey's, 2000.
2. M. Frater and M. Ryan, *Electronic Warfare for the Digitized Battlefield*, Artech House, 2001.
3. M. Ryan and M. Frater, *Tactical Communications for the Digitized Battlefield*, Artech House, 2002.
4. M. Ryan and M. Frater, *Communications and Information Systems*, Argos Press, 2002.
5. R. Faulconbridge and M. Ryan, *Managing Complex Technical Projects*, Artech House, 2002.
6. M. Ryan, *Principles of Satellite Communications*, Argos Press, Canberra, 2004.
7. R. Faulconbridge and M. Ryan, *Engineering a System: Managing Complex Technical Projects*, Argos Press, 2005.
8. C. Benson, M. Frater and M. Ryan, *Tactical Electronic Warfare*, Argos Press, Canberra, 2007.
9. M. Ryan and M. Frater, *Battlefield Communications Systems*, Argos Press, Canberra, 2007.
10. M. Ryan, M. Frater, and M. Pickering, *Fundamentals of Communications and Information Systems*, Argos Press, 2011.
11. R. Faulconbridge and M. Ryan, *Systems Engineering Practice*, Argos Press, Canberra, 2018.
12. M. Ryan, *Requirements Practice*, Argos Press, Canberra, 2017.

Book Chapters

1. M. Ryan, "Satellite-based Mobile Communications", in *Handbook on Antennas in Mobile Communications*, L. Godara (ed), CRC Press, Boca Raton, FL, 2002.
2. M. Frater and M. Ryan, "Military Information Systems Security: Challenges and Vulnerabilities", in L. Jain (ed), *Advances in Intelligent Systems for Defence*, World Scientific Publishing Company, 2002.
3. M. Pickering and M. Ryan, "An Architecture for the Compression of Hyperspectral Imagery", in G. Motta, F. Rizzo, and J. Storer (eds), *Hyperspectral Data Compression*, Kluwer Academic, 2006.

Major Consultancies

1999	An analysis of the effect of radio-frequency directed-energy weapons (RF DEW)
1999	Development of an architecture for a battlespace communications system for the Australian Army
2000	An analysis of the fitness-for-purpose of SSB mode for receive-only Link-11 communications
2001	An investigation into the impact of environment on a ship-based UHF SATCOM receiver
2002	C4I study and development of technical specification for ATHOC: Athens 2004 Olympic Games
2002	Land 125 (WUNDURRA) Soldier Combat System—System Integration Study—Communications
2003	Independent validation and verification (IV&V) of NZ Joint Command and Control System (JCCS)
2003	Land 125 (WUNDURRA) Soldier Combat System—System Integration Study—Security
2004	Development of Strategy Paper for the ADF Tactical Information Exchange Environment
2005	Development of a Security Architecture for the Land Force Information Network
2005	Development of a Space Policy for the Australian Army
2005	Development of a web-services strategy for Air Services Australia
2005	Review of functions and responsibilities for delivery of the ADF Battlespace Network
2005	Strategic appreciations for the layers of the Defence Information Infrastructure (DII)
2005-6	Rewrite of Defence Approved Technology Standards List (ATSL)
2006	Independent validation and verification (IV&V) for JP2072
2007	Independent validation and verification (IV&V) for JP2097
2007	Advice on design acceptance for JP141/2087
2007	Systems Engineering Independent Review Team for JP2072
2007	Independent validation and verification (IV&V) for Land 75/125 BMS T&E
2007	Physical/Functional Audit Review for the Hazard Prediction Modelling and Geospatial Subsystem
2008	Development of system architecture / functional specification for Modular Engineer Force
2008	Development of CDD suite for Land 125 Phase 4
2009	Business Case for Annual Defence-wide EW Capability Review
2009	Business Case for Defence-wide EW Training and Education Review
2010	JP 2089 3B—Tactical Information Exchange Domain—ARH—Requirements Workshop facilitation
2010	Rewrite of Defence Approved Technology Standards List (ATSL)
2011	IV&V for ADF EW Training Needs Analysis
2011	Review of AIR 5431 OCD
2012	Requirements Workshop for ADF Enterprise Content Management and Collaboration System
2012-3	JP 2030 Phase 8 Ev 1 and 2 Operational Test and Evaluation (OT&E) Documentation Update
2013	IV&V for drafting of JP2089 Phase 3A Function and Performance Specification
2015	Revision of Defence Simulation Strategy and Roadmap
2015	AIR 9000 Capability Development Document Redevelopment
2015	AIR 9000 Lifecycle Cost Analysis Modelling
2016	AIR 6500 Facilitation and Modelling
2016	AIR 9000 Life cycle Modelling
2016	Lifecycle Modelling—LAND 2110 and LAND 907
2016	Land Network Integration Centre Test & Evaluation Study
2016	Land Training Areas and Ranges (LTAR) Design Facilitation
2017	SEA129 Modelling
2017	SEA1000 Through life support modelling
2017	SEA 1180 Ship Zero functions development
2017	HJCMI I2 Framework (I2F) Development
2017	HJCMI IAMD IV&V
2017	CASG Report on the Schedule Compliance Risk Assurance methodology (SCRAM)
2017	JP9101 Report - Communications in a Satellite-denied/degraded Environment
2017	JP9101 Advice on Development of OCD and FPS
2018	Development of SCRAM lessons learned database
2018	JP9101 Report – Shared Load Study
2018	SEA1180 Development of Ship Zero functional specification
2018	SEA1180 Modelling of capability transition
2018	SEA1000 Modelling of through-life support
2018	JP9101 Expert Advisory Panel for tender CDD suite
2018	Capability Management modelling for Protected Mobility Capability Assurance Program
2018	System Specification development for Protected Mobility Capability Assurance Program
2019	Workshop for Space Situational Awareness Sub-Program
2019	Preliminary PIOCD for Land Training Support System
2019	Functional description of AEGIS Enterprise

Acronyms and Abbreviations

AAI	Accountable Authority Instructions
ABL	Allocated Baseline
ACAT	Acquisition Category
ACCS	Australian Capability Context Scenarios
ADF	Australian Defence Force
ADFA	Australian Defence Foce Academy
ADO	Australian Defence Organisation
AFS	Average Funded Strength
AIC	Australian Industry Capability
AIOS	Acceptance into Operational Service
AIPM	Australian Institute of Project Management
AJOC	Australian Joint Operating Concept
AMS	Australian Military Strategy
ANAO	Australian National Audit Office
ANSI	American National Standards Institute
APS	Australian Public Service
ASDEFCON	Australian Standard for Defence Contracting
AT&E	Acceptance Test and Evaluation
BBC	Better Business Case
BC	Business Case
BoE	Basis of Estimates
BNR	Business Needs and Requirements
C2	Command and Control
C4	Command, Control, Communications and Computers
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance
CabSub	Cabinet Submission
CAD	Computer-aided design
CAE	Computer-aided engineering
CAM	Computer-aided manufacturing
CASG	Capability Acquisition and Sustainment Group
CASE	Computer-aided Support Environment
CASSS	Capability Acquisition and Sustainment Support Services (Panel)
CCB	Configuration Control Board
CCP	Contract Change Proposal
CDD	Capability Development Documents
CDF	Chief of the Defence Force
CDIC	Centre for Defence Industry Capability
CDMRT2	Capability Development Management and Reporting Tool 2
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CFO	Chief Finance Officer
CI	Configuration Item
CI	Critical Issue
CIOG	Chief Information Officer Group
CITE	Capability Integration, Test and Evaluation (Branch)
CLC	Capability Life Cycle
CM	Capability Manager
CM	Configuration Management
CMGR	Capability Manager Gate Review
CMS	Contract Master Schedule
CNC	Computer numerically controlled
COD	Concept of Operations Document
COE	Centre of Expertise
COI	Critical Operational Issue
CONOPS	Concept of Operations
COTS	Commercial-off-the-Shelf
CPN	Capability Program Narrative
CPR	Commonwealth Procurement Rules
CPSG	Capability Program Steering Group
CSC	Computer Software Component
CSCI	Computer Software Configuration Item
CSU	Computer Software Unit
CWBS	Contract Work Breakdown Structure
DA	Design Authority
DA	Design Attribute
DAF	Defence Architecture Framework
DASR	Defence Aviation Safety Regulation
DC	Defence Committee
DCAP	Defence Capability Assessment Program
DDR	Detailed Design Review
DID	Data Item Description
DIP	Defence Investment Plan
DLOD	Defence Lines of Development
DMO	Defence Materiel Organisation (obsolete post FPR)
DoD	(U.S.) Department of Defense
DOF	Department of Finance
DOR	Description of Requirement
DOTMLPF	Doctrine, organization, training, materiel, leadership, personnel, facilities
DPG	Defence Planning Guidance
DPG	Defence People Group
DPPM	Defence Procurement Policy Manual
DSwMS	Defence Seaworthiness Management System
DT&E	Developmental Test and Evaluation
DWP	Defence White Paper
E&IG	Estate & Infrastructure Group
EBC	Enterprise Business Committee
ECP	Engineering Change Proposal
eFFBD	Enhanced Functional Flow Block Diagram
EIA	Electronics Industry Association
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EPBC	Environment Protection and Biodiversity Conservation Act 1999
EtP	Endorsement to Proceed
FACRR	Facilities Readiness Review
FBL	Functional Baseline
FCA	Functional Configuration Audit
FDD	Force Design Division
FEA	Finite element analysis
FELSA	Front-End Logistics Support Analysis
FFBD	Functional Flow Block Diagram
FFBNW	Fitted-for-but-not-with

FIC	Fundamental Inputs to Capability
FJOC	Future Joint Operating Concept
FMECA	Failure Modes, Effects and Criticality Analysis
FOC	Final Operating Capability
FOE	Future Operating Environment
FOREX	Foreign Exchange
FPC	Fixed price contract
FPR	First Principles Review
FPS	Function and Performance Specification
FQR	Formal Qualification Review
FRACAS	Failure reporting, analysis and corrective action system
FSR	Force Structure Review
FTE	Full Time Equivalent
G&S	Goods and Services
GOTS	Government off the Shelf
HMI	Human Machine Interface
HR	Human Resources
HWCI	Hardware Configuration Item
I2	Integration and Interoperability
I2F	Integration and Interoperability Framework
IA	Independent Assurance
IAR	Independent Assurance Review
IBR	Integrated Baseline Review
IC	Investment Committee
ICD	Interface Control Document
ICT	Information and Communications Technology
ICWG	Interface Control Working Group
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IIP	Integrated Investment Program
ILS	Integrated Logistics Support
ILSM	ILS Manager
ILSP	ILS Plan
IMS	Integrated Master Schedule
INCOSE	International Council on Systems Engineering
IOC	Initial Operating Capability
IOC	Integrating Operational Concept
IPM	Integrated Project Manager
IPMP	Integrated Project Management Plan
IPMT	Integrated Project Management Team
IPT	Integrated Project/Product Team
IS	Interim Standard
ISC	Integrated Support Contractor(s)
ISO	International Standards Organisation
ISREW	Intelligence, Surveillance, Reconnaissance and Electronic Warfare
ISREWCS	ISREW Cyber Space
ITR	Invitation to Register Interest
IV&V	Independent Verification and Validation
JCA	Joint Capability Authority
JCF	Joint Concepts Framework
JCG	Joint Capability Group
JCN	Joint Capability Narrative
JCNS	Joint Capability Needs Statement
JD	Joint Directive
JFA	Joint Force Authority
JICA	Joint Integration Concepts and Assurance
JP	Joint Program
JWC	Joint Warfare Council
LCC	Life Cycle Cost
LCCA	Life Cycle Cost Analysis
LCD	Life-cycle Concepts Document
LORA	Level of Repair Analysis
LSA	Logistic Support Analysis
LSAR	Logistics Support Analysis Report
MCE	Major Capital Equipment
MIL-HDBK	(U.S.) Military Handbook
MIL-STD	(U.S.) Military Standard
MINCE	Minor Capital Equipment
MinSub	Ministerial Submission
MOE	Measure of Effectiveness
MOP	Measure of Performance
MOS	Measure of Suitability
MOTS	Military off the Shelf
MRD	Maintenance Requirements Determination
MSR	Mandated System Review
MYEFO	Mid-Year Economic Fiscal Outlook
NCOSE	National Council on Systems Engineering
NDI	Non-Developmental Item
NJF	Networked Joint Force
NRE	Non-Recurring engineering
NSC	National Security Committee (of Cabinet)
OCD	Operational Concept Document
ODA	Offer Definition Activity
OT&E	Operational Test and Evaluation
OTS	Off the Shelf
PBL	Product Baseline
PCA	Physical Configuration Audit
PDR	Preliminary Design Review
PES	Project Execution Strategy
PGPA	Public Governance Performance & Accountability Act 2013
PHS&T	Packaging, handling, storage and transportation
PIOC	Program Integrating Operational Concept
PLCD	Preliminary Life-cycle Concepts Document
PLICIT	Professionalism, Loyalty, Integrity, Courage, Innovation, Teamwork
PM	Project Management
PM&C	Prime Minister and Cabinet (Department)
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PMP	Project Management Plan
PMSG	Project Management Stakeholder Group
PO	Project Office

PRICIE	Personnel, research and development, infrastructure, concepts and doctrine, information technology, equipment
PRR	Project Risk Register
PS	Program Strategy
PWBS	Program/Project Work Breakdown Structure
PWD	Planned Withdrawal Date
QA	Quality Assurance
RAAF	Royal Australian Air Force
RAM	Reliability, Availability, Maintainability
RAN	Royal Australian Navy
RBS	Requirements Breakdown Structure
RFI	Request for Information
RFP	Request for Proposal
RFT	Request for Tender
RI	Repairable Items
RMP	Risk Management Plan
S&Q	Survey and Quote
SA	Support Analysis
SAA	System Acceptance Audit
SBS	System Breakdown Structure
SCRAM	Schedule Compliance Risk Assessment Methodology
SDD	System Design Document
SDR	System Design (Definition) Review
SE	Systems Engineering
SEBoK	Systems Engineering Body of Knowledge
SEDS	Systems Engineering Detailed Schedule
SEI	Software Engineering Institute
SEMP	Systems Engineering Management Plan
SEMS	Systems Engineering Master Schedule
SLOC	Source Lines Of Code
SME	Small-to-Medium Enterprise
SME	Subject Matter Expert
SNR	Stakeholder Needs and Requirements
SOI	System of Interest
SOP	Standard Operating Procedure(s)
SoS	System of Systems
SoSE	SoS Engineering
SOW	Statement of Work
SP&I	Strategic Policy & Intelligence (Group)
SPPR	Spares Provisioning Preparedness Review
SRD	Stakeholder Requirement Document
SRR	Systems Requirements Review
SS	(Mission) System Specification
SSCC	Support System Constituent Capabilities
SSDDR	Support System Detailed Design Review
SSSPEC	Support System Specification
STD	Standard
StRS	Stakeholder Requirements Specification
SW	Software
SWEBOK	Software Engineering Body of Knowledge
SyRS	System Requirements Specification
T&E	Test and Evaluation
TARR	Task Analysis Requirements Review
TCD	Test Concept Document
TCO	Total Cost of Ownership
TDRL	Tender Data Requirement List
TEMP	Test and Evaluation Master Plan
TEPPR	Training Equipment Provisioning Preparedness Review
TIRA	Technical Implementation Risk Assessment
TLS	Through Life Support
TNGRR	Training Readiness Review
TPM	Technical Performance Measures
TRAP	Technical Review and Audit Plan
TRA	Technical Risk Assessment
TRR	Test Readiness Review
TXRR	Transition Requirements Review
URD	User Requirements Document
URS	User Requirements Specification
V&V	Verification and Validation
VCDF	Vice Chief of the Defence Force
VCDFG	VCDF Group
VCRM	Verification Cross Reference Matrix
VFM	Value for Money
WBS	Work Breakdown Structure
WHS	Workplace Health and Safety
WHS	Workplace Health and Safety Act 2013
WSOI	Wider SOI

Review Questions

1. List the six *core recommendations* of the First Principles Review (FPR).
2. List the ten *CLC Principles*.
3. Draw a diagram of the four phases of the *CLC Process* (Answer: diagram showing Strategy and Concepts, Risk Mitigation and Requirements Setting, Acquisition, and In-Service and Disposal).
4. What is the principal purpose of the *Strategy and Concepts* phase of the CLC Process?
5. What is the principal purpose of the *Risk Mitigation and Requirements Setting* phase of the CLC Process?
6. What is the principal purpose of the *Acquisition* phase of the CLC Process?
7. What is the principal purpose of the *In-Service and Disposal* phase of the CLC Process?
8. Briefly describe the *Force Design* activity.
9. Briefly describe the *Smart Buyer* framework.
10. Briefly describe the role of *Contestability*.
11. Briefly describe the four CLC *management layers* (Answer: Portfolio, Capability Stream, Program, Product/Project).
12. Draw a simple diagram of the *CLC Accountability Model*.
13. List the nine *Fundamental Inputs to Capability (FIC)*.
14. List the five *Support System Constituent Capabilities (SSCC)*.
15. Draw a simple hierarchical diagram of the principal *CLC proposal artefacts* (Answer: JCN, CPN, PIOC, JCNS, OCD, FPS).
16. A system can be described *functionally* and *physically*. Explain what each description provides and describe the relationship between the two descriptions.
17. Briefly outline the differences between a *system* and a *system-of-systems*.
18. Briefly describe the *system life cycle* (as proposed by Blanchard and Fabrycky) and explain briefly the two main phases and the activities that occur within each.
19. Explain the relationship between an *RBS* and a *WBS*.
20. Explain why *Technical Reviews and Audits* are vital to Systems Engineering Management and describe the major formal reviews that may occur prior to Construction and/or Production.
21. List and describe the three categories of *Test and Evaluation (T&E)* and describe the primary focus of each of them.
22. List the ten *knowledge areas* of the Project Management Body of Knowledge (PMBOK).

Capability Life Cycle (CLC) Management

Dr Mike Ryan
Dr Shari Soutberg

UNSW CANBERRA | Capability Systems Centre

Capability Life Cycle (CLC)

2

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.

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Course Program

- Background to CLC
- Context and Behaviours
- Overview of CLC Process including frameworks, roles, management, practices, documents, and artefacts
- Overview of Capability Management Practices
- Systems Engineering
- Project and Program Management
- Integrated Logistics Support
- CLC Process in detail
- Procurement and Contracting
- Governance, Risk Management, and Assurance
- CLC Documents and Artefacts, including examples

Background to CLC

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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

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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

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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

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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

One Defence Business Model

Source: VCDF Group

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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

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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

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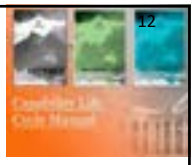
CLC – Principles



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

Principles are to be applied throughout the CLC

Source: Updated Interim CLC Manual

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So ….

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

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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'.

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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).

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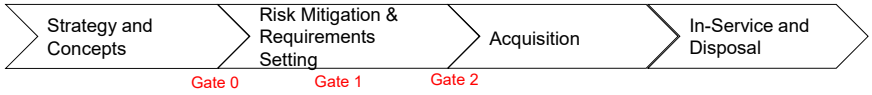
Snapshot of key changes post-CLC

Modified Process and Decision Points up to Acquisition Phase



Behaviours and Approach	Additional frameworks	New Management roles and 'structures'
• One Defence • Joint/integrated • Transparency • Tailored • Sufficiency • Risk-based	• Force Design (incl DCAP) • Contestability • Smart Buyer • Integration and Interoperability	• 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	

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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.

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CLC – Implementation

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

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Revision

1. List four of the six core recommendations of FPR:

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

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Revision

2. List six of the ten 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

Applying the CLC

CLC Capability Development: Challenge

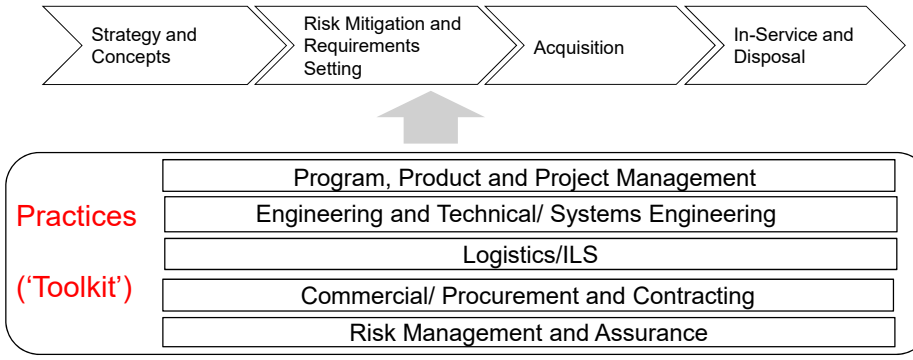
Management of Public Monies → Accountability; Legal obligation; Govt processes

+

Technical endeavour to deliver and support capability → Significant Complexity; Science & Engineering; Precision and rigour

Intersection of Public Sector obligations and technical endeavour.

Capability Development Practices



Established, proven Practices that enable the CLC.

Context for CLC

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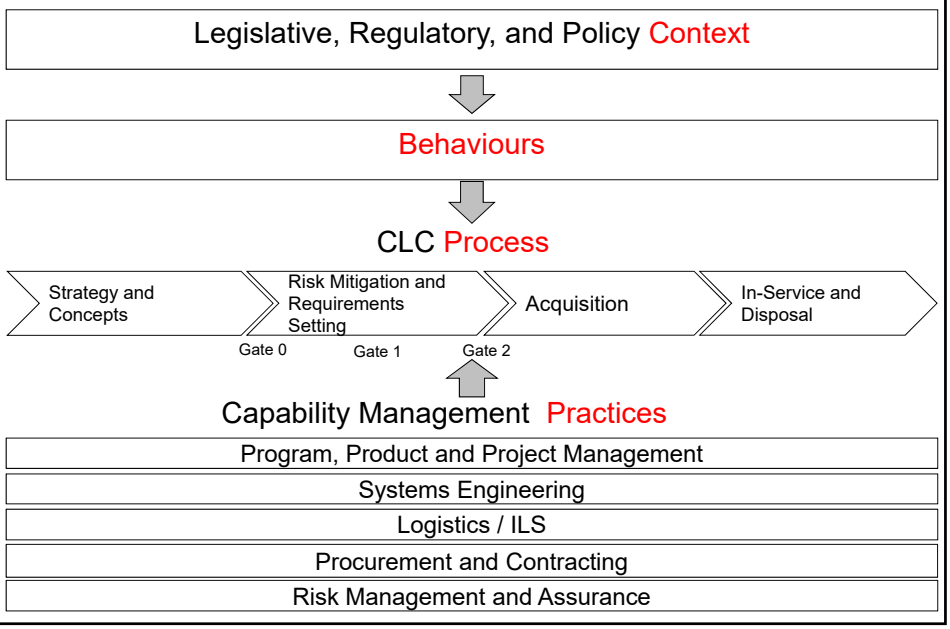

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CLC Examples

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

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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); and
  - missiles eg ballistic and cruise missiles (missile defence).
- Integrated: operational and technical collaboration between systems.

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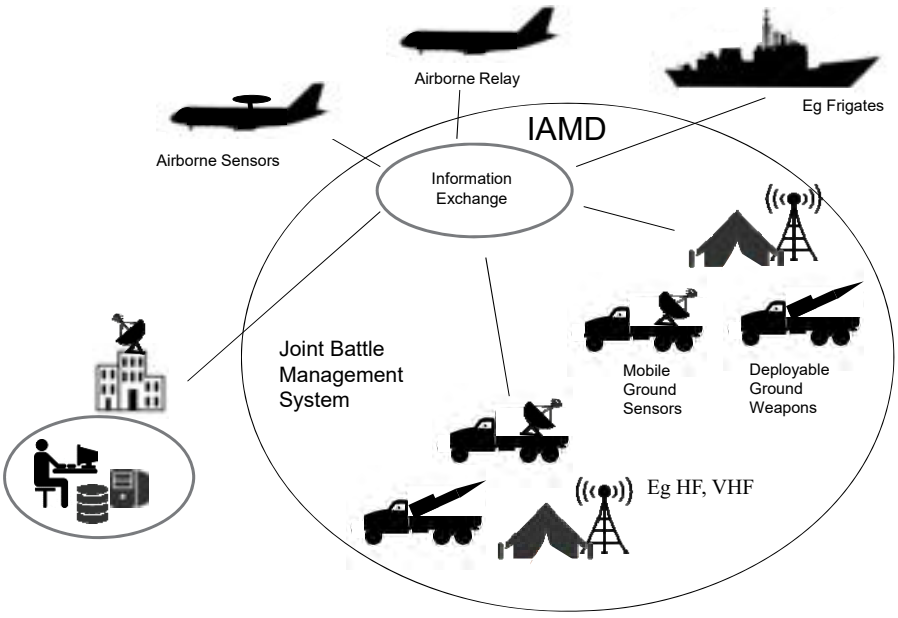
IAMD Example

- ADF IAMD Program announced in 2016 Defence White Paper.
- "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



29

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.

30

SEA 1448 Ph4A: Project Example

- Electronic Support Measures (ESM).
- Undertaken before CLC introduced.
- 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.

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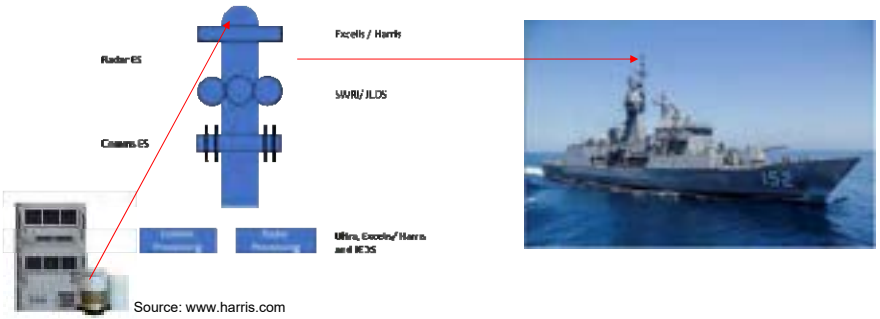
SEA 1448 Ph4A Project: ESM

- 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

32

SEA 1448 Ph4A Project: Key Factors

- Installed on multiple existing platforms across 3 different classes of ship.
- Installation 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.

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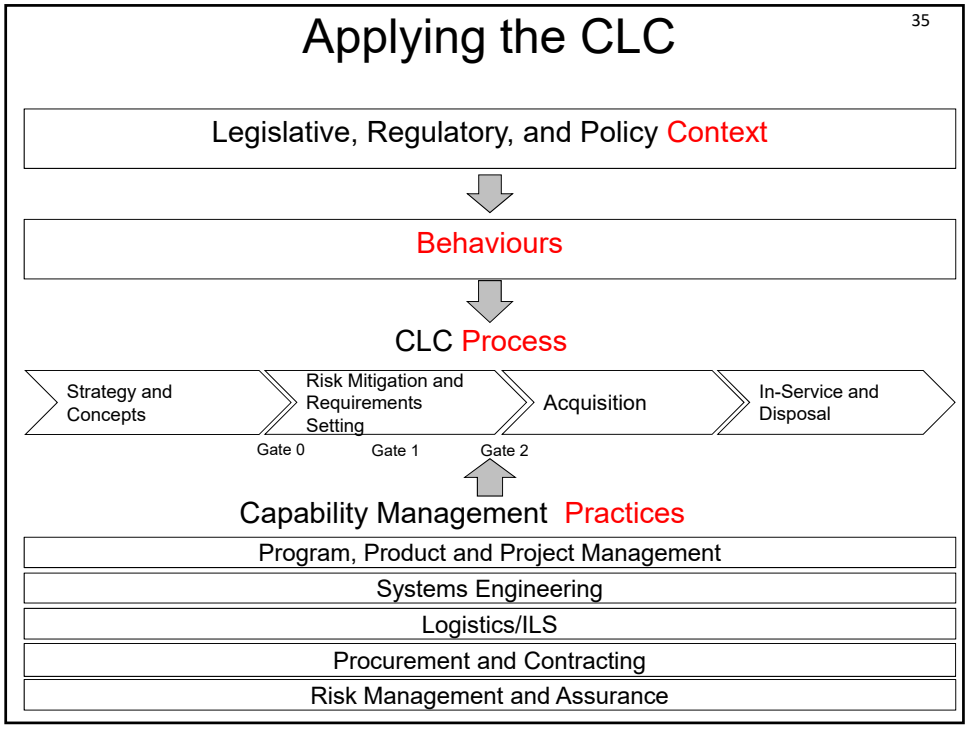
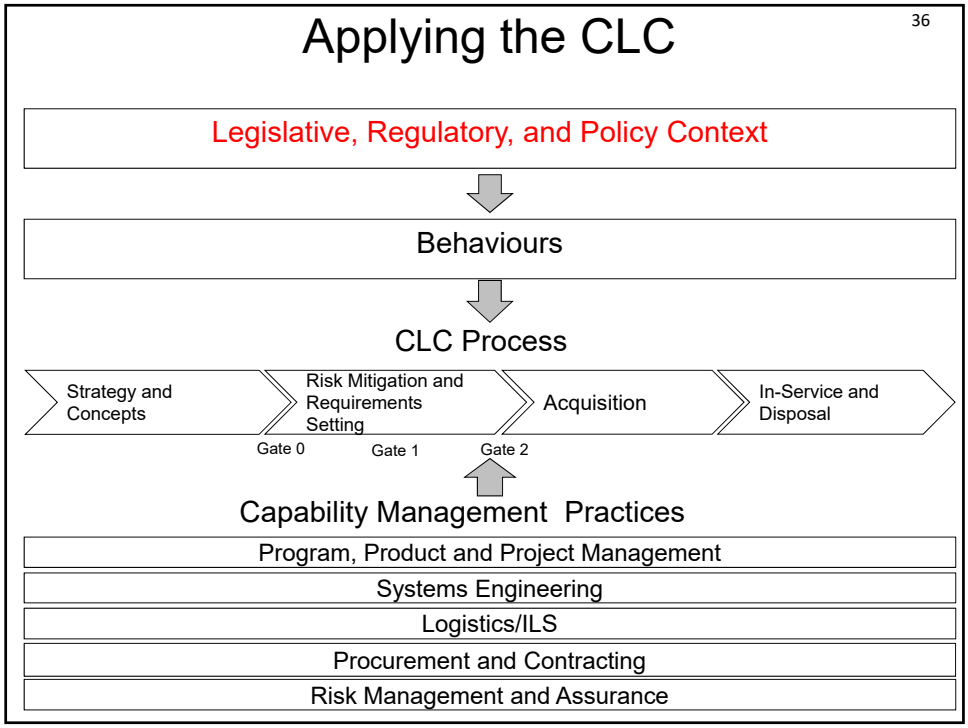
SEA 1448 Ph4A Project Example

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.

CLC Context and Behaviours


Applying the CLC
35
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
36
Legislative, Regulatory, and Policy Context
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Gate 2
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

Commonwealth Legislation
Commonwealth Policy
Defence Policy
Defence Regulation

Key Commonwealth Legislation

Including but not limited to…

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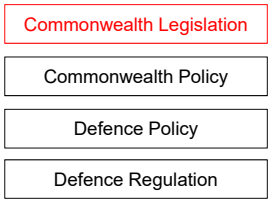

40

PGPA Act 2013

- The PGPA Framework requires Defence officials to:
  - not be inconsistent with Aust Government policies;
  - 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 or information; and
  - disclose interests relating to performance of their duties.

Source: DPPM April 2017, Paragraph 21

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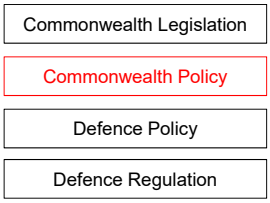
Key Commonwealth Policies

- Including but not limited to:
  - Commonwealth Procurement Rules;
  - Procurement Connected Policies (eg Indigenous Procurement Policy); and
  - Commonwealth Risk Management Policy.



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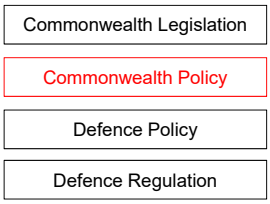

43

Commonwealth Procurement Rules

- Commonwealth Procurement Rules (CPR) have effect under the PGPA Act 2013.
- CPR:
  - set out rules for procuring goods and services;
  - indicate good practice;
  - keystone of Govt's procurement policy framework; and
  - fundamentally focused on achieving value for money.

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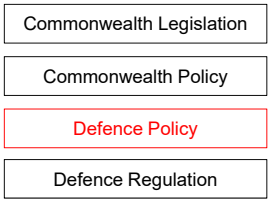
Key Defence Policies

- Including but not limited to …
  - Defence Environment Policy;
  - Defence Industry Policy Statement 2016;
  - Defence Procurement Policy Manual (DPPM); and
  - Joint Directive on the Management of Risk in Defence (30/2015).



45

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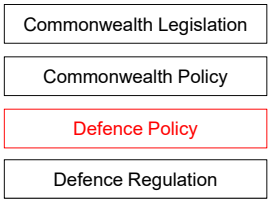

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Defence Procurement Policy

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

Source: DPPM April 2017

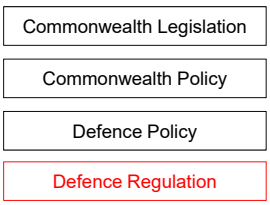
Key Regulations

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.



Technical Regulation

48

- 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.
- Land Technical Regulation: ADF Materiel Manual - Land (TRAMM-L)*.
- Explosive Ordnance Regulation: Technical Airworthiness Advisory Circular.

* Will be replaced by Landworthiness Manual

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Bottom Line on Context

- Those involved in the CLC must comply with legislative, regulatory and policy requirements.
- Defence Policy leads and discipline 'Functions' 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.

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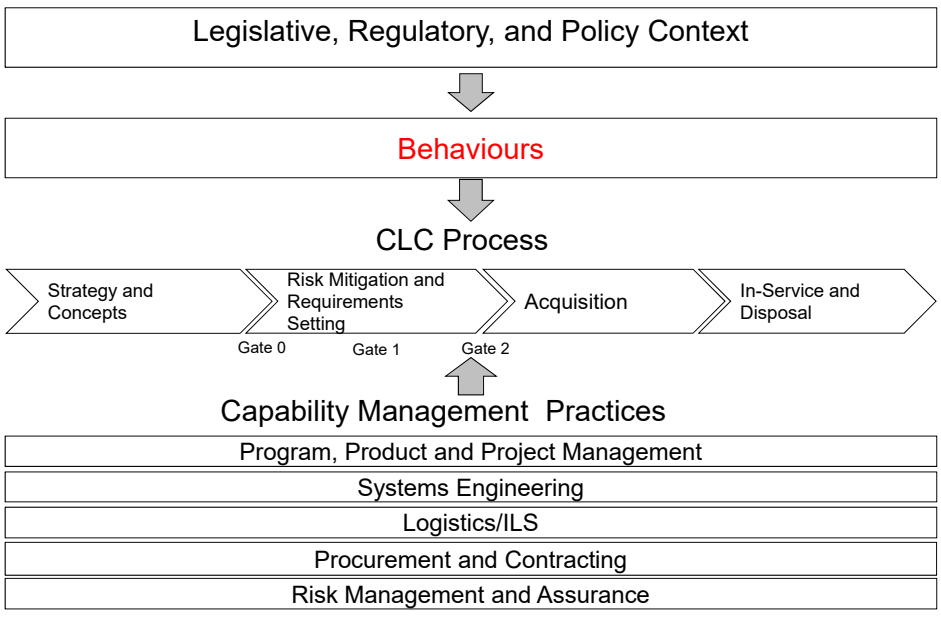
Applying the CLC



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Importance of Behaviours

- CLC changes have introduced new 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.

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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.

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Key Behaviour: Embrace Contestability

- Culture of wanting ideas, proposals and agendas contested.
- Makes proposals robust and helps improve decisions
- Establish trust with Government and Central Agencies.
- Engage early with Contestability 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.
- To be demonstrated from working level practitioners through to senior committees eg:
  - Investment Committee
  - Independent Assurance Reviews.
- Critical to development of the Joint Force.

55

Key Behaviour: Tailoring and Sufficiency

- Tailor: Implement appropriate to circumstances:
  - commensurate with complexity, risk
  - no prescribed approaches
  - not a 'cookie cutter' approach.
- Sufficiency: Work and documentation only done to extent necessary.
- Discipline in Documentation: limit level, volume of detail to that necessary.
- Those accountable and responsible must define and argue the tailored approach.

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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 2107

57

Key Behaviour: Manage Risk

- Manage risk:
  - deal with ambiguity, and
  - discourage risk aversion.
- Conscious risk reduction mindset throughout the CLC.
- Use risk management techniques to:
  - clearly identify risks,
  - develop risk profile, and
  - determine risk reduction/mitigation activities.

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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

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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

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Defence-wide Values

- Defence-wide Values (PLICIT):
  - Professionalism
  - Loyalty
  - Integrity
  - Courage
  - Innovation
  - Teamwork
- Applies to everyone in Defence ADF members, APS employees.
- APS employees: must follow APS Values, Employment Principles and APS Code of Conduct.
- PLICIT:
  - does not replace or override Single Service, APS Values
  - they are complementary

One Defence Leadership Behaviours (CLARITI)

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- 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

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Specialist practitioners are also subject to Codes of Ethics eg:

- 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.

63

Specialist Practitioners: Common Features

- Professionalism.
- Integrity.
- Competence.
- Act on basis of a well-informed conscience.
- Act on basis of adequate knowledge.

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Implications for Defence Managers

Defence officials:

- will employ specialist (non-core) skills sets.
- must assure they have:
  - appropriate competencies, and
  - comply with applicable codes of ethics.

CLC Process

Implementing the CLC

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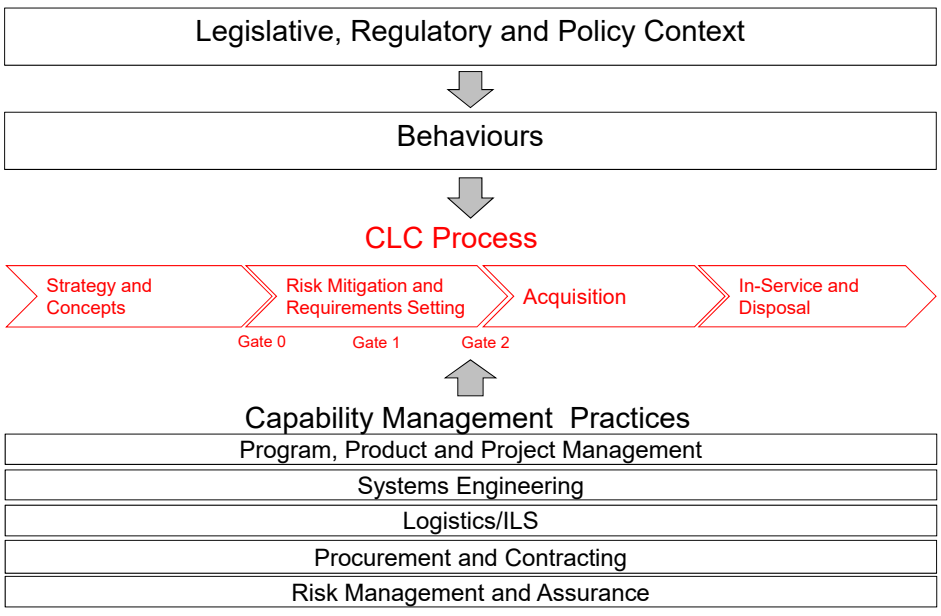
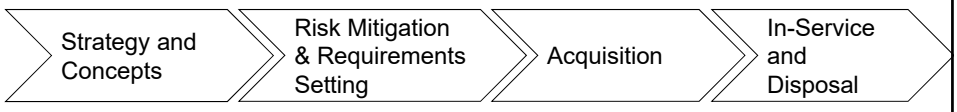


67

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.

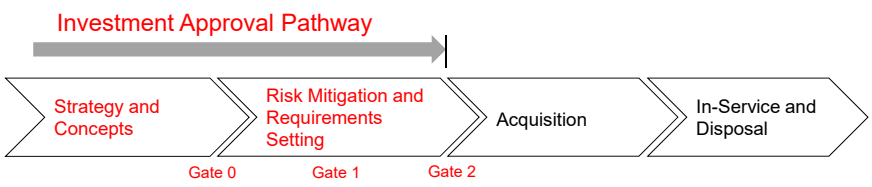


68

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.



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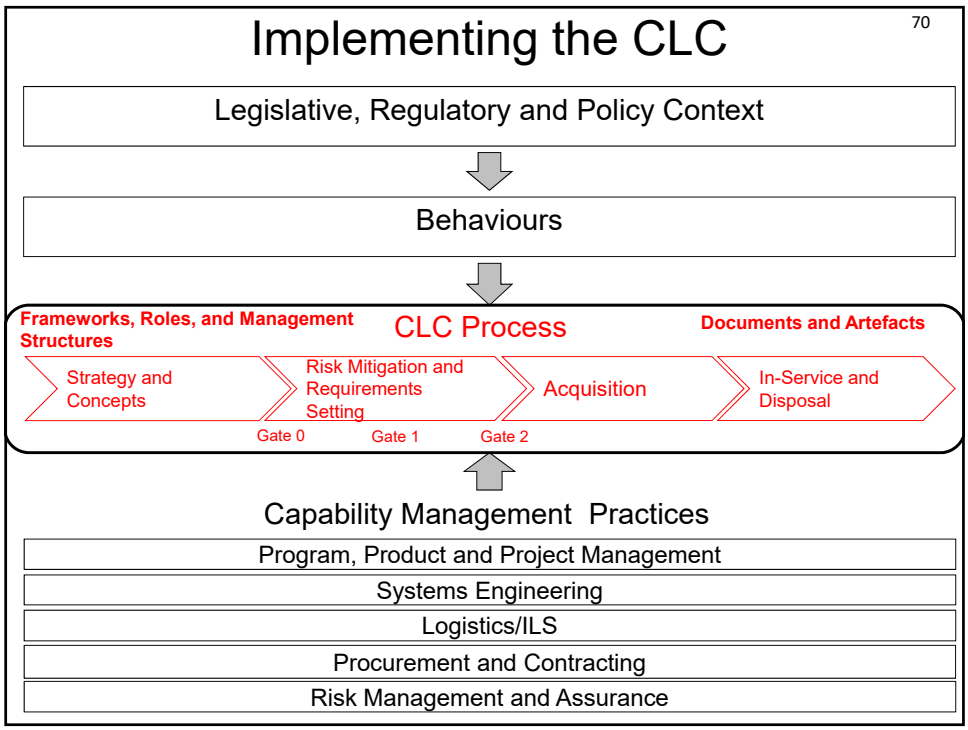
CLC Process

- 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.

70

Implementing the CLC



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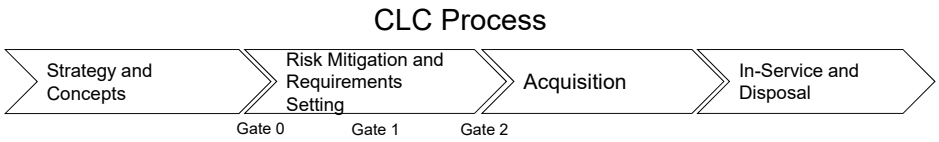
Revision

3. Draw a diagram of the four phases of the CLC Process.



4. What is the principal purpose of the *Strategy and Concepts* Phase?

5. What is the principal purpose of the *Risk Mitigation and Requirements Setting* Phase?

6. What is the principal purpose of the *Acquisition* Phase?

7. What is the principal purpose of the *In-Service and Disposal* Phase?

Defence Frameworks, Roles, and Management Structures

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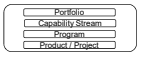
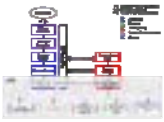
Frameworks

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

Force Design Framework

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

Force Design Framework (DCAP)

Gate 0 Gate 1 Gate 2

Force Design Framework

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

Force Design Framework (DCAP)

Gate 0 Gate 1 Gate 2

Defence Capability Assessment Program (DCAP)

- 'front-end' to the CLC
- core function of Strategy and Concepts phase
- identifies capability needs
- 'joint force by design' is key consideration

DCAP

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

DCAP: Annual Cycle

Often shown as an annual program of activities supporting the Force Design Cycle.

DCAP: Modes of Operation

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- Annual:
  - gaps and opportunities
  - inputs from:
    - Force Design analyses, and
    - Capability Managers.
- Agile:
  - rapid assessment & resolution inside the annual cycle eg
    - urgent operational requirement, and
    - Government direction.
- Fundamental: approximately every four years as basis of Force Design Update.

Fundamental Mode

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- 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 Integrated Investment Program (IIP).

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Revision

8. Briefly describe the Force Design activity.

Defence Capability Assessment Program (DCAP)

- identifies capability needs—'joint force by design'

Annual:

- inputs from Force Design analyses and CM

Agile:

- rapid assessment & resolution inside the annual cycle:
  - urgent operational requirement, and
  - Government direction.

Fundamental:

- approximately every four years as basis of Force Design Update providing basis for:
  - review of force structure,
  - update to strategic guidance,
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Smart Buyer Framework

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What is Smart Buyer?

- Decision-making framework that helps:
  - analyse circumstances for capability gap or opportunity identified through DCAP;
  - define how to best progress the capability need;
  - develop proposals appropriate to capability need; and
  - ensures strategy tailored to circumstances.
- Develops the Project Execution Strategy (PES).

84

What is Smart Buyer?

- Explicitly addresses:
  - risks, opportunities and drivers;
  - all relevant factors eg technical, commercial, financial;
  - whole of capability lifecycle; and
  - securing required capability outcomes and value for money.

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Smart Buyer: Main Steps

- Understand the circumstances
  - eg capability need, strategic factors, industry capability, finance constraints.
- Identify risks and drivers
  - develop a 'risk profile', and
  - across range of categories.
- Develop a tailored strategy
  - Project Execution Strategy (PES) based on four strategies:
    - Approval Strategy.
    - Acquisition Strategy.
    - Sustainment Strategy.
    - Project Management Strategy.

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Smart Buyer Workshops

- Core to Smart Buyer are structured workshops:
  1. Risk and drivers analysis.
  2. Tailored strategy development.
- Uses CASG Independent Assurance Review (IAR) team.
- Develops a tailored approach captured in the PES.
- First Smart Buyer workshop conducted prior to Gate 0.

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Smart Buyer: Flexible Application

- Smart Buyer method can be used across the CLC:
  - analysis, and
  - strategy development.
- Smart Buyer can be applied for different purposes:
  - early definition of a Project—that is, pre-Gate 0;
  - during the In-Service and Disposal Phase;
    - changes to sustainment activities; or
    - upgrade Projects within the In-Service Phase.

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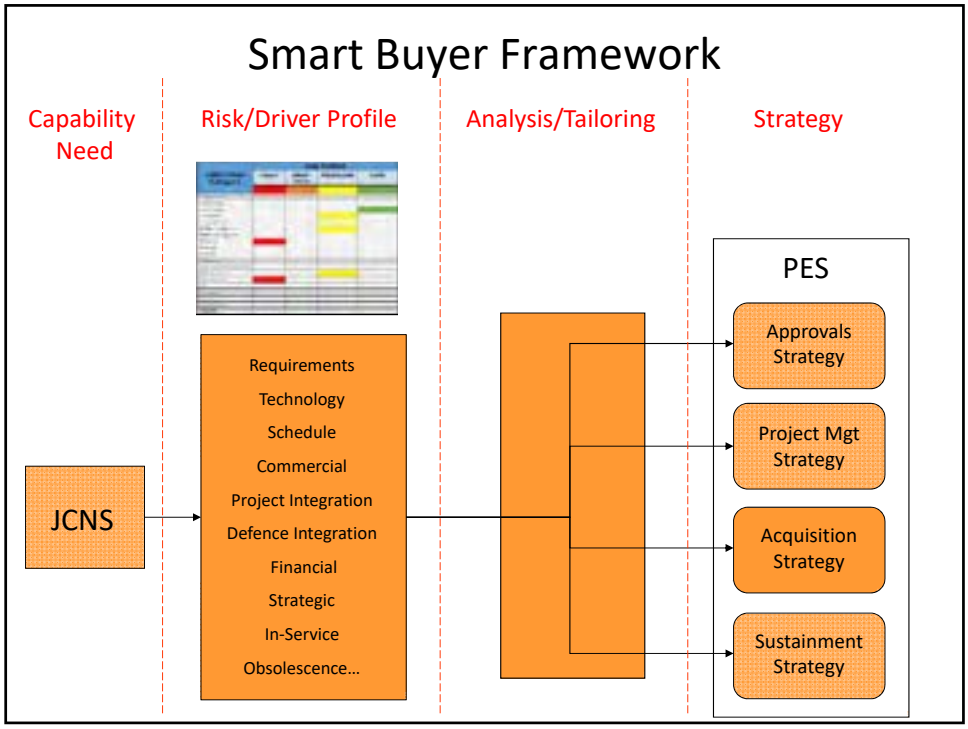
'Risk and Drivers' Categories

- 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.



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Revision

9. Briefly describe the Smart Buyer framework.

- Decision-making framework that helps:
  - analyse circumstances for capability gap or opportunity identified through DCAP;
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  - ensures strategy 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 and value for money.
- Develops the Project Execution Strategy (PES).

Contestability Framework

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Contestability Framework

- Key assurance function.
- Function complements the behaviours
- Function performed by Contestability Division.
- Contestability Division structure: environmental domains.

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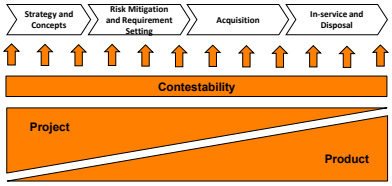
Contestability across the CLC

- Use it to assess:
  - Force Design outputs.
  - Key artefacts eg Joint Concepts, CPN, JCNS.
  - Gates or other major decisions/approvals.
  - Programs as they change strategy.
  - Changes to Sustainment Strategies.
  - Contract renewals.



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Contestability Framework

- Contestability checks:
  - 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.

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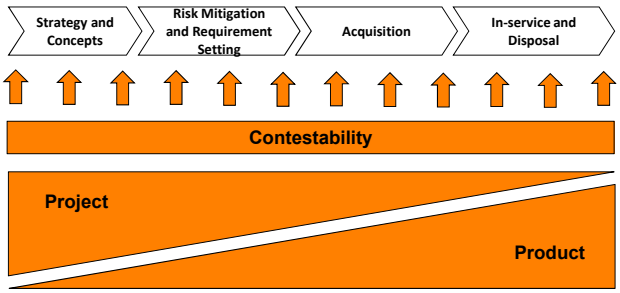
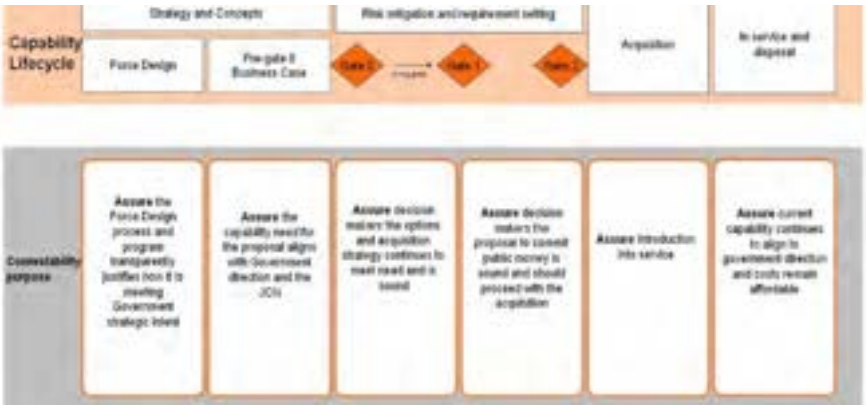
Contestability

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



96

Contestability Model across the CLC



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

Source: Department of Defence

97

Benefits of Contestability

- Makes submissions robust.
- Helps improve decisions (not make them).
- Checks key content:
  - needs statement before Smart Buyer workshops; and
  - needs and strategy before Gates.
- Helps establish and maintain trust with Government and Central Agencies.
- Supports a strengthened Defence strategic centre.

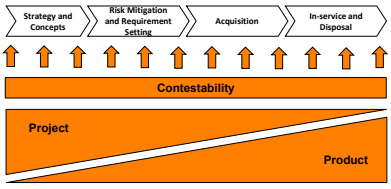
98

Revision

10. Briefly describe the role of Contestability.

Key assurance function used to assess:

- Force Design outputs.
- Key artefacts.
- Gates and other major decisions.
- Changes to Strategies and Contracts.



Benefits:

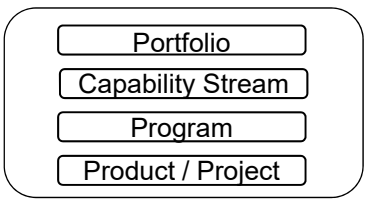
- Makes submissions robust.
- Helps improve decisions (not make them).
- Checks key content:
- Helps establish and maintain trust with Government and Central Agencies.
- Supports a strengthened Defence strategic centre.

Management Layers in the CLC

100

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) delivered by a Project: delivers/establishes all FIC for Product lifecycle.

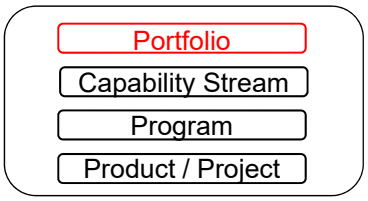


Source: Updated Interim CLC Manual

101

Portfolio

- Portfolio view: holistic view of approved and potential future investment.
- Two key investment concepts:
  - Investment Portfolio: all approved and non-approved proposals and concepts.
  - Integrated Investment Program (IIP): all approved proposals for action.



102

Portfolio

Investment Portfolio creates pipeline of Programs or proposals that may eventually enter the Integrated Investment Program (IIP).

All potential and approved investment

Approved Investment

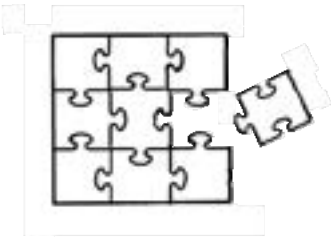
103

Portfolio: Benefits

Portfolio approach provides comprehensive view of Defence capability investment:

- ensure all investments achieve Defence's strategic goals.
- optimise use of allocated resources.
- manage risks at Portfolio level.
- adjust investment actions as necessary.

Capability Portfolio
=
Strategic Goals



Proposed Investment (Program/ Project)

104

Portfolio: Managing Investment

- Defence capability investment Portfolio managed through:
  - an Integrated Investment Program (IIP);
  - comprises multiple Programs of initiatives; and
  - clearly reflects Defence's strategic goals.
- 'Managing the Portfolio' means balancing:
  - prioritised strategic capability needs;
  - resources; and
  - risk.

105

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 (IPMB).

106

Integrated Investment Program (IIP)

- Rolling ten-year expenditure plan.
- Approved annually by Government.
- Managed through Investment Committee (IC) and Defence Committee (DC).
- Includes activities and projects approved via:
  - Defence White Paper (DWP).
  - Program update.
  - Gate 1.
- Spans all capability investment (over whole CLC):
  - Major Capital Equipment.
  - Enterprise ICT.
  - Estate initiatives.

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Capability Streams

- Six Capability Streams taken from Defence White Paper.
- Better communication with Government of Defence priorities.
- 40 Programs mapped to the Capability Streams.

Six Capability Streams

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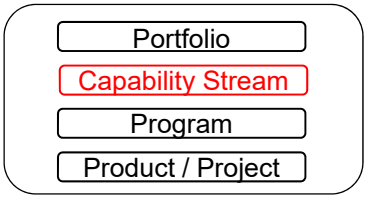
Six Capability Streams

- 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.



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Six Capability Streams

- Used for:
  - Structuring the IIP.
  - Seeking innovation proposals (Defence Innovation Hub).
  - Defence Industrial Capability Plan.
  - Australian industrial strategies (from mid-2019).

DEFENCE INNOVATION HUB

Portfolio
Capability Stream
Program
Product / Project

Capability Stream to Program Matrix

Capability Streams (to prioritise over multiple domains)

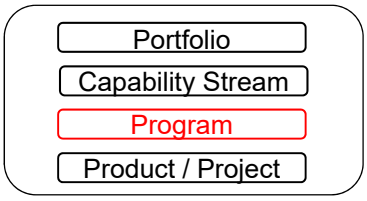
Capability Manager Domains	ISREW, Space and Cyber (Chief Joint Capabilities)	Air & Sea Lift (Chief of Air Force)	Land Combat & Amphib Warfare (Chief of Army)	Strike & Air Combat (Chief of Air Force)	Maritime & Anti-Sub Warfare (Chief of Navy)	Key Enablers (Chief Joint Capabilities Assoc Secretary)
Joint Integration – Chief Joint Capabilities	C4I and Joint Battle Management Systems Joint ISR and EW Warfighting Innovation (inc Cyber) Asymmetric Response					Health Services Fuel Explosive Ordnance Training Support and Simulation
Maritime – Chief of Navy	Maritime Tactical C4I	Sea Lift	Amphibious Combat		Major Surface Combatants Submarines Naval Aviation Maritime Logistics Minor Combatants	Maritime Infrastructure and Ranges
Land – Chief of Army	Land ISREW Land C3	Battlefield Aviation	Combat Vehicles Soldier Systems Non-combat Vehicles Combat Support Special Operations			Combat Service Support Systems
Air & Space – Chief of Air Force	Air and Space Awareness	Air Mobility		Airborne Electronic Attack Integrated Air and Missile Defence Air Combat	Maritime Patrol and Response	Base Operations Aircrew Training
Intelligence & Cyber – DepSec SPI	Strategic Intelligence Strategic Cyber Geospatial Information and Intelligence					

Source: Interim CLC Manual

111

CLC Programs

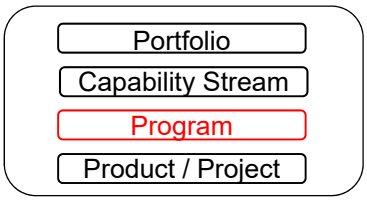
- CLC focus on Programs rather than individual Projects.
- Programs deliver capability outcomes in support of Government-endorsed Capability Streams.
- To deliver capability outcomes at Program level requires Program Management.



112

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.

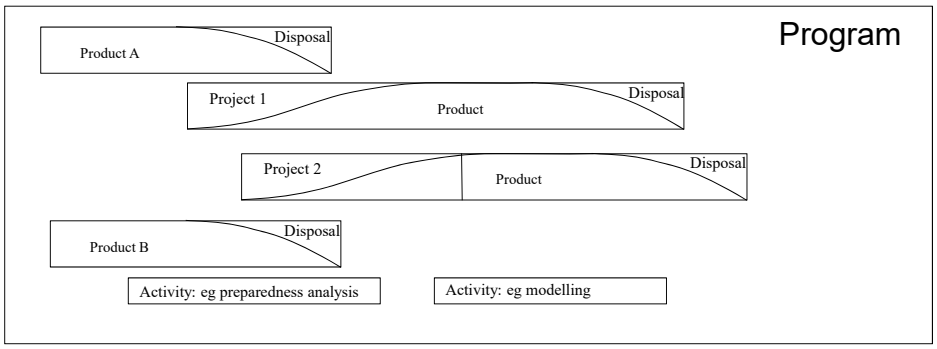


113

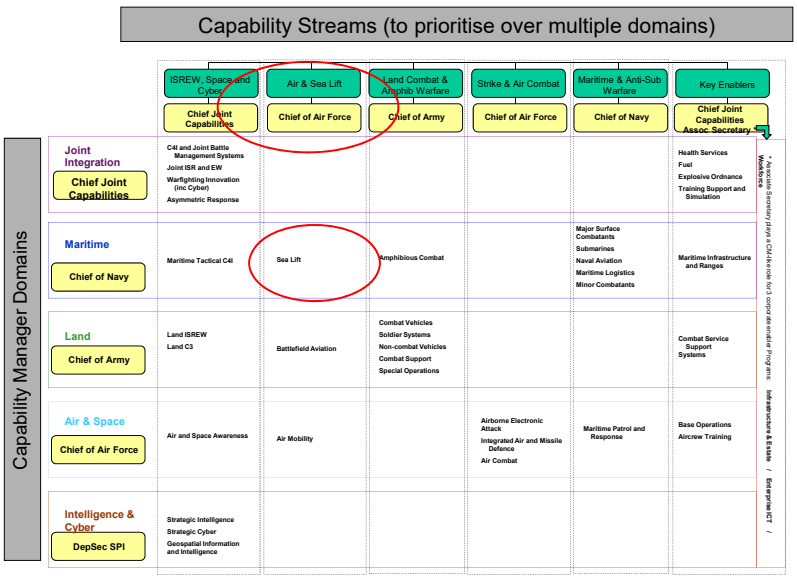
Program

Program is made up of Products, Projects, and Activities which:

- deliver a capability outcome,
- have relationships, and
- likely need to be synchronised or coordinated.



Capability Stream to Program Matrix



Source: Interim CLC Manual

115

Capability Streams and Programs

- Integrated Capability outcomes (vertical):
  - Structure for Defence priorities.
  - Communication with Government.
  - Make Defence efforts visible.
- Domain specific (horizontal):
  - Capability Manager domains (eg Land, Air, Sea).
  - Whole of FIC.
  - Whole of Life.
  - 40 Capability Programs.
  - Programs based on strategic narratives in DWP16 and FSR.
  - Eventually proposals to Government may be Program level.

116

Program Approach - Benefits

- Can better prioritise across Defence Portfolio.
- Improves the strategic view for government direction.
- Efficiencies across similar Products and Projects.
- Facilitates Joint Force by Design.
- Common reference across interdependencies between Projects and Products:
  - Operational;
  - Functional;
  - Technical; and
  - Management (across CLC).

117

Program Management across the CLC

- Management of interdependencies between capability systems:
  - Force Design.
  - Requirements Setting.
  - Acquisition.
  - Integration and Interoperability.
  - Acceptance into Service.
  - Sustainment.

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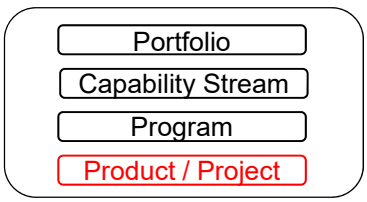
Product

- Product:
  - Capability system (platform, equipment, commodity) within a Program.
  - Includes all FIC.
  - Whole of life cycle (concept to disposal).
  - Delivers capability effect.



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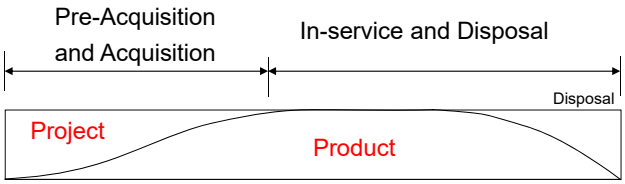
Project

A Project is:

- A temporary, multidisciplinary and organised endeavour to create a unique product, service or result.

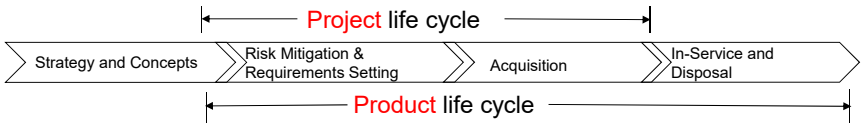


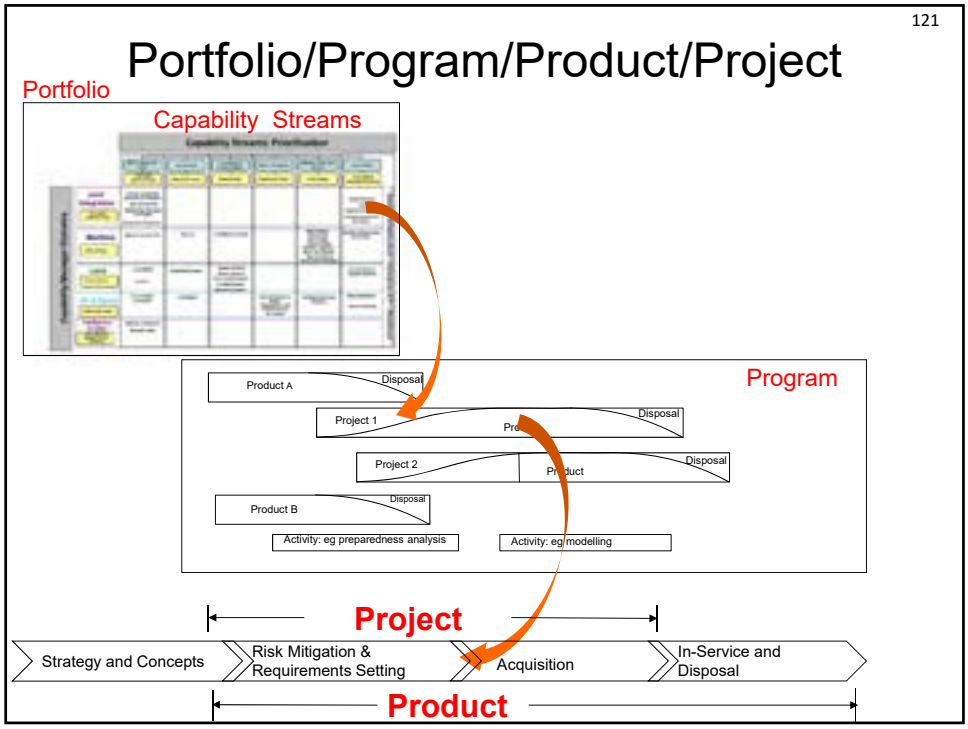
120

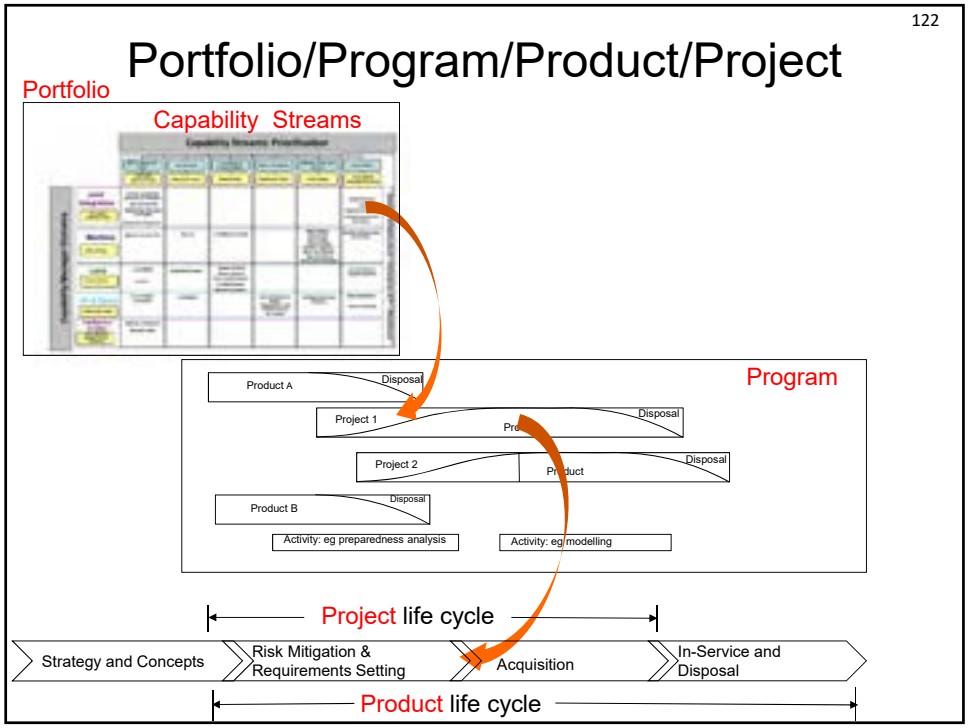
CLC Project

A CLC Project is:

- The means by which a Product/s are delivered.
- Project delivers all (FIC).
- Requires Integrated Project Management.
- Part of a Program.



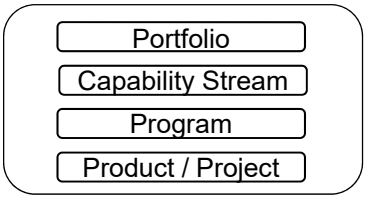

121
Portfolio/Program/Product/Project
Portfolio
Capability Streams
Program
Product A
Disposal
Project 1
Disposal
Project 2
Disposal
Product B
Disposal
Activity: eg preparedness analysis
Activity: eg modelling
Project
Strategy and Concepts
Risk Mitigation & Requirements Setting
Acquisition
In-Service and Disposal
Product


122
Portfolio/Program/Product/Project
Portfolio
Capability Streams
Program
Product A
Disposal
Project 1
Disposal
Project 2
Disposal
Product B
Disposal
Activity: eg preparedness analysis
Activity: eg modelling
Project life cycle
Strategy and Concepts
Risk Mitigation & Requirements Setting
Acquisition
In-Service and Disposal
Product life cycle

123

Revision

11. Briefly describe the four CLC management layers.



Roles in the CLC

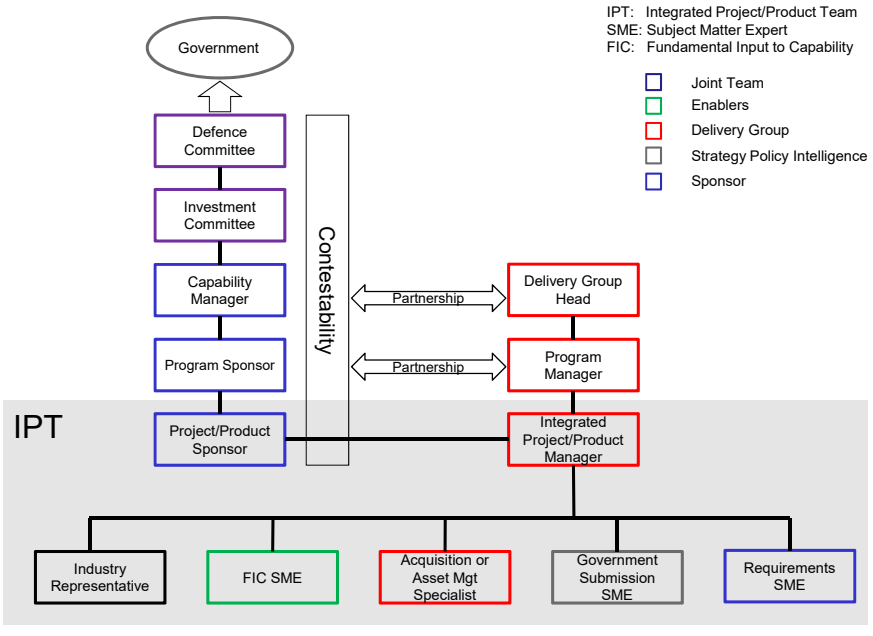
125

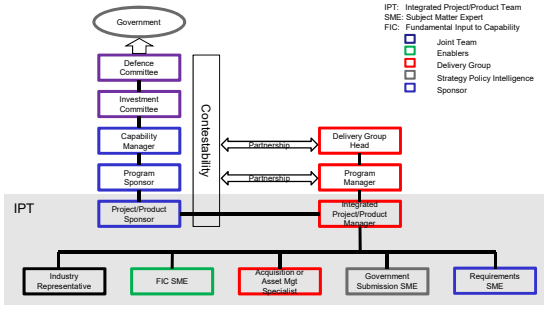
CLC Leadership

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 Accountability Model





128

Accountability: Meaning

- An **accountable** person is ultimately answerable for the correct and thorough completion of the task, deliverable or outcome.
- A person is held accountable and is accountable **to** someone.
- Accountability cannot be delegated.

129

Responsible: Meaning

- **Responsibility** comes about via:
  - delegation of a task, or
  - by virtue of your position.
- Others can be delegated to assist in the work required.

130

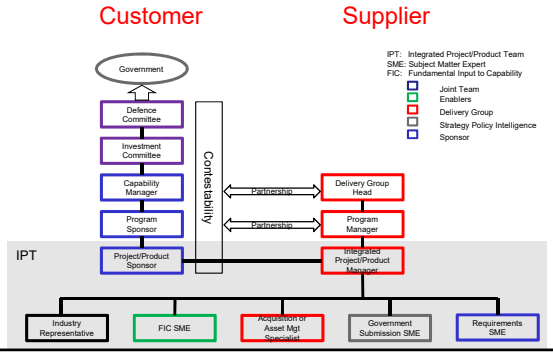
Accountable/Responsible

- Accountability goes beyond responsibility.
- The Delivery Group Head is responsible to deliver capability to an agreed scope, budget and schedule to achieve the capability outcome set by the accountable Capability Manager.

131

CLC Accountability Model

- Two vertical streams of accountability:
  - Customer – left.
  - Supplier (Delivery) – right.
- Integrated teams from both 'sides'.
- Partnerships are key.



132

Customer: Defence Committees

Defence Committee (DC):

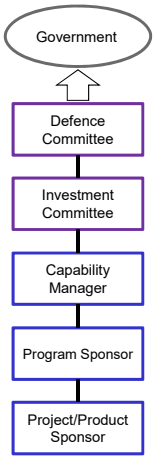
- Chaired by Secretary.
- Primary decision committee for Defence.

Investment Committee:

- Chaired by VCDF.
- Supports DC on capability investment.

Enterprise Business Committee:

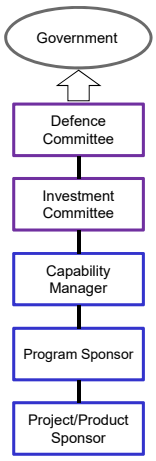
- Chaired by Associate Secretary.
- Ensures effective running of Defence.
- In-year sustainment allocations for capability systems that are in-service.



133

Investment Committee (IC)

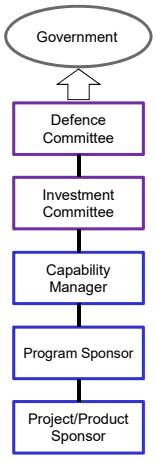
- Subsidiary of Defence Committee.
- Ensures resourcing consistent with Defence's strategic priorities.
- Makes Gate 0 decisions for majority of proposals.
- Oversees implementation and integrity of IIP.
- VCDF (Chair), Assoc Sec, CJC, DEPSEC SP&I, CFO, CN, CA, CAF, DEPSEC CAS, CDS, FAS Contestability, Central Agencies (Finance, PM&C).



134

Capability Managers (CM)

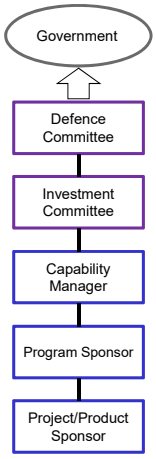
- Accountable to:
  - raise, train and sustain capabilities as directed by Secretary and CDF; and
  - Secretary and CDF, through the IC, for management of their Programs.
- Accountable for (inter alia):
  - Appropriate allocation of resources.
  - Setting and managing requirements incl FIC.
  - Execution of budgets and financial delegations for relevant Program activities.



135

Capability Managers (CM)

- 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.



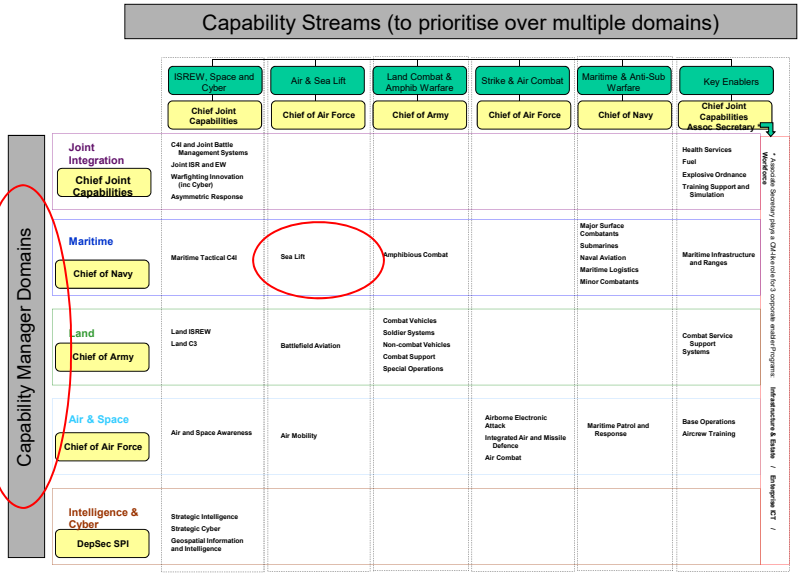
136

Capability Manager (CM)

- Develops the capability needs as tasked by VCDF.
- Sponsors Gate proposals to the Investment Committee
- Supports Delivery Group's development of Project Execution Strategy (PES).
- Makes funding available to Delivery Groups.

Dr Mike Ryan & Dr Shari Soutberg

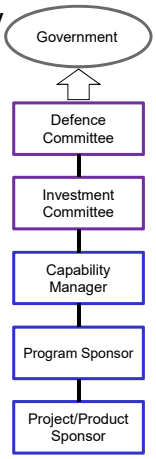
Capability Stream to Program Matrix



Source: Interim CLC Manual

Program Sponsor

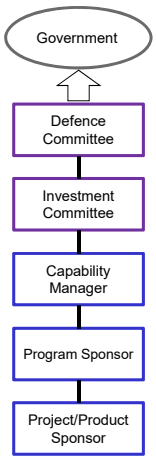
- Held individually accountable to the Capability Manager.
- Accountable for (inter alia):
  - delivering within resources;
  - Program aligning with strategic objectives;
  - developing JCNS, Program Strategy;
  - Project and Product outcomes;
  - ensuring all I2 directives identified and managed;
  - leading Test & Evaluation; and
  - capability performance, availability, readiness and preparedness.



139

Project Sponsor

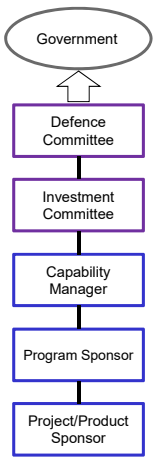
- Project Sponsor is accountable to the Capability Manager and Program Sponsor for delivery of the Product.
- Accountable for (inter alia):
  - development of capability needs incl FIC and I2;
  - Business Case;
  - setting direction for the Project; and
  - approving the overall risk profile.



140

Project/Product Sponsor

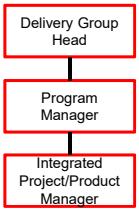
- Product Sponsor is accountable to CM and Program Sponsor for:
  - Product outcomes; and
  - preparedness levels in alignment with strategic priorities.



141

Delivery Groups

- Supports CM.
- Develops Project Execution Strategy (PES).
- Conduct Independent Assurance Reviews (IAR).
- Coordinate early Industry involvement.
- Execute Integrated Project Management Plan (IPMP).
- Sustain and dispose capability as directed & resourced by CM.



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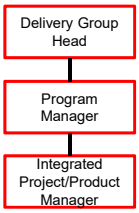
Delivery Groups

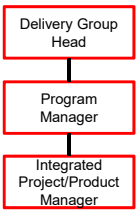
- Includes:
  - CASG (materiel);
  - CIOG (ICT);
  - SP&I (classified projects); and
  - E&IG (facilities).



143

Program Manager

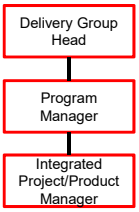
- Appointed within Delivery or Enabler Group.
- Conducts Program Management for acquisition, sustainment, and disposal activities.
- Pivotal to:
  - coordinating across related Projects, Products, and activities; and
  - optimisation of available resources.
- Program Management related policies and practices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



144

Integrated Project Manager (IPM)

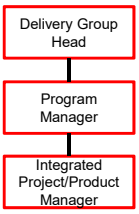
- Responsible to plan and deliver the Project:
  - inclusive of all agreed FIC; and
  - to specified:
    - scope,
    - schedule, and
    - budget.
- Coordinate delivery and integration of FIC and other enabler elements.



145

Integrated Product Manager

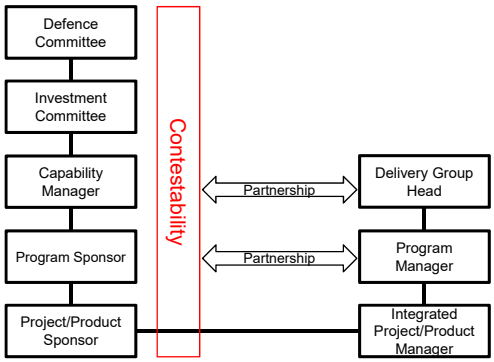
- Responsible (to SPO Director and Product Sponsor) to:
  - ensure all FIC identified and available to sustain the Product;
  - plan and coordinate inputs from FIC providers including industry; and
  - coordinate development, management of delivery agreement including the Product Schedule.



146

Contestability Division

- Independent assurance to VCDF, Secretary, CDF, Central Agencies, Ministers and Government.
- Ensures Defence's capability needs aligned with strategy and resources.
- Ensures proposals can be delivered.



147

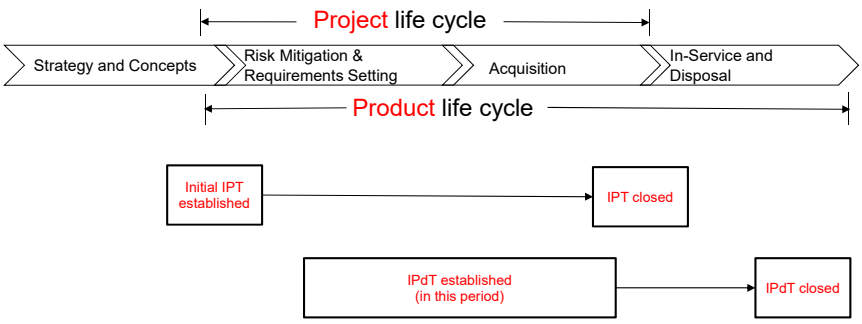
Enabler Groups

- Enabler Group Head accountable to the Secretary and CDF for providing assets and resources to IPT for delivery and/or sustainment of capability.
- Deliver and manage FIC and enabler components:
  - as coordinated by the Delivery Group (lead);
  - as documented in Integrated Project Management Plan (IPMP);
  - support capability throughout its service life; and
  - dispose of facilities and systems.
- Contribute to CM's Program strategies and initial Project planning.

148

Integrated Project/ Product Teams

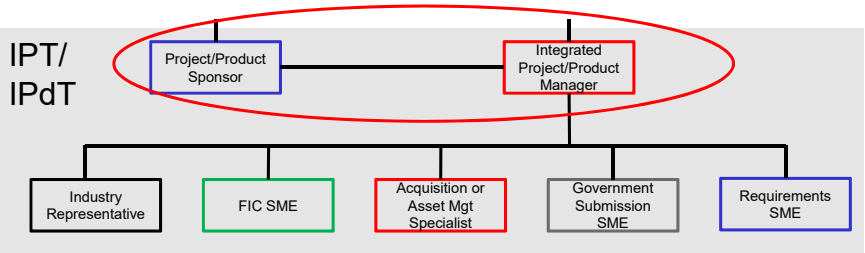
- IPT: established to manage Project functions up to end of Acquisition Phase.
- IPdT: established before end of the Acquisition Phase to conduct asset management activities for a Product.



149

Integrated Project/ Product Teams

- In both Project and Product cases:
  - customer and supplier sides share a partnership; and
  - comprise representatives from all relevant stakeholders.



150

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.

151

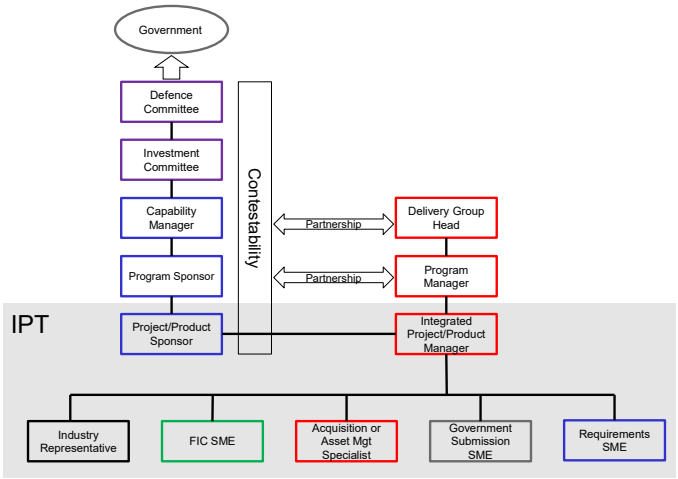
Capability Manager Gate Review (CMGR)

- Capability Manager-led governance forum.
- Not compulsory (choice of CM).
- Quality control point for Projects/Programs prior to IC.
- Opportunity for:
  - high level consultation; and
  - identify and resolve key concerns.
- CMGR Synopsis and Documentation to be submitted by x working days prior to CMGR meeting.
- Contestability advice either:
  - Stand-alone Contestability Brief, or
  - Sponsor's Paper/Business Case with embedded Contestability advice.

152

Revision

12. Draw a diagram of the CLC Accountability Model.



Funding

154

Integrated Investment Program (IIP)

- Single integrated program: all investment needed to deliver and sustain Australia's defence capabilities.
- Includes equipment, infrastructure, ICT, science and technology, and workforce.

155

Capability Development Investment Fund (CDIF)

- Funding line in IIP.
- Governance principles for access and management of CDIF.
- Primarily for high-level strategy development and early risk reduction activities for current & future IIP Programs and Projects.
- Allocation:
  - Up to Gate 0 Program level CDIF allocated annually to CMs by IC.
  - Post Gate 0 CDIF allocated by IC on case-by-case basis.
- CMs bid (Oct) for pre-Gate 0 Program CDIF for coming FY.

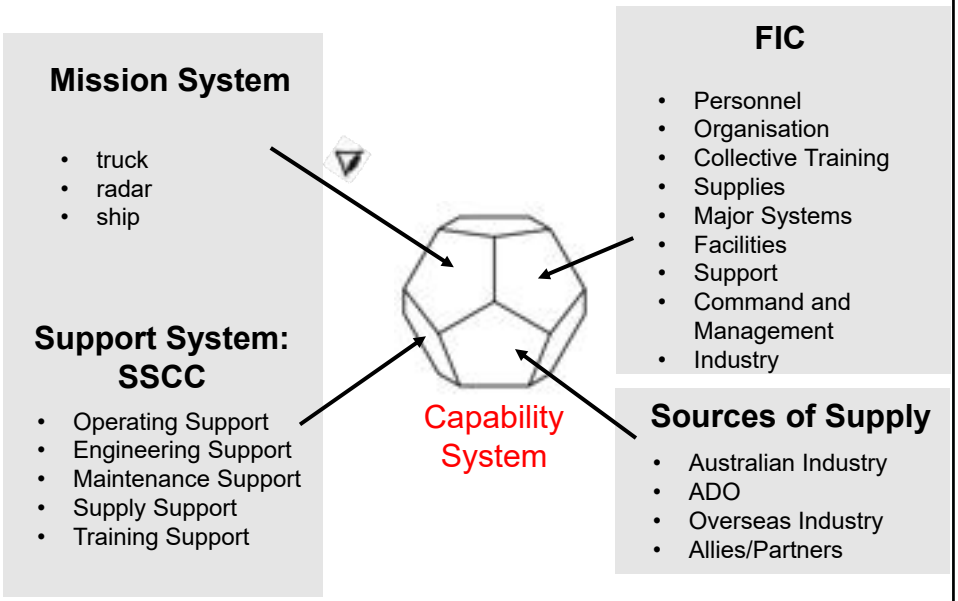
156

Capability Development Investment Fund (CDIF)

- CDIF is for:
  - early investigation activities to identify & research options;
  - development of PES and Gate 0 Business Case;
  - Smart Buyer workshops; and
  - concept demonstrators.
- Early access to IIP funding should be sought before defaulting to CDIF.
- Where IIP funding not available, additional CDIF can be requested.
- Consult with IPMB to discuss optimal funding mix between CDIF and early access to IIP provision.

Frameworks to Understand Components of Capability

Capability Perspectives



159

Defence Capability

Force Structure + **Defence Preparedness**

Force elements capable of delivering specific effects and countering threats

Maintaining the force structure at an appropriate state of preparedness

160

Defence Capability

Force Structure + **Defence Preparedness**

Force elements capable of delivering specific effects and countering threats

Maintaining the force structure at an appropriate state of preparedness

Readiness

Being ready to deploy on military operations.

Sustainability

Being able to continue operating

161

Defence Capability

Force Structure + **Defence Preparedness**

Force elements capable of delivering specific effects and countering threats

Maintaining the force structure at an appropriate state of preparedness

Readiness

Being ready to deploy on military operations.

Sustainability

Being able to continue operating

162

Defence Capability (System)

Force Element + **What keeps the force element prepared**

eg command structure for using truck

Not everything!

eg training for personnel who operate truck

eg trained personnel to operate truck

eg trained personnel to keep truck maintained

Not everything!

Eg facility in which to maintain the truck

Eg maintenance training

163

Mission and Support System

Force Element

(etc) +

What keeps the force element prepared

(etc)

Mission System

Focus on the equipment and its use

Support System

Supporting it In-Service

Mission and Support Systems

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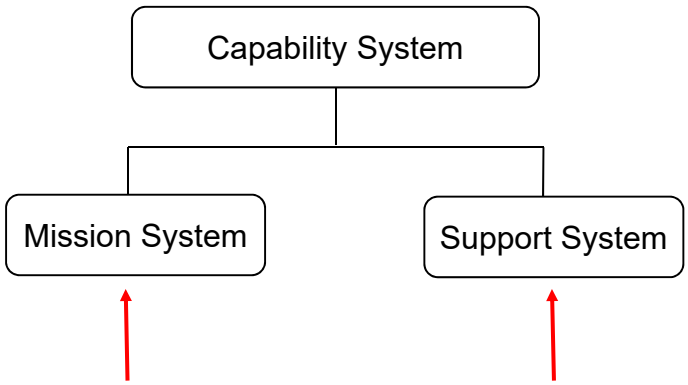
Mission and Support System Perspective



Used to focus on bringing the system into being (centred on the equipment and its use)

What is needed to support it during the **In-service Phase**

Fundamental Inputs to Capability (FIC)

167

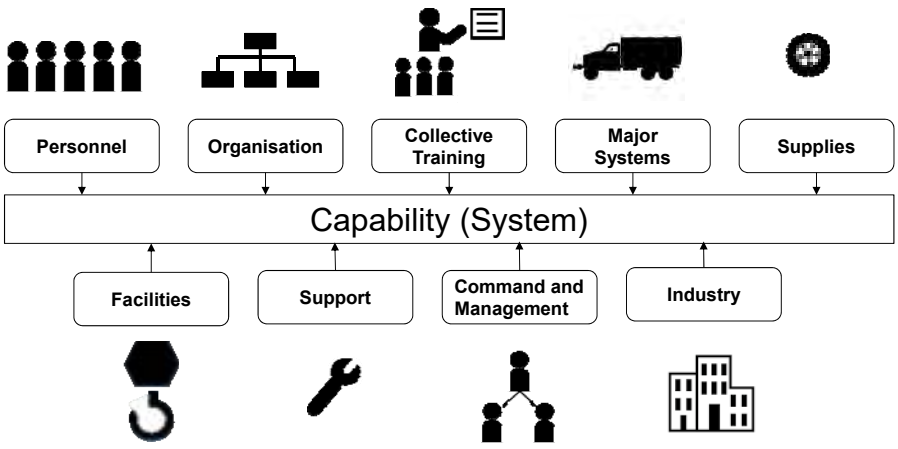
Defence Capability

- Defence capability is viewed as the capacity or ability to achieve an operational effect
- Operational effect relies on a combination of contributions or inputs:
  - referred to as Fundamental Inputs to Capability,
  - not just the equipment, and
  - all inputs must be in place to deliver operational effect.
- A deficiency in any one adversely impacts the whole.

168

Fundamental Inputs to Capability (FIC)

Comprehensive



169

Fundamental Inputs to Capability (FIC)

- Fundamental Inputs to Capability (FIC) construct provides a framework to enable:
  - comprehensive analysis and planning of capability;
  - consideration of all inputs for effective and ongoing generation of Defence capabilities; and
  - focus on combination and integration of inputs rather than on individual inputs separately.
- Makes sure nothing is forgotten to deliver operational effect.
- Everything for the capability is covered to ensure continued and assured lethality and preparedness.

170

Fundamental Inputs to Capability (FIC)

- Organisation: capability employed within functional groupings with appropriate balance of competency, structure, and command and control.
- Command and Management: effective command and management arrangements at all levels to safely and effectively employ the capability.
- Personnel: a competent workforce, including ADF, APS and contractors, for delivery, operation, sustainment and disposal of capability.

Source: http://www.defence.gov.au/publications/docs/Capability-Life-Cycle-Detailed-Design.pdf

171

Fundamental Inputs to Capability (FIC)

- Collective Training: capability supported by a collective training regime.
- Major Systems: includes significant platforms, fleets of equipment and operating systems that enable the effective generation of Defence capabilities.
- Facilities and Training areas: infrastructure necessary to support the delivery, sustainment and operation of a capability system, including training areas.
- Supplies: include managing all classes of supply to maintain a capability at the designated readiness state, including sustainment funding and fleet management.

Source: http://www.defence.gov.au/publications/docs/Capability-Life-Cycle-Detailed-Design.pdf

172

Fundamental Inputs to Capability (FIC)

- Support: engineering support; maintenance support; supply support; training support; packaging handling, storage and transportation; facilities; support and test equipment; personnel; technical data and computer support.
- Industry: consideration of the resilience and capacity of industry, such as the reliability and health of supply chains.

Source: http://www.defence.gov.au/publications/docs/Capability-Life-Cycle-Detailed-Design.pdf

173

Revision

13. List the nine Fundamental Inputs to Capability (FIC).

- Organisation.
- Command and Management.
- Personnel.
- Collective Training.
- Major Systems.
- Facilities and Training areas.
- Supplies.
- Support.
- Industry.

Support System Constituent Capabilities (SSCC)

175

Support System Constituent Capabilities

- Defence groups the support elements that comprise the Support System through five functional categories:
  - Operating Support.
  - Engineering Support.
  - Maintenance Support.
  - Supply Support.
  - Training Support.

176

SSCC Elements

1. Operating Support Capability.
   - operating facilities system operators,
   - support equipment,
   - operator manuals and technical data,
   - operating support procedures, and
   - operating support information systems.

177

SSCC Elements

2. Engineering Support Capability.
   - engineering facilities,
   - engineering personnel,
   - engineering support and test equipment,
   - engineering technical data,
   - engineering processes,
   - engineering information management system, and
   - software support.

178

SSCC Elements

3. Maintenance Support Capability.
   - develop, establish and integrate a maintenance support system capable of sustaining a system throughout its life
     - maintenance facilities,
     - maintenance personnel,
     - maintenance support and test equipment,
     - maintenance technical data,
     - maintenance processes, and
     - maintenance information management system.

179

SSCC Elements

4. Supply Support Capability.
   - supply facilities,
   - supply personnel,
   - supply support equipment,
   - supply technical data,
   - supply processes,
   - supply information management system,
   - spares, and
   - packaging.

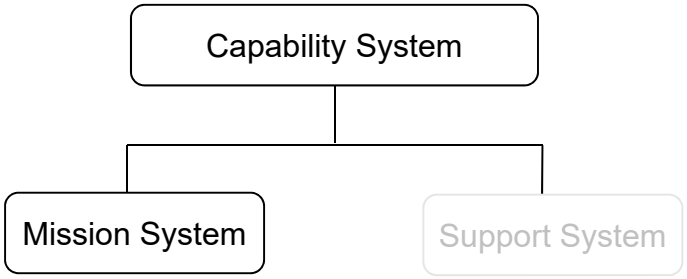
180

SSCC Elements

5. Training Support Capability.
   - training facilities
   - training personnel,
   - training equipment,
   - training materials and other technical data,
   - training processes, and
   - training information management system.

181

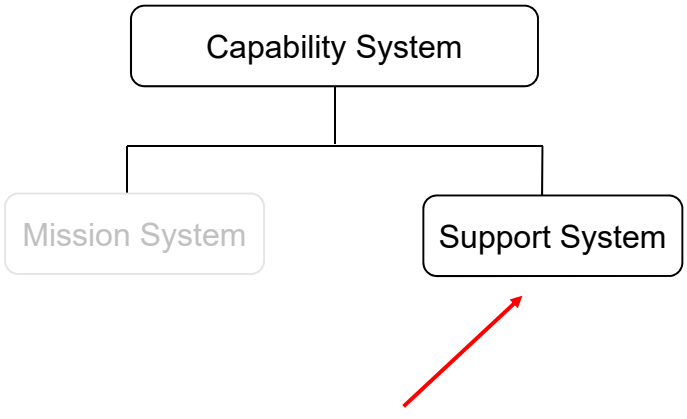
Mission and Support System Perspective



- Equipment
- Trained personnel to use it
- Training for personnel who use it
- Command structures
- Doctrine for its use
- Training facilities …

182

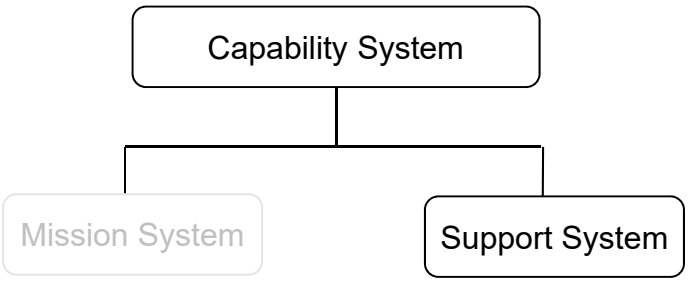
Support System Perspective



Support System Constituent Capabilities (SSCC) framework helps break down Support requirements for in-service phase

183

Mission and Support System Perspective

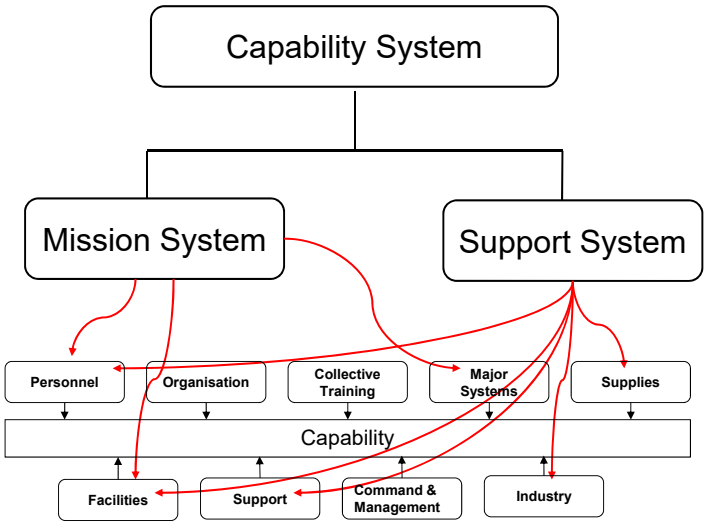


Support System Constituent Capabilities (SSCC)

- Operating Support
- Engineering Support
- Maintenance Support
- Supply Support
- Training Support

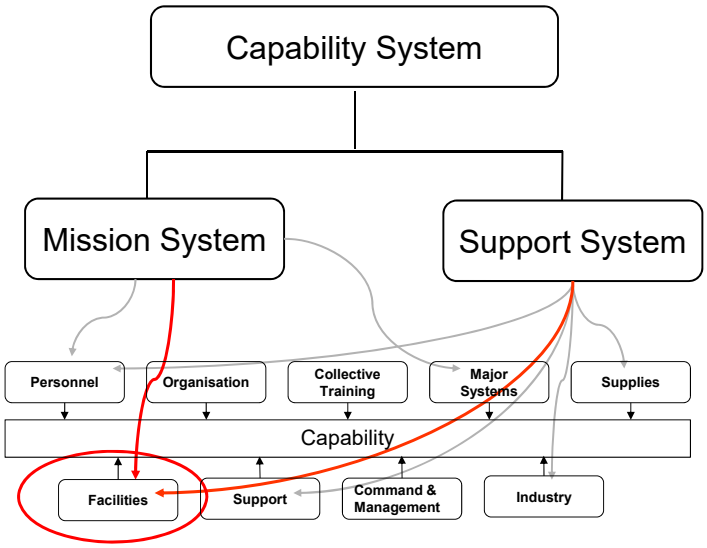
184

FIC Perspective



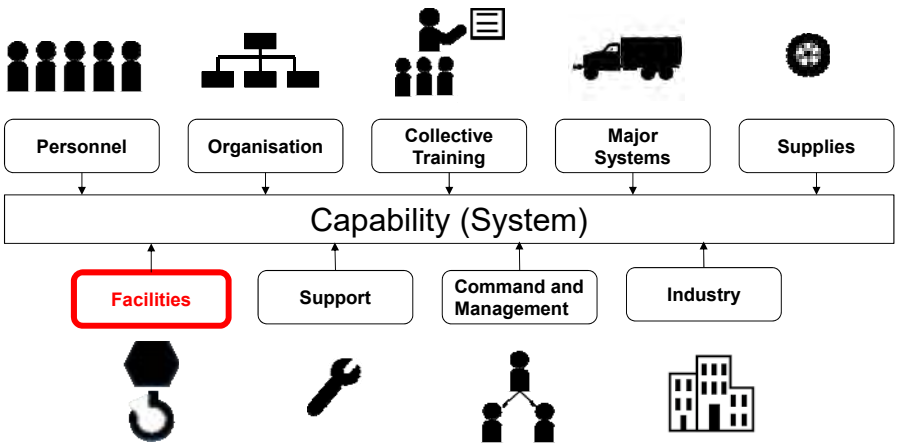
185

FIC Perspective



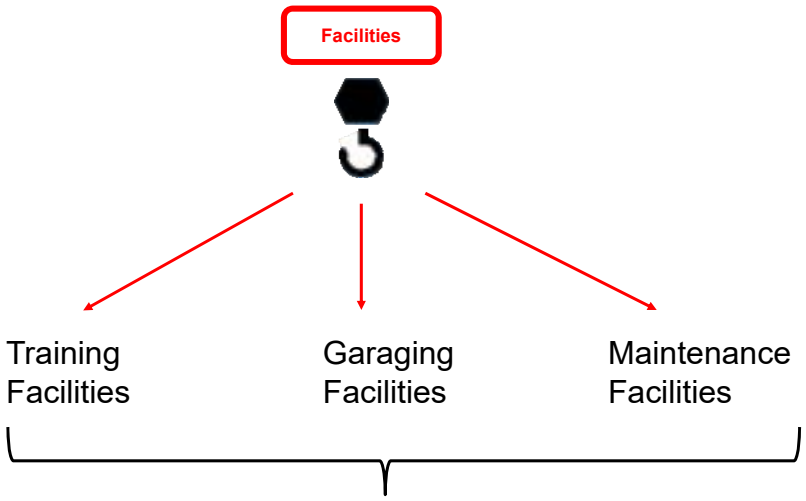
186

Fundamental Inputs to Capability (FIC)



187

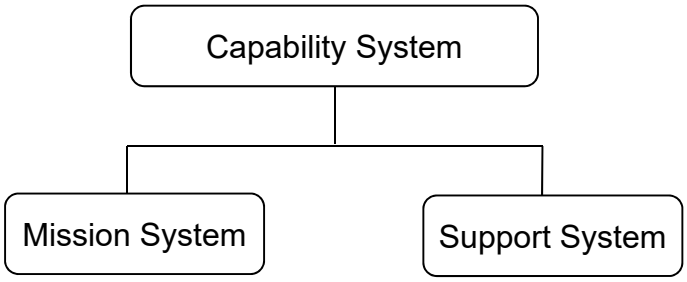
Fundamental Inputs to Capability (FIC)



Estate and Infrastructure Group (E&IG) organises

188

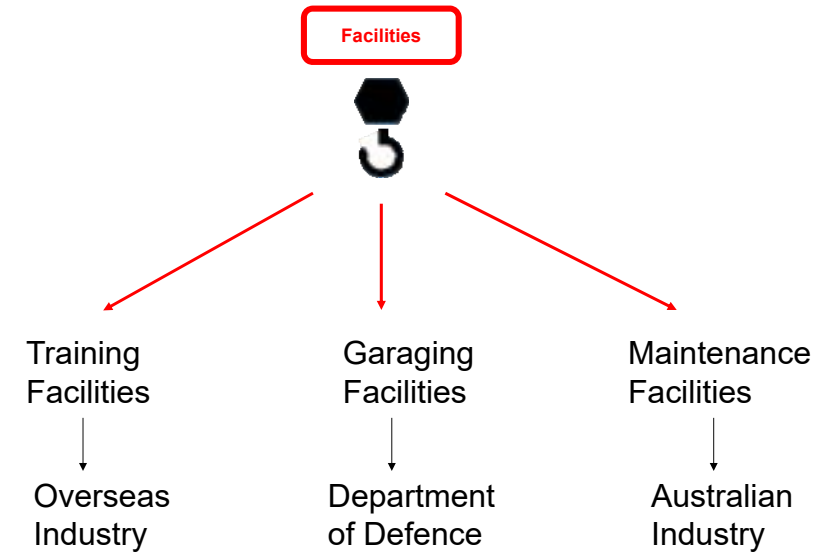
Supplier Perspective



- Department of Defence
- Australian Industry
- Overseas Industry
- Other Defence organisations (eg US DoD)

189

Supplier Perspective



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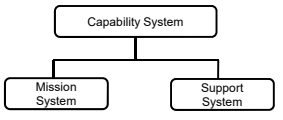
Capability Perspectives

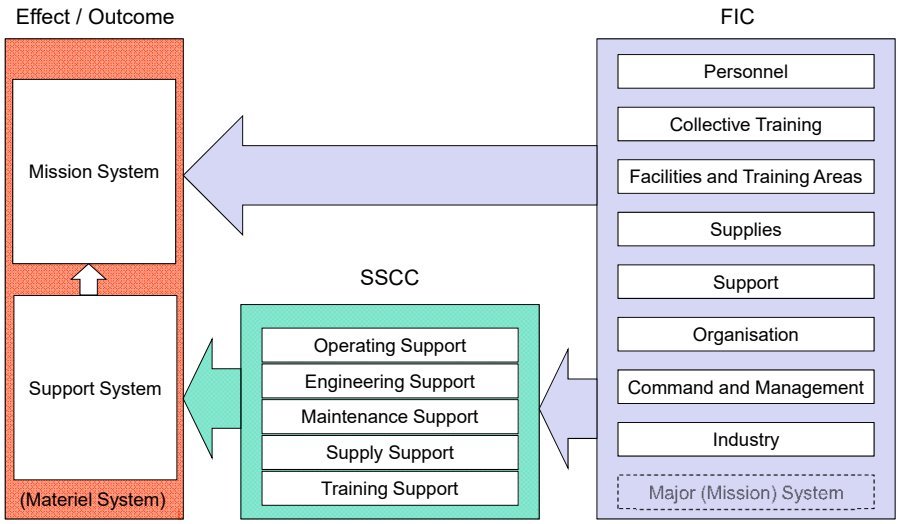


SSCC

These structures help:

- ensure everything is covered
- define requirements of mission system & its support system
- delineating what CM, CASG, E&IG, CIO etc organises
- defining who supplies the different elements
- defining elements for which industry is contracted.

Capability System



192

Revision

13. List the nine Fundamental Inputs to Capability (FIC).

- Organisation.
- Command and Management.
- Personnel.
- Collective Training.
- Major Systems.
- Facilities and Training areas.
- Supplies.
- Support.
- Industry.

193

Revision

14. List the five Support System Constituent Capabilities.

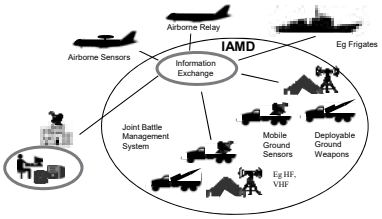
- Operating Support.
- Engineering Support.
- Maintenance Support.
- Supply Support.
- Training Support.

Integration and Interoperability Framework (I2F)

195

I2 Framework (I2F)

- Supports Joint Force outcomes:
  - Integration between ADF force elements.
  - Interoperability with Allies, Coalition, civil/government elements.

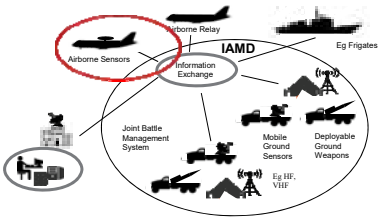


Source: Architecture Development as a Mission System Integrator, Steven J. Saunders Raytheon Australia, SETE 2008 Canberra

196

I2F: Purpose

- Purpose of I2F is to help:
  - define interdependencies and interfaces between related systems;
  - keep interfaces (and related system functionality) in 'lock step'; and
  - ensure system/interface changes that affect related systems are known.



197

I2F: Elements

- What does it provide?
  - structured approach to I2 information capture:
    - reflects CLC management layers; and
    - traceable to strategic guidance and other drivers.
  - common authoritative reference:
    - assigned authorities;
    - overarching design and 'drivers' (eg design patterns and standards); and
    - configuration controlled.
  - 'living' information source which captures I2 features of systems and can be updated:
    - during definition and acquisition; and
    - in-service systems (Products).

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I2 Framework (I2F)

- Components of I2F:
  - 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.

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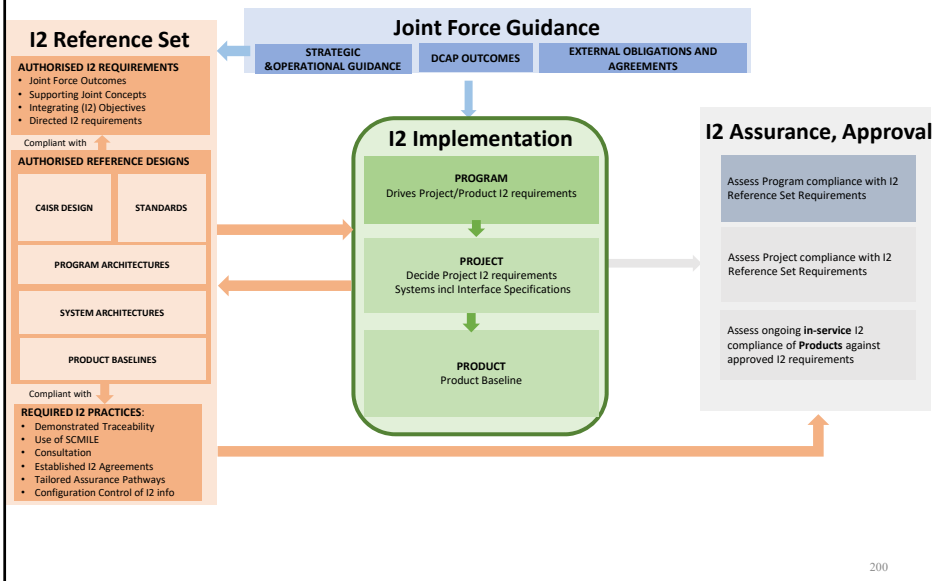
I2 Reference Set

- The I2 Reference Set provides:
  - Authoritative and up-to-date source of I2 information:
    - configuration status, and
    - requirements for all joint force efforts.
  - A reliable 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.

I2 Framework (I2F)



200

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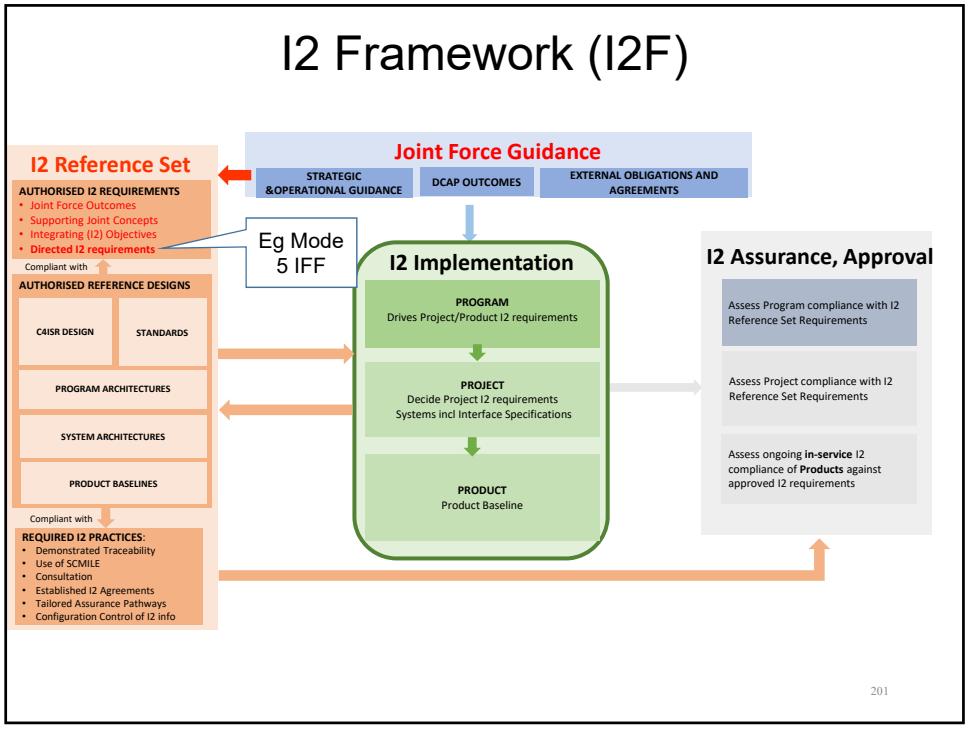
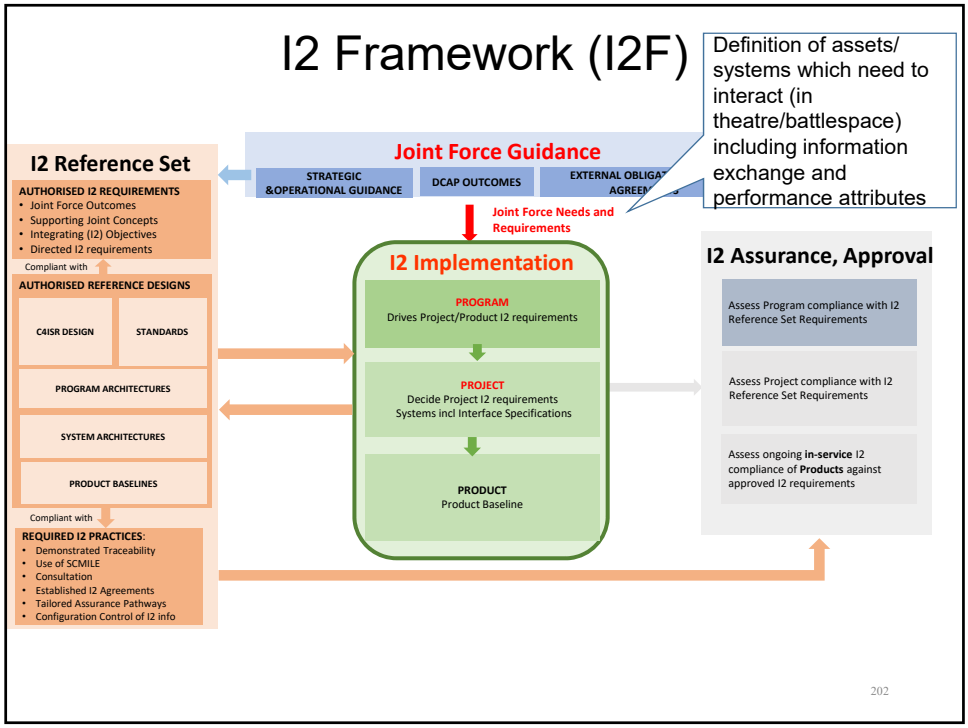
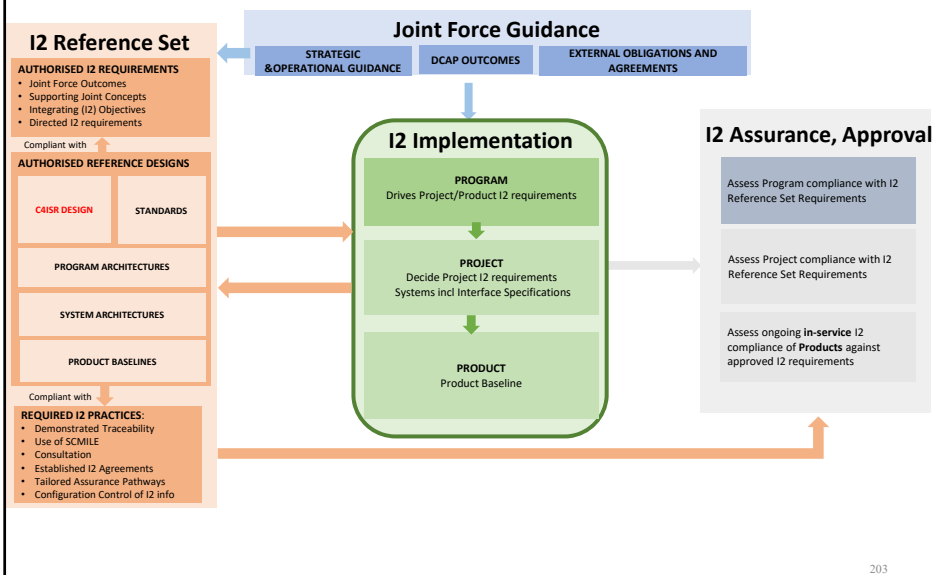




I2 Framework (I2F)



204

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.
- …

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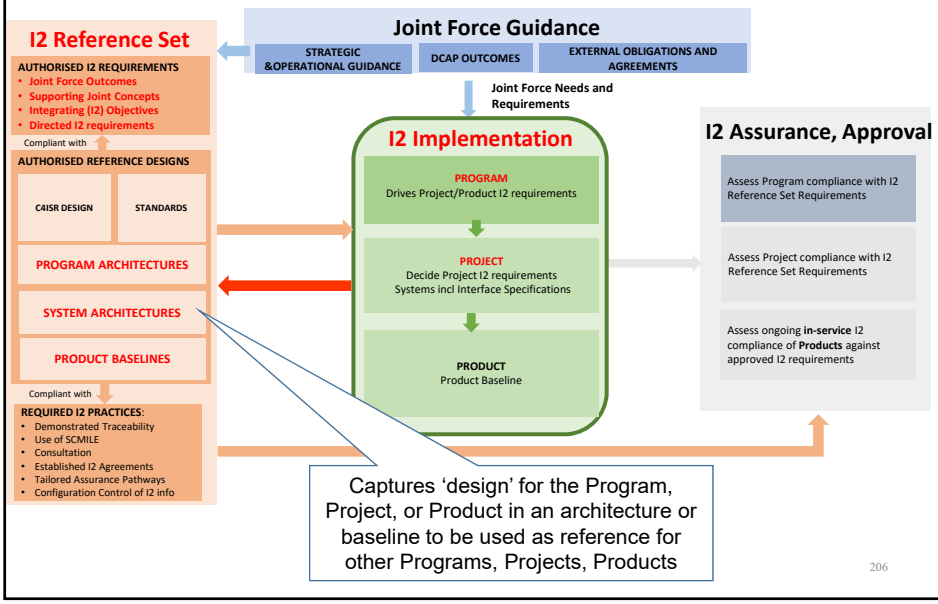
C4ISR Design

- …
- 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 and future systems, and
  - trusted, relevant and timely decision quality information.

I2 Framework (I2F)



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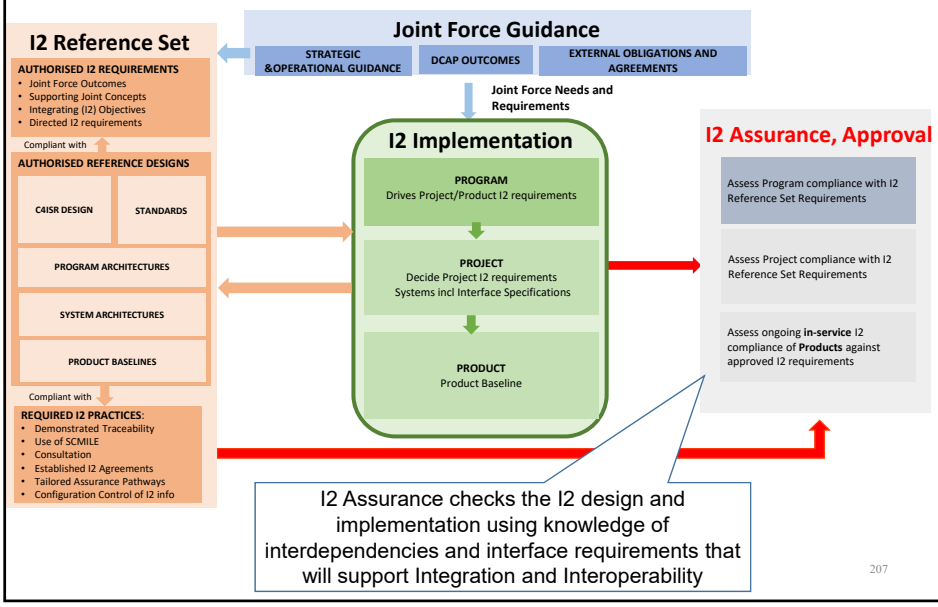
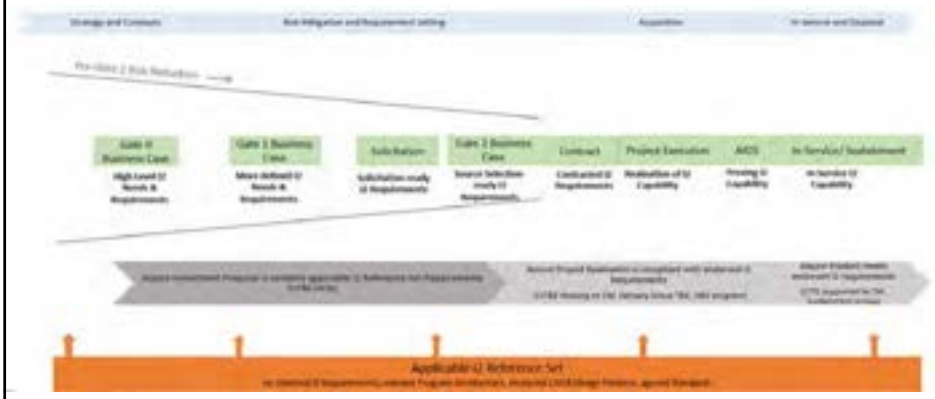
I2 Framework (I2F)



I2 is Addressed Across the CLC



PREVIEW OF COMING COURSE CONTENT

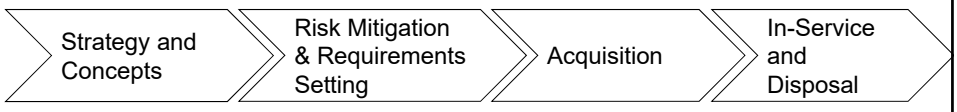
PHASES OF THE CLC

211

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.



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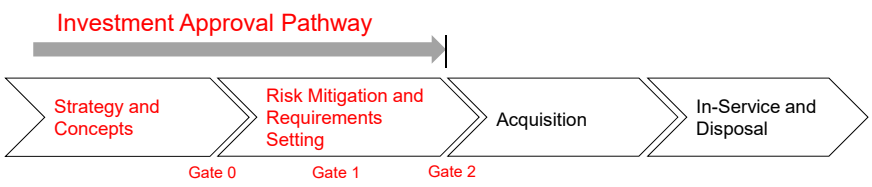
CLC Gates

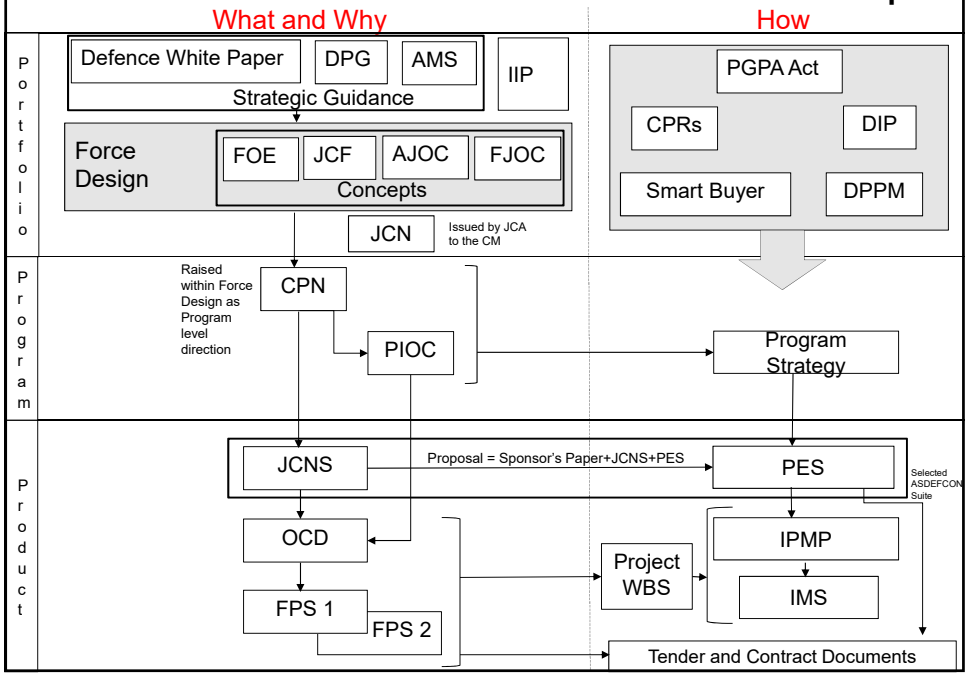
There are three decision gates:

- 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.



PREVIEW OF CLC DOCUMENTS AND ARTEFACTS

Overview: CLC Artefacts and Relationships



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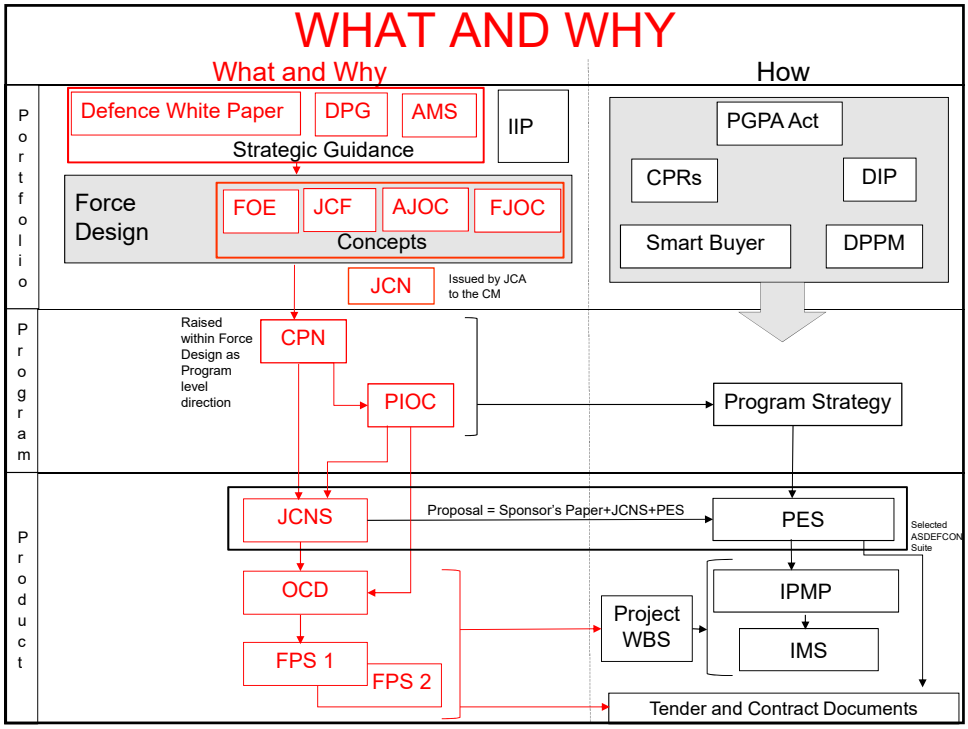

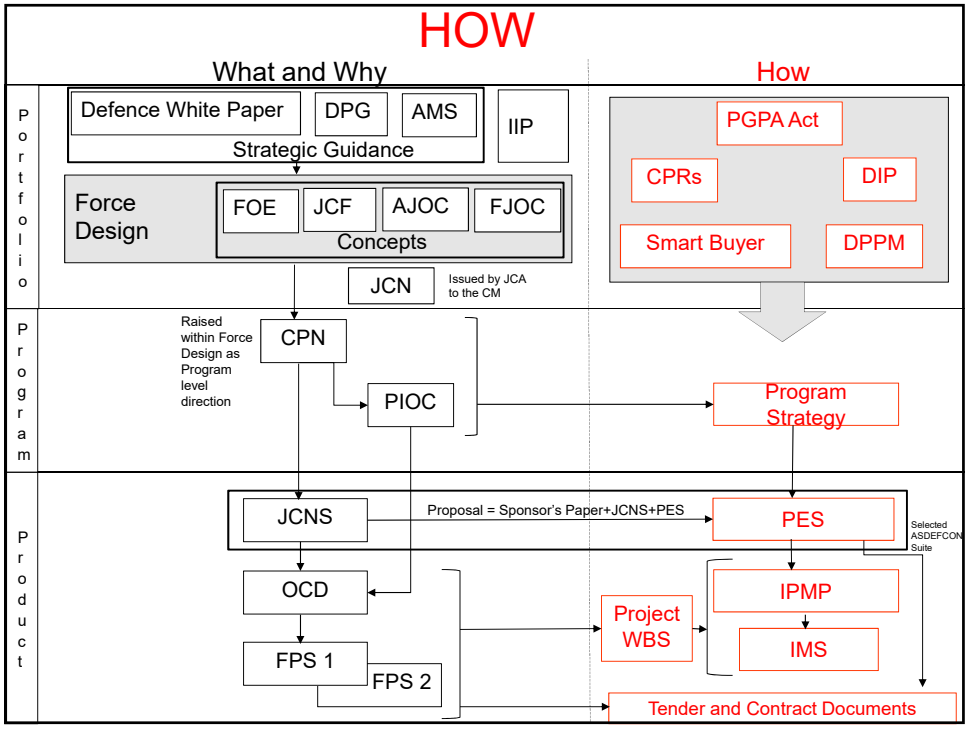

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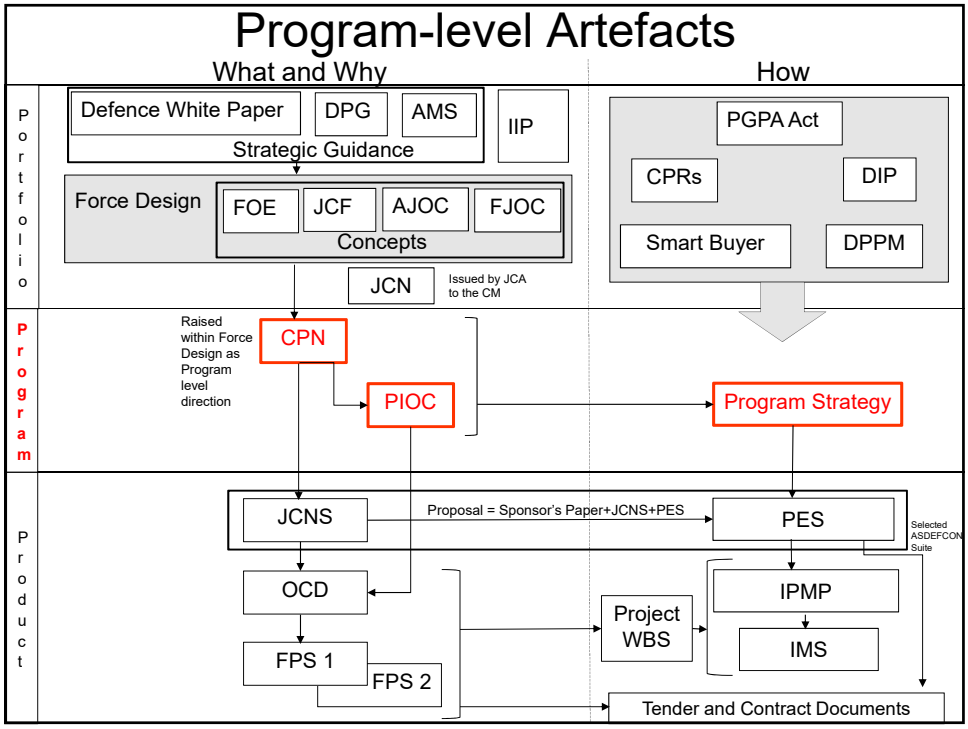
Key CLC Artefacts

- 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-level Artefacts



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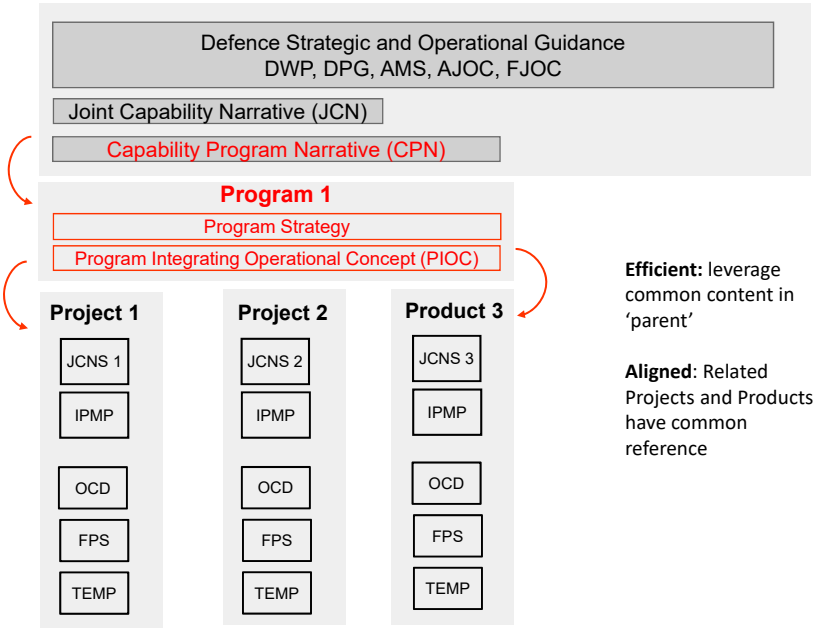
Key Enablers for Program Management

- 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.
- ….

Program Layer as 'Umbrella' Reference



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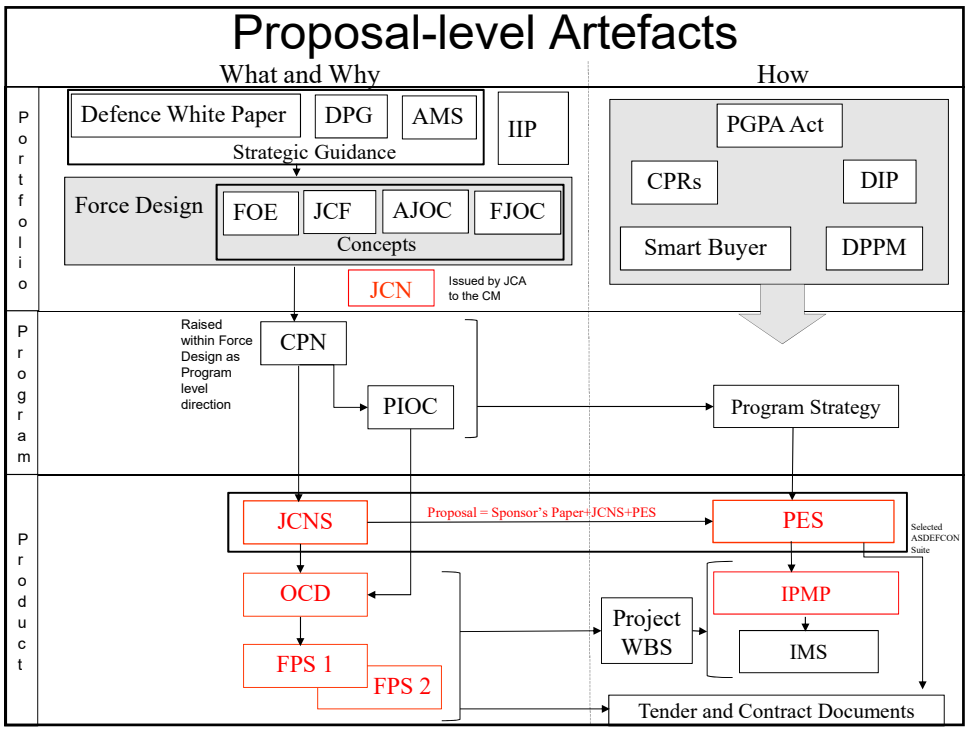

Proposal Artefacts

222

- 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).

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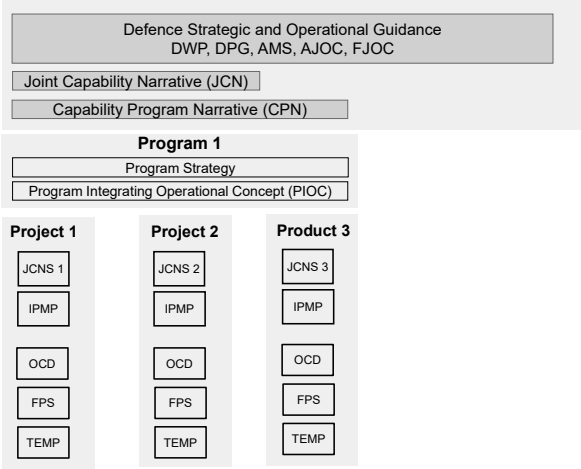
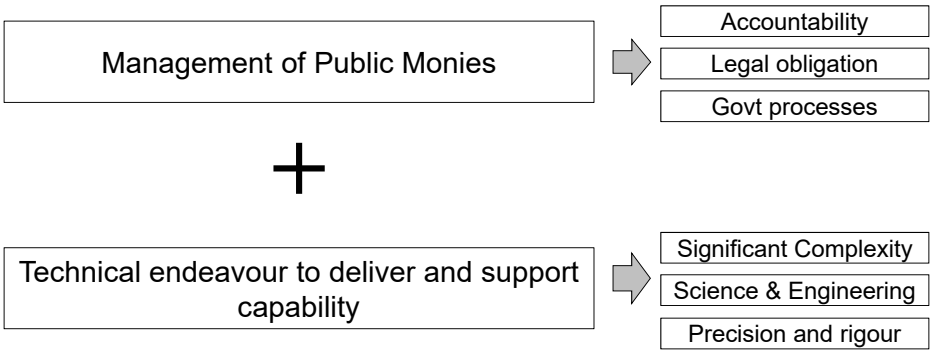
Revision

15. Draw a simple hierarchical diagram of the principal CLC proposal artefacts.



CAPABILITY MANAGEMENT PRACTICES

CLC & Capability Development: Challenge



Intersection of Public Sector obligations and technical endeavor

CLC, Capability Development Context

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- Context:
  - Significant complexity, scale and cost.
  - Interdependencies.
  - Many stakeholders.
  - High cost.
  - Leading edge technologies.
  - Changing environment.
- Successful capability development depends on proven professional Practices beyond organisational processes.

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Capability Development Practices

- Developed by experts in each field.
- Based on best practice.
- Captured in:
  - International and Australian standards; and
  - Bodies of Knowledge (BoK).
- Proven techniques, methodologies.
- Flexible: can be tailored to specific circumstances.

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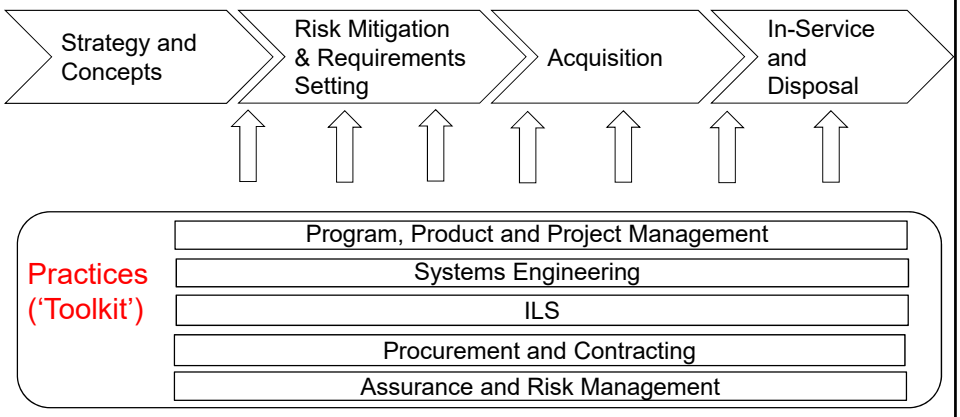
Capability Development Practices

- 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 Practice provides a different 'lens' and role for capability development.

Capability Development Practices



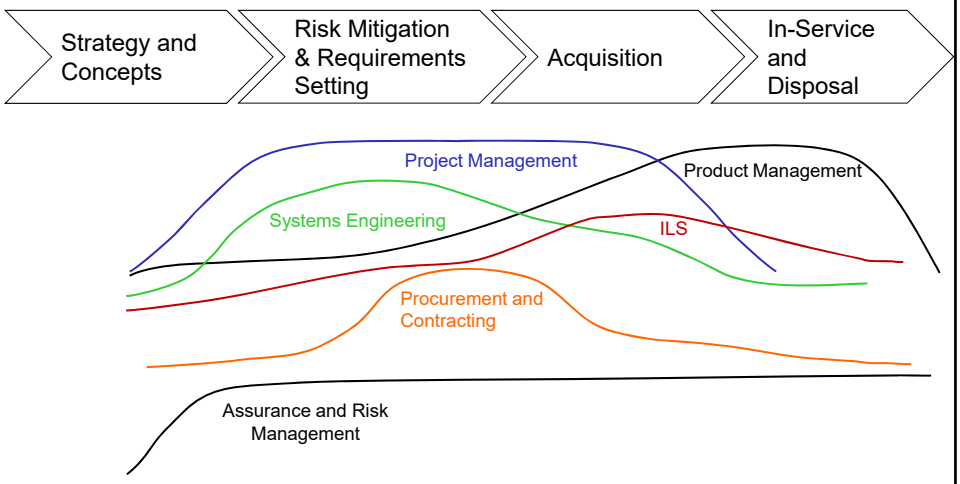
Practices are applied throughout the CLC Process tailored to the CLC Phase and the nature of effort.

Practices: Level of Effort over CLC

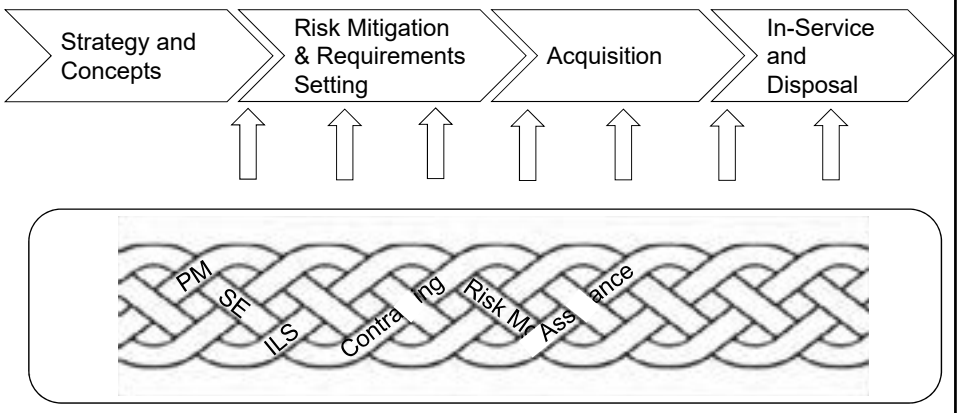
Practices applied:

- throughout the CLC
- at different levels of intensity and depth
- depending on the phase and the nature of the effort

Practices: Level of Effort over CLC

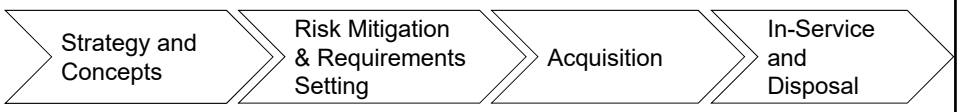


Capability Development Practices



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

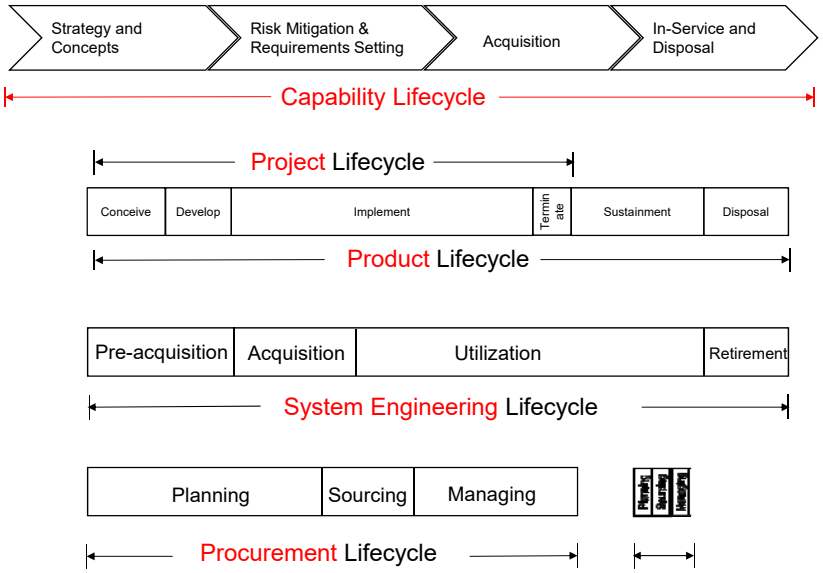
Practices: Lifecycles



Practices:

- Often described in terms of specific lifecycles.
- Generic Practice lifecycles can be adapted/ tailored.

Lifecycle Views of CLC Practices



PROGRAM MANAGEMENT

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Program Management and Defence

- Two core Defence challenges:
  - warfighting advantage: joint force; and
  - resource constraints: efficiencies.
- CLC Programs help manage relationships and interdependencies:
  - complex and complicated; and
  - endure over time.
- Program Management Practice can be applied:
  - Capability Programs (eg IAMD).
  - 'Delivery' Programs (eg Radar SPO).

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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.

PRODUCT MANAGEMENT

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Asset Management

- Product Management is 'end to end' management of the Product that delivers capability.
- Interim CLC Manual emphasises 'asset management' approach for the CLC:
  - holistic view;
  - balanced approach; and
  - delivering value to the organisation.

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Product Management

Product management within CASG involves the planning, management and integration of all constituent assets and services, to achieve the agreed level of Product performance as defined in Product delivery agreements.

CASG manages Defence Products through the application of asset management principles described in AS ISO 55000-55002:2014 Asset Management Standards.

Source: Product Management Manual

Defence Product Management

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

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

Asset Management

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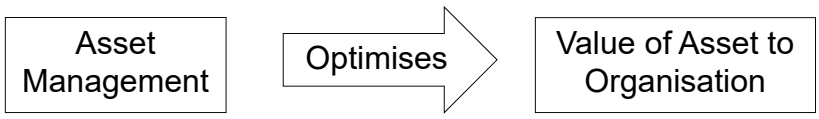
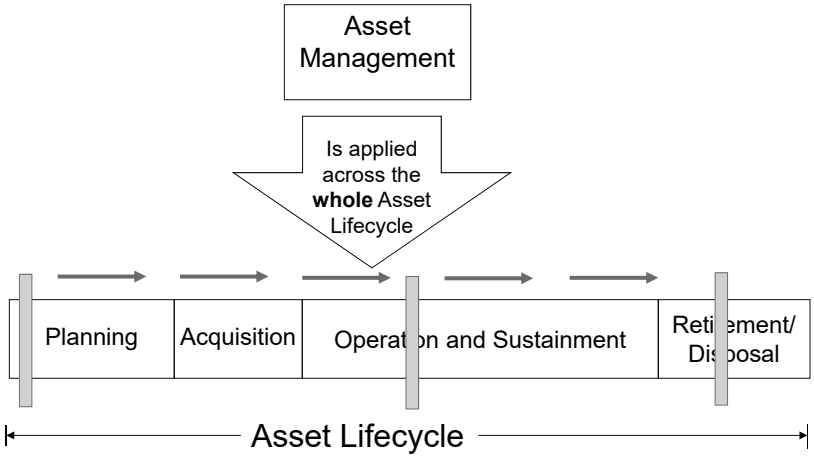


243

Asset Management



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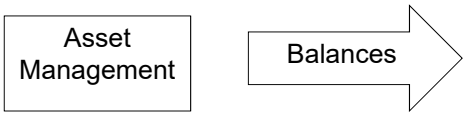
Asset Management



- Acquisition outcomes.
- Asset Availability and Performance.
- Support and Operational costs.
- Total Cost of Ownership.
- Organisational Risk.

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Asset Management Fundamentals

Asset Management is based on a set of fundamentals as described in AS ISO 55002:2014:

- Value.
- Alignment.
- Leadership.
- Compliance and Assurance.

PROJECT MANAGEMENT

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Defence Project Management

- Structured and reliable means to deliver a Product.
- CASG Project Management follows principles from:
  - Project Management Body of Knowledge (PMBOK®).
  - AS ISO 55000-55002:2014.
  - Managing Successful Programs (MSP).
  - AS ISO 21500:2016 Guidance on Project Management.

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Integrated Project Management: Dimensions

Project Management is an integrating discipline which ensures:

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Integrated Project Management: Dimensions

Project Management is an integrating discipline which ensures:

- consideration of Whole of Lifecycle

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Integrated Project Management: Dimensions

Project Management is an integrating discipline which ensures:

- consideration of Whole of Lifecycle
- Joint Force Integration.

251

Integrated Project Management: Dimensions

Project Management is an integrating discipline which ensures:

- consideration of Whole of Lifecycle
- Joint Force Integration.
- coordinating and integrating FIC.

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Integrated Project Management: Dimensions

Project Management is an integrating discipline which ensures:

- Consideration of Whole of Lifecycle.
- Joint Force Integration.
- FIC coordination and integration.
- Integration of supporting Practices.

SYSTEMS ENGINEERING

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Defence Capability Context

Defence materiel characterised by:

- highly sophisticated engineered systems:
  - leading-edge technology;
  - novel adaptation of technology;
  - significant integration;
  - electronics-based and software intensive;
  - particular demands on availability, redundancy, endurance, security, and safety; and
  - integrates several engineering disciplines eg mechanical, civil, electrical, aerospace.
- Can only be realized through rigorous formalised methods.

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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.

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Systems Engineering and the CLC

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

- trusted method for deriving requirements.
- rigorous approach to deciding alternatives and best solution
- ensures holistic consideration of all factors
- provides structured assurance (e.g. System Review process)
- rigorous identification technical risks for risk reduction.

INTEGRATED LOGISTICS SUPPORT

258

Defence Sustainment

- "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"

ANAO Report No.2 2017–18,

Performance Audit Defence's Management of Materiel Sustainment.

259

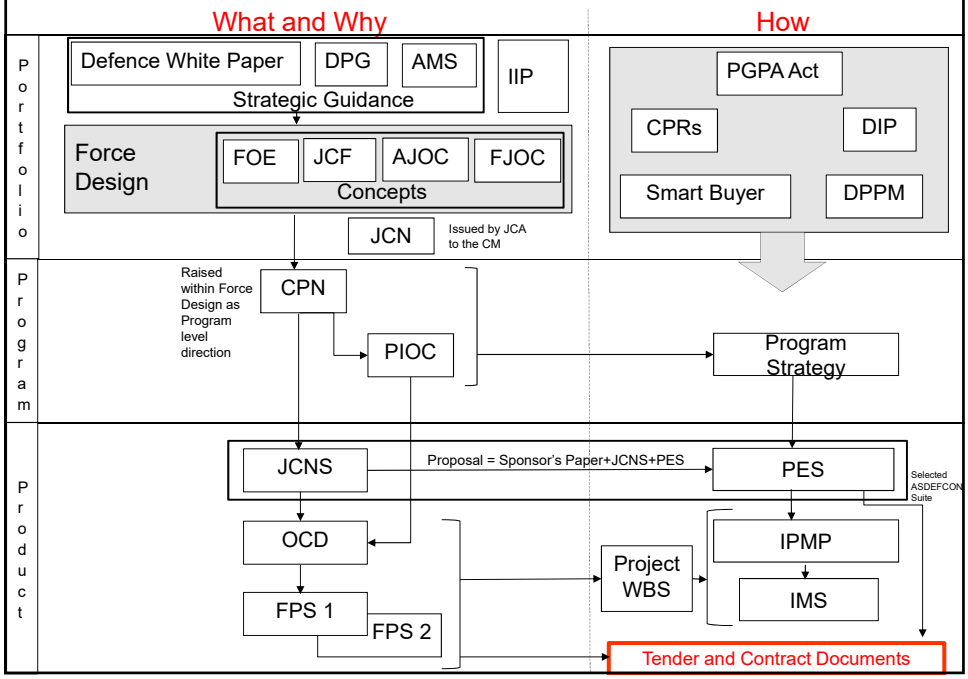
ILS

- Ensures that availability, supportability, and lifecycle cost of capability is considered during design and development of mission and support system.
- ILS practitioners:
  - influence system requirements and design;
  - define support elements for capability lifecycle; and
  - contribute to planning and management of support system.

PROCUREMENT AND CONTRACTING

Dr Mike Ryan & Dr Shari Soutberg

CLC: Tender and Contract Documents



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Procurement and Contracting

- Materiel acquisition and sustainment contracts worth approximately $12 billion.
- Dependent on sound procurement and contracting practices:
  - maximise return on investment in capability;
  - delivers on cost and schedule;
  - match 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

RISK MANAGEMENT AND ASSURANCE

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Duties with Respect to Risk Management

- PGPA Act requires Commonwealth entities to manage, risk.
- Officers of the Commonwealth must observe their obligations on risk management and risk control
- Defence must establish and maintain:
  - system of risk oversight and management; and
  - system of internal control for the entity.

Source: PGPA Section 16

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Assurance in Capability Management

- Assurance provides confidence to decision-makers and managers:
  - arguments presented are sound and based on evidence;
  - claimed status is accurate; and
  - outcomes satisfy organisational objectives.
- Assurance conducted across the entire CLC
- Assurance across all dimensions of capability management incl:
  - technical,
  - safety,
  - financial,
  - seaworthiness.

SYSTEMS ENGINEERING

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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.

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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'?

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Definition of a system

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

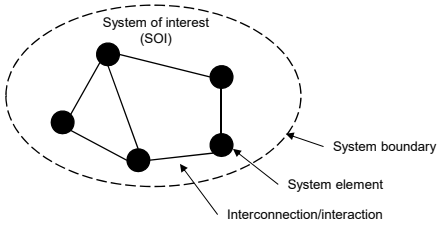
  *a combination of interacting elements organized to achieve one or more stated purposes**

* ISO/IEC 15288-2015, *Systems and Software Engineering—System Life Cycle Processes*, 2015.

270

Definition of a system

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



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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.

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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 precedented elements.

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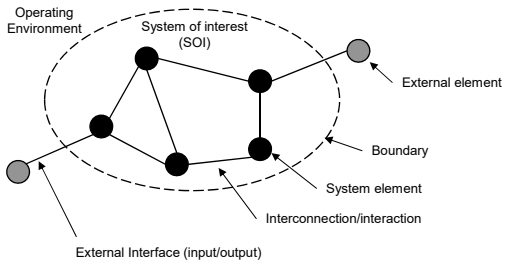
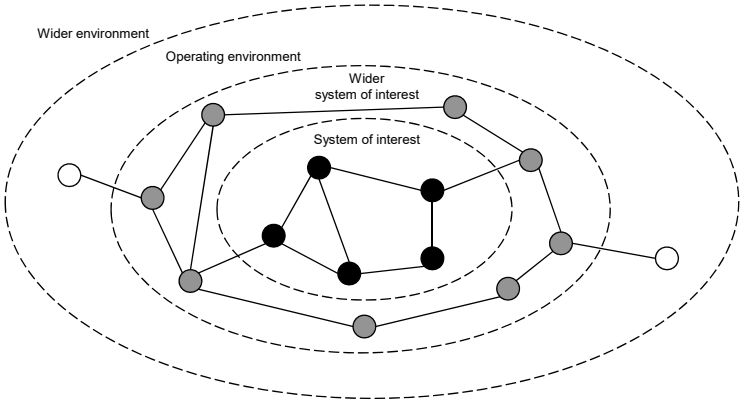
Definition of a system

- 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



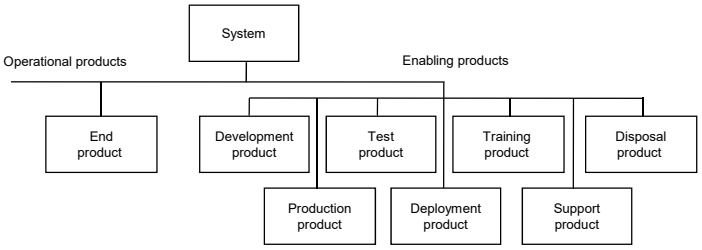
A system and its environment



276

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.



ANSI/EIA-632-1998, *Processes for Engineering a System*, Washington, D.C.: Electronic Industries Association (EIA), 1999.

277

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.

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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.

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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.

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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.

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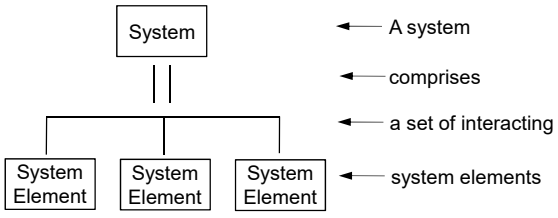
Logical and physical descriptions

- 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).

282

Hierarchical descriptions of a system

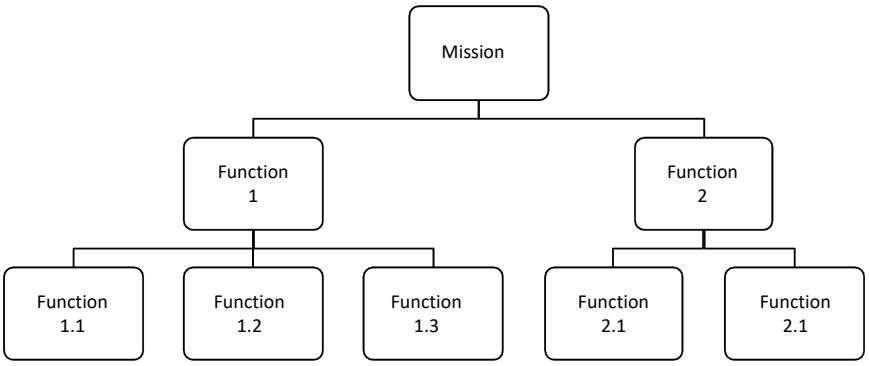
- We can consider the system to be a hierarchical composition of system elements (either logical or physical).



283

Logical (functional) hierarchy

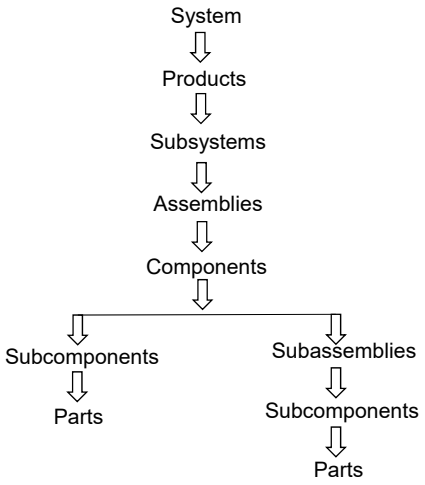
- In a logical description of a system, the system's mission is broken down into a hierarchical structure of its major functions—to form a functional hierarchy, or a functional architecture.



284

Physical hierarchy

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



IEEE-STD-1220, *IEEE Standard for Application and Management of the Systems Engineering Process*, New York: IEEE Computer

285

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).

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Revision

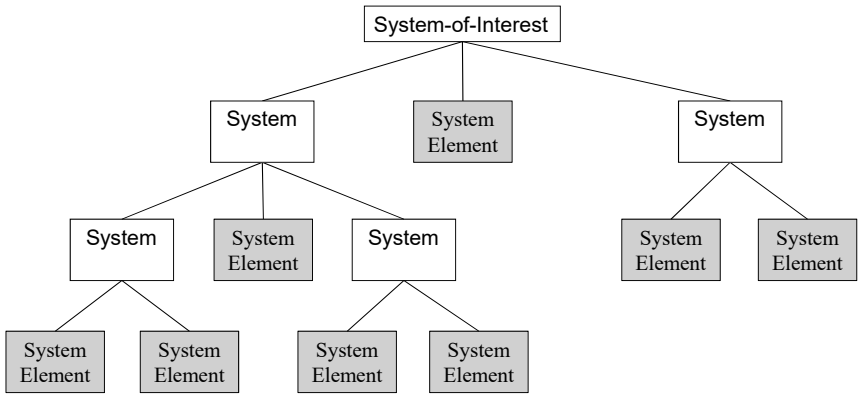
16. A system can be described *functionally* and *physically*. Explain what each description provides and describe the relationship between the two descriptions.

- 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.

287

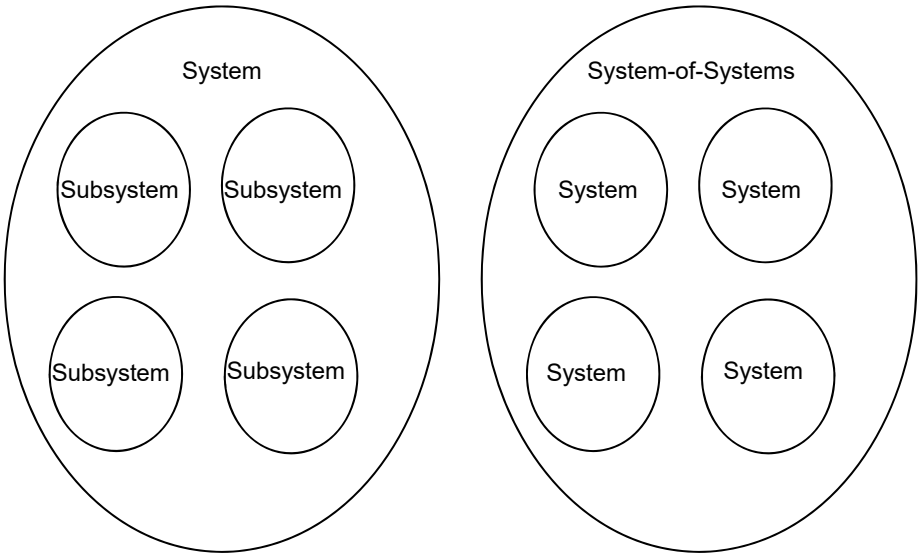
Hierarchy of an SOI

- 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.

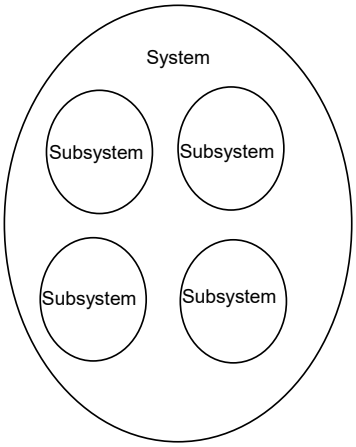


ISO/IEC 15288-2015, *Systems and Software Engineering—System Life Cycle Processes*, 2015.

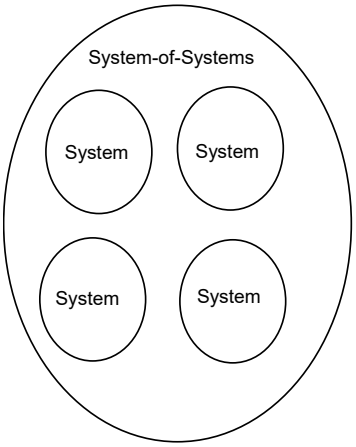
System or system-of-systems (SoS)?



System or system-of-systems (SoS)?



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.

290

Revision

17. Briefly outline the differences between a *system* and a *system-of-systems*.

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

292

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	Acquisition Phase	Utilization Phase	Retirement Phase

293

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.

Pre-acquisition Phase	Acquisition Phase	Utilization Phase	Retirement Phase

294

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.

Pre-acquisition Phase	**Acquisition Phase**	Utilization Phase	Retirement Phase

295

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.

Pre-acquisition Phase	Acquisition Phase	**Utilization Phase**	Retirement Phase

296

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.

Pre-acquisition Phase	Acquisition Phase	Utilization Phase	**Retirement Phase**

297

Revision

18. Briefly describe the (Blanchard & Fabrycky) system life cycle.

Pre-acquisition Phase	Acquisition Phase	Utilization Phase	Retirement Phase

298

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.

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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.

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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.

301

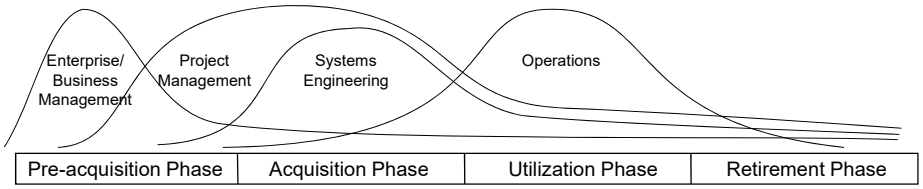
Parties involved

- 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.

302

Responsibilities of the parties involved

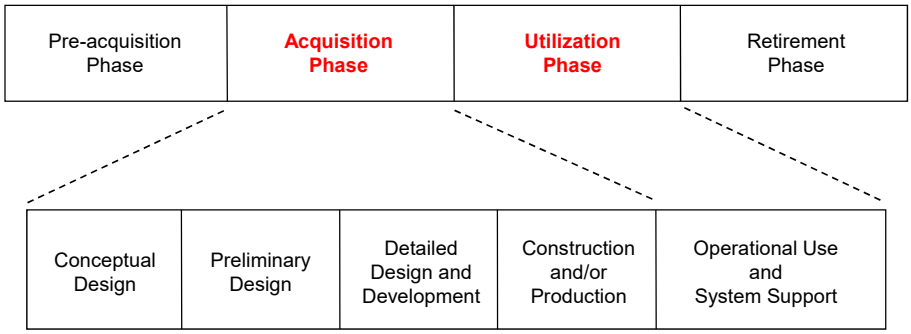
- Responsibility for the various phases of the system life cycle is spread across the enterprise (or organisation) within which the eventual system will operate.
- Note that all parties are involved at all stages in the life cycle, with the roles and responsibilities of each party shifting in emphasis between stages.



303

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.

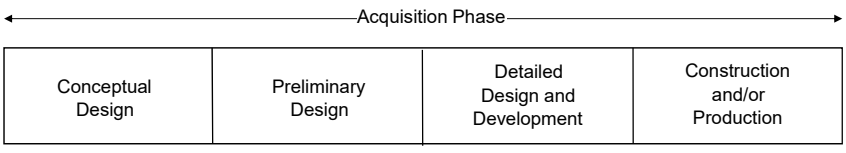


Blanchard, B. and W. Fabrycky, *Systems Engineering and Analysis*, Upper Saddle River, N.J.: Prentice-Hall, 1998.

304

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.



305

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.

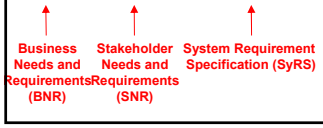
Conceptual Design	Preliminary Design	Detailed Design and Development	Construction and/or Production

306

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).

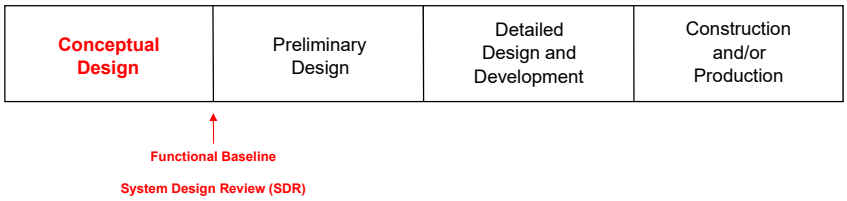
Conceptual Design	Preliminary Design	Detailed Design and Development	Construction and/or Production



307

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.



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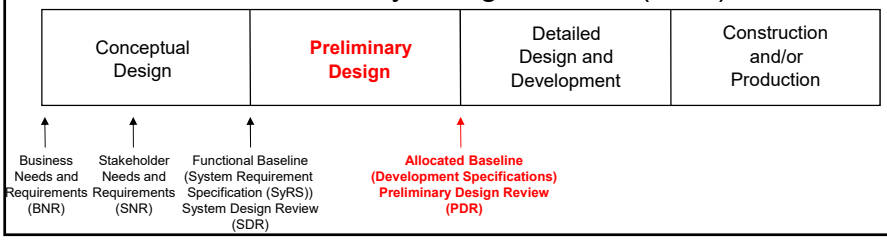
Preliminary Design

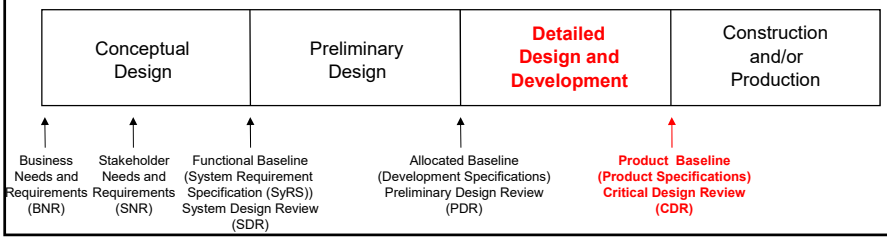
- Converts the logical architecture in the initial FBL into description of the physical subsystems (the upper-level physical architecture) that will meet the system requirements.
- Results in the Allocated Baseline (ABL), so-called because the functionality of the system is now allocated to physical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



309

Detailed Design & Development

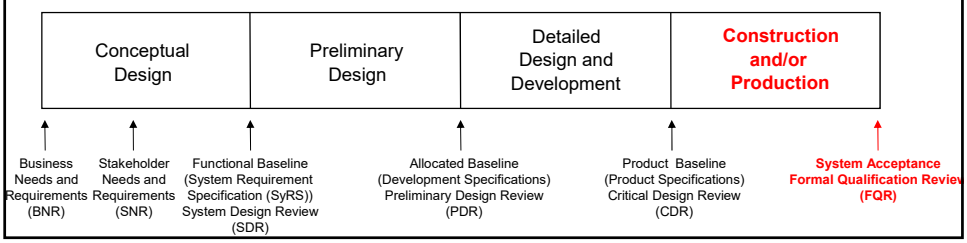
- Uses engineering disciplines to develop the individual subsystems, assemblies, and components in the system.
- Results in the Product Baseline (PBL) as the system is now defined by the numerous products (subsystems, assemblies, and components) as well as the materials and processes for manufacturing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



310

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)



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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.

Pre-acquisition Phase	Acquisition Phase	**Utilization Phase**	**Retirement Phase**

312

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

314

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

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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.

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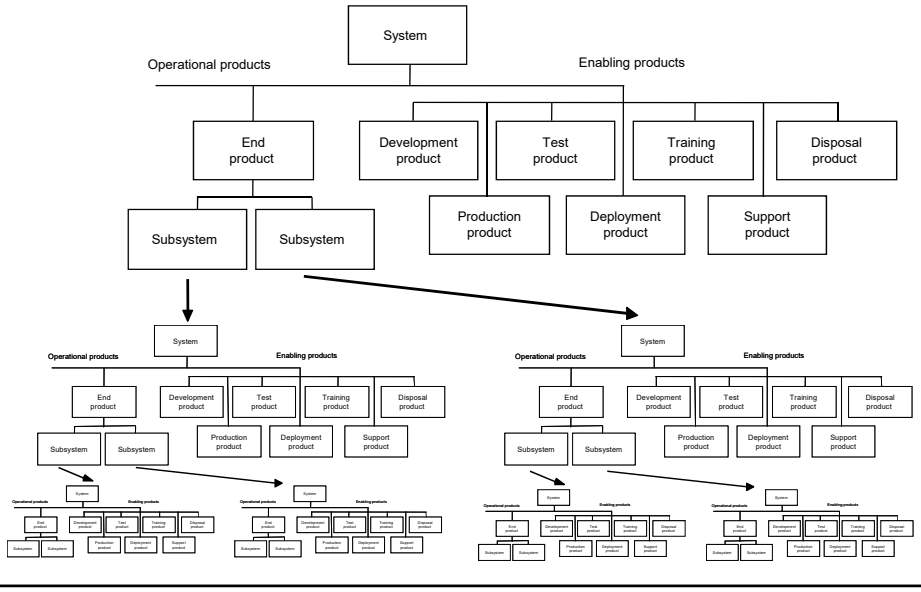
Top-down approach

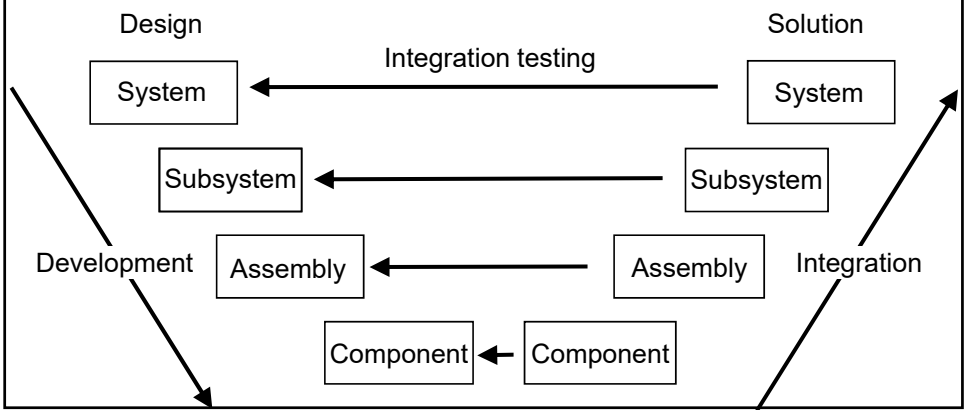
- Start by looking at the system as a whole to provide a thorough understanding of the system and its environment and interfaces.
- System-level requirements are developed.
- Likely subsystems can then be considered and requirements assigned to individual subsystems, the subsystems further broken down 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.



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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).

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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.

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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).

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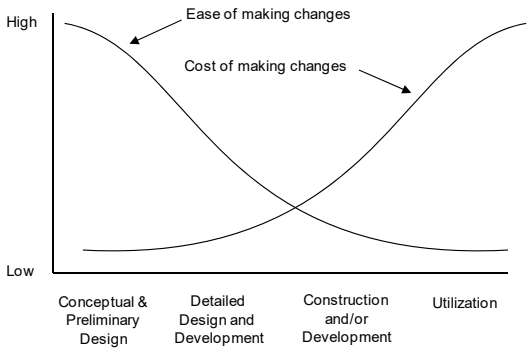
Reduction in overall acquisition schedule

- 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.



323

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).

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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.

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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

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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	Preliminary Design	Detailed Design and Development	Construction and/or Production

328

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.

329

Conceptual Design

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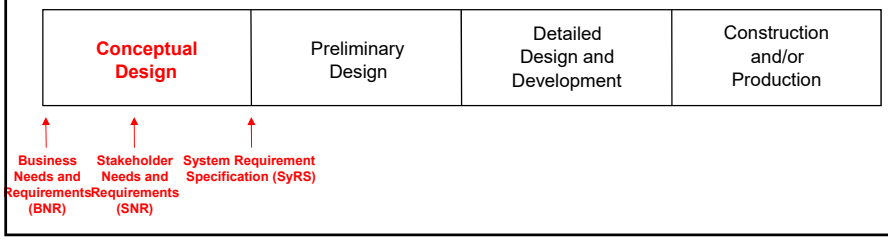

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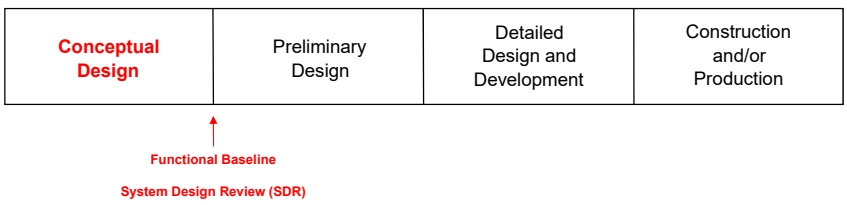
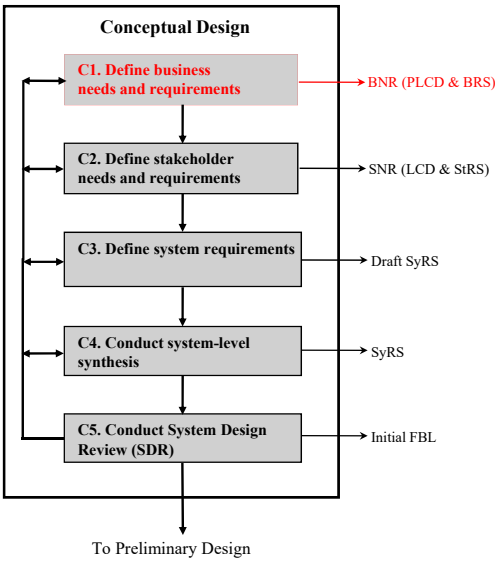
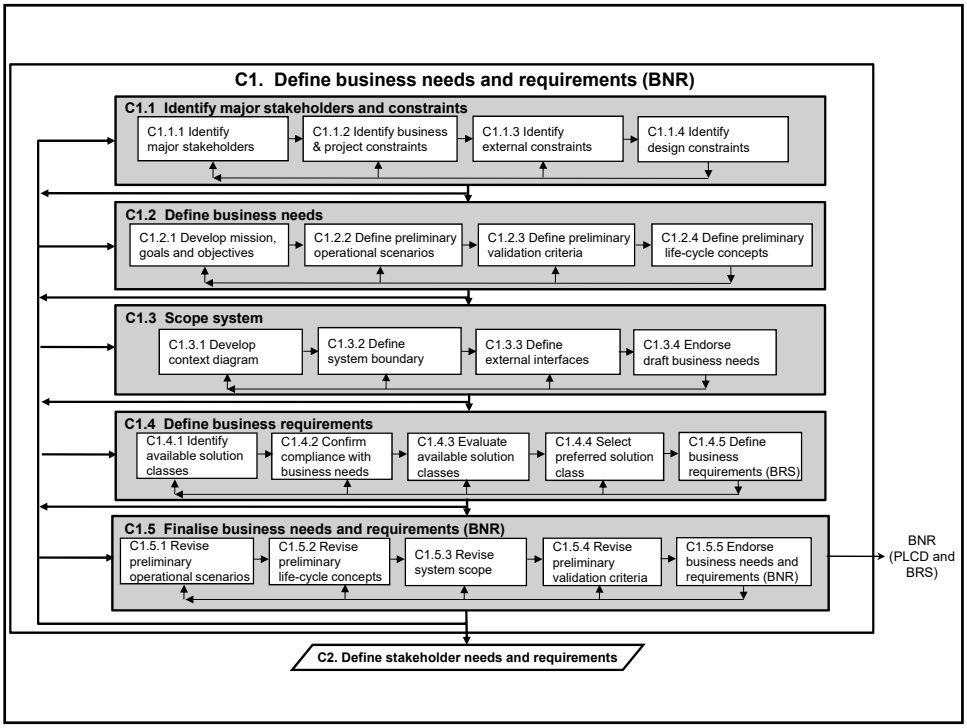
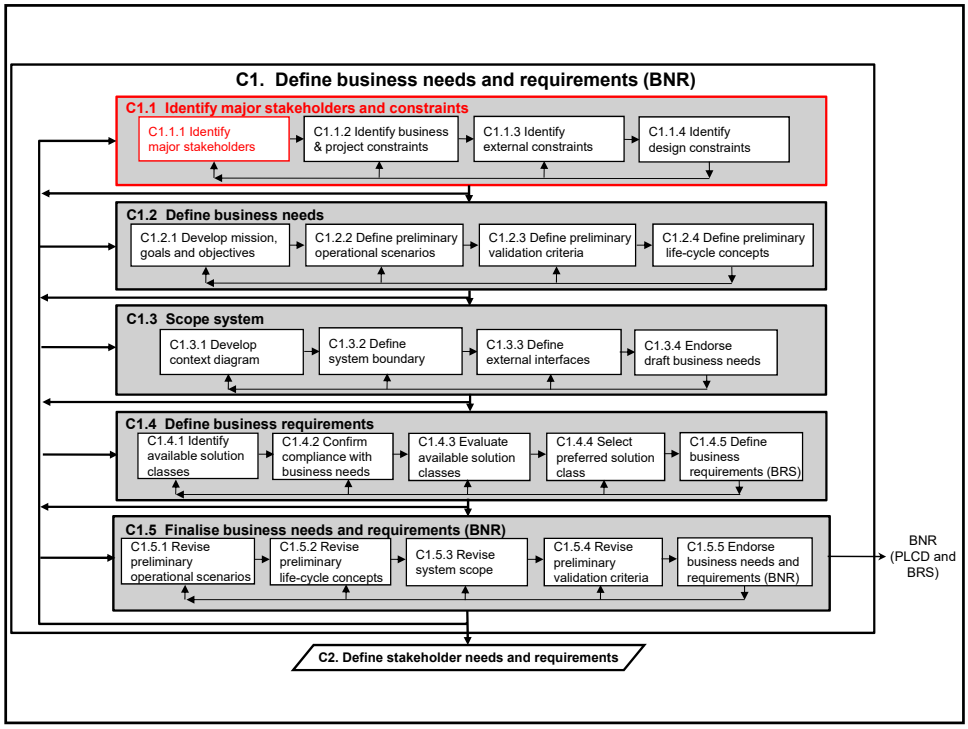


Dr Mike Ryan & Dr Shari Soutberg

Conceptual Design







334

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.

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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.

336

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.

337

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.

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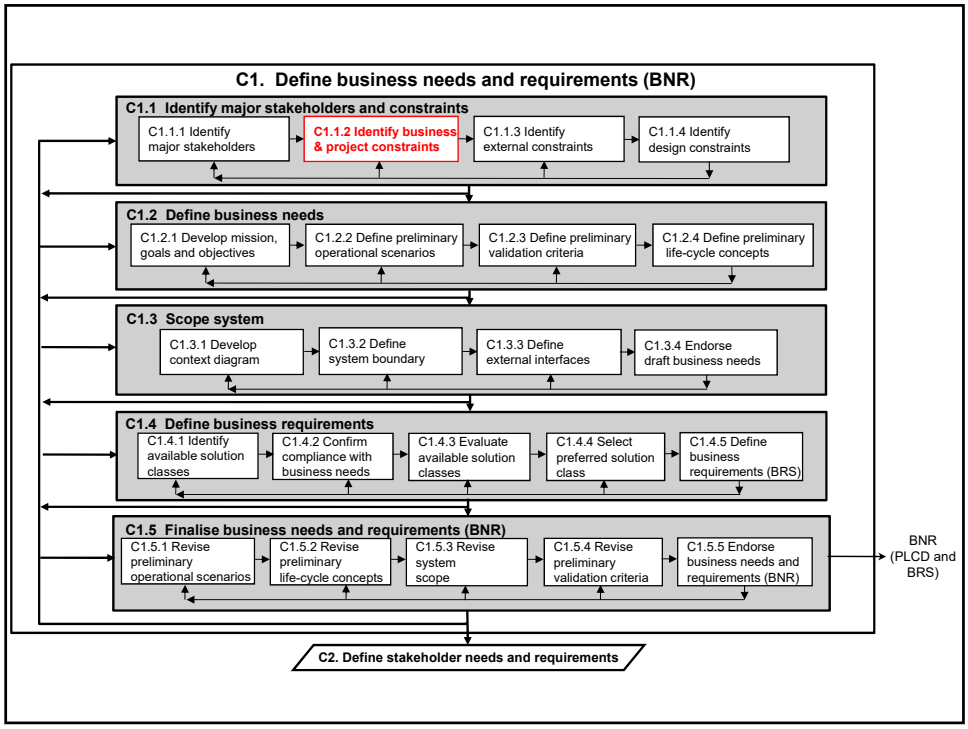
Identify major stakeholders

- 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.



340

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.

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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.

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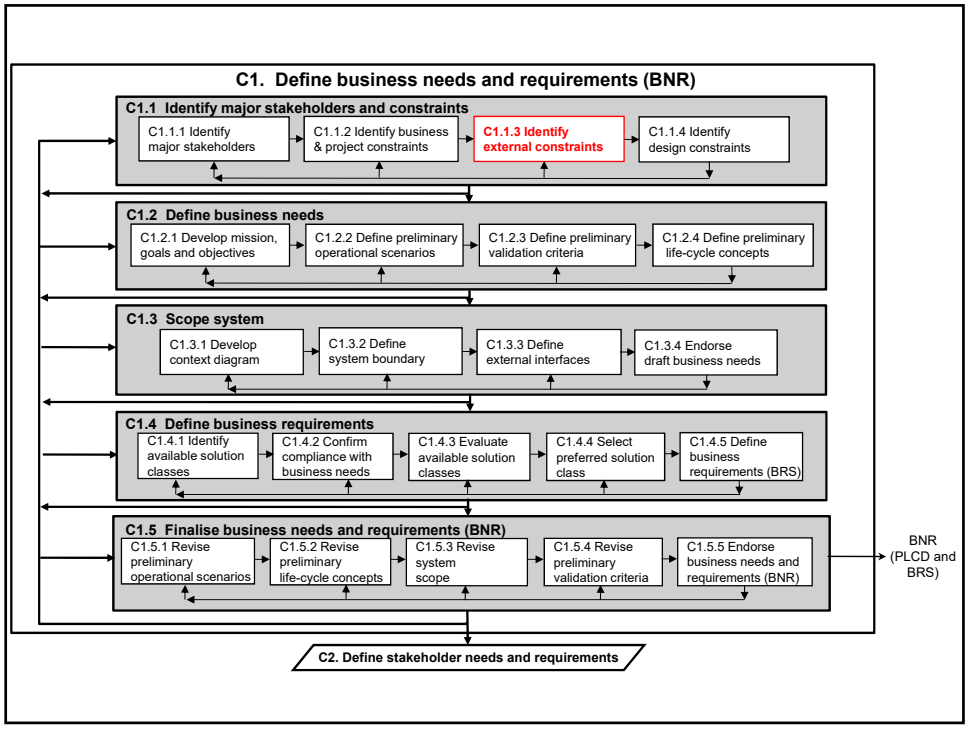
Business and project constraints

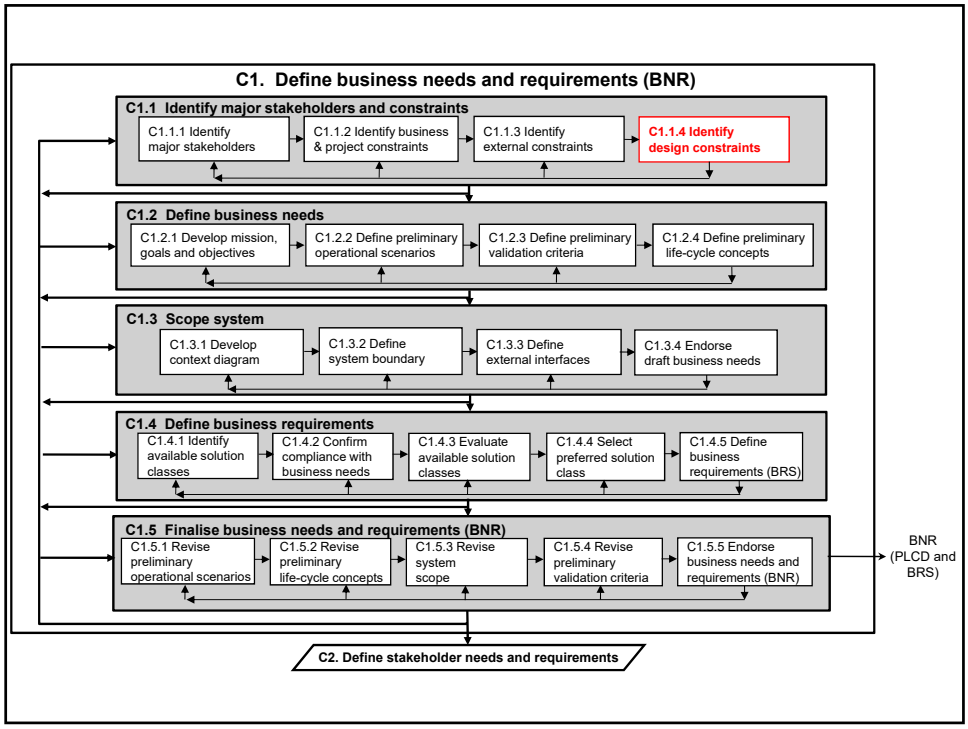
- Project constraints include budget and schedule constraints, but also the resource allocations to the project as well as any externally imposed deliverables and acquisition timeframes.
- Many companies have enterprise-wide standards for processes such as quality assurance and systems engineering and 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.



344

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.



346

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.

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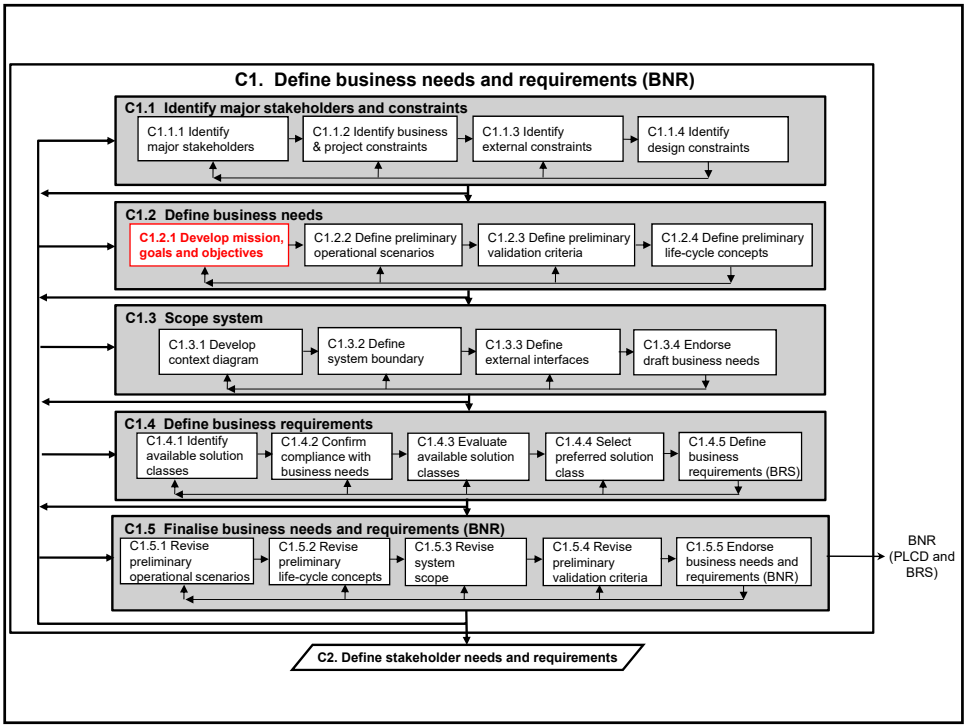
A cautionary note WRT constraints

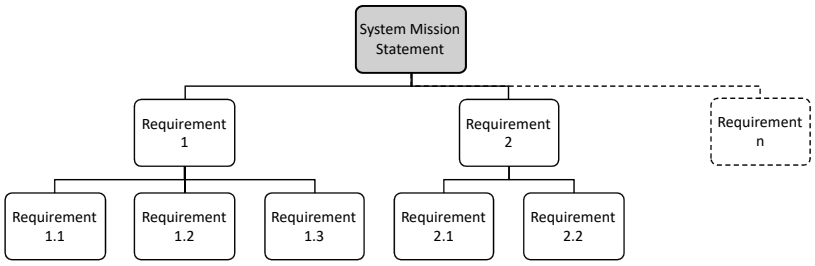
- Having identified constraints, work should not progress until each constraint is tested and taken on knowingly into the next activity.
- That is, we must convince ourselves that each constraint is actually a constraint and is inviolate.
- It also doesn't necessarily follow that a current constraint 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.



349

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.



350

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).

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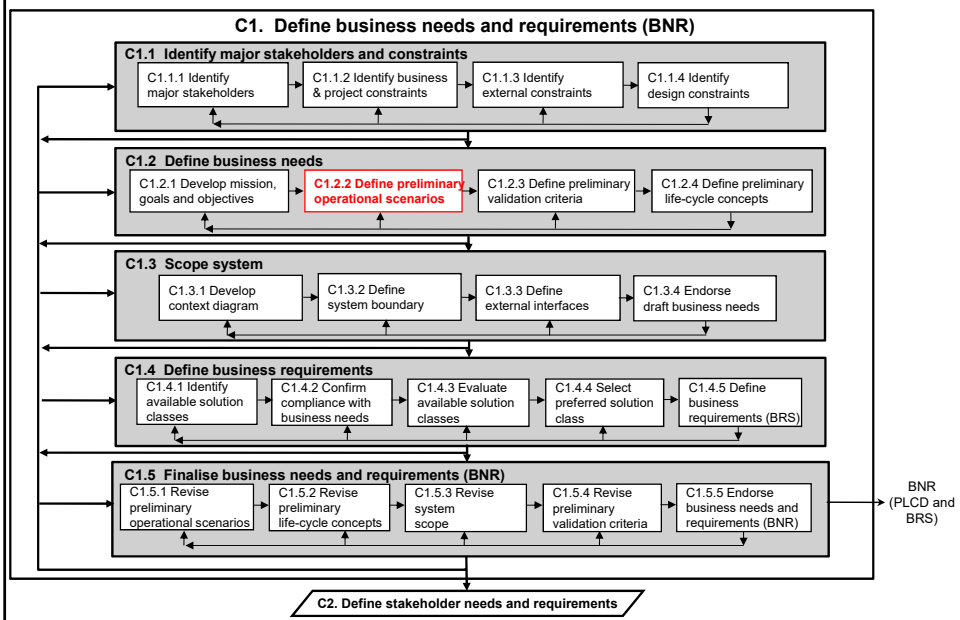
Mission statement for the Aircraft System

- 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?)".

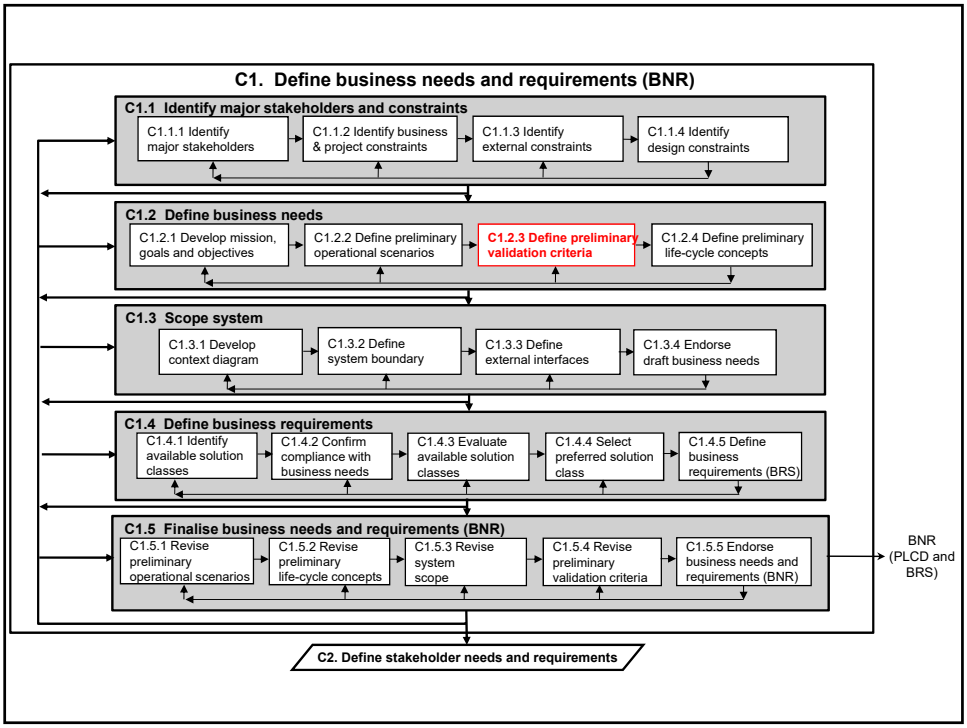
- In this example, the goals and objectives would then need to elaborate on such matters as what is meant by 'class-leading' and 'medium-range', how many passengers are to be carried, as well as operational issues such as crewing and maintenance.



353

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.



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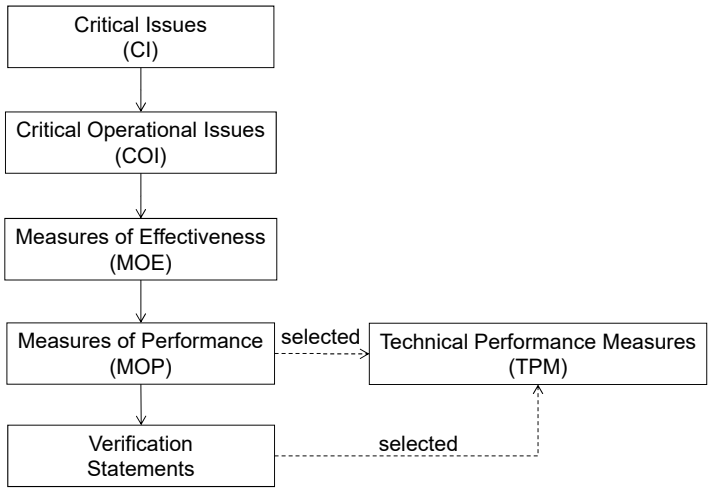
Measures hierarchy

- 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.

Measures hierarchy



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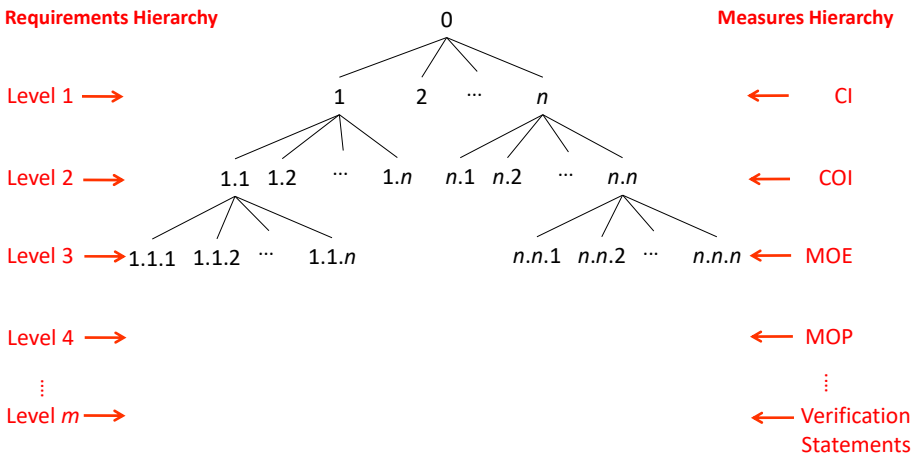
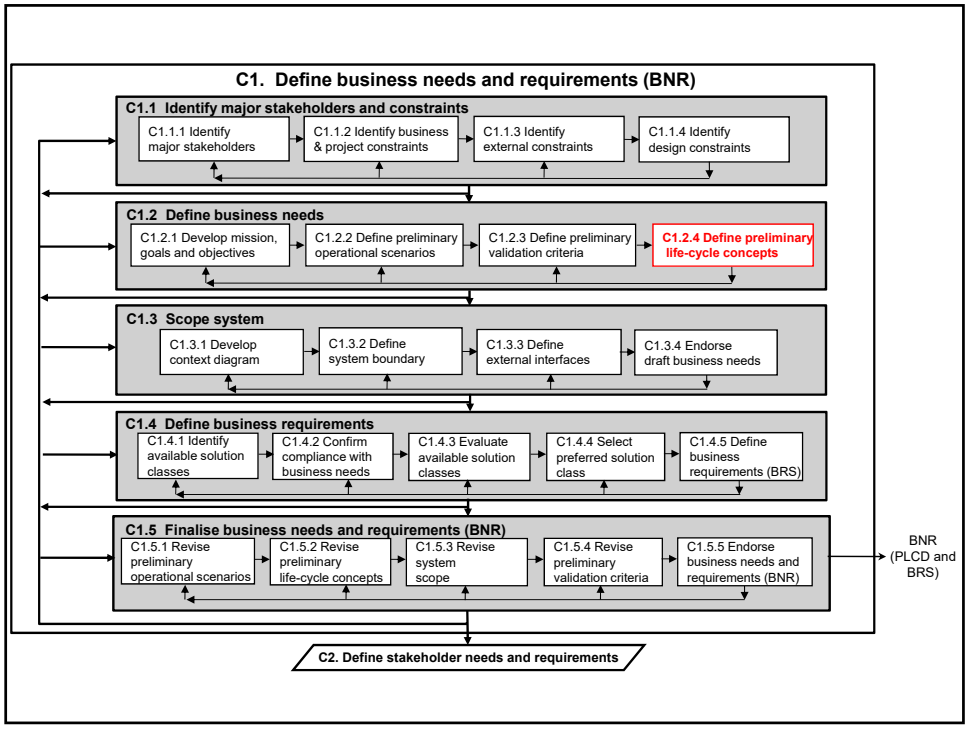
Validation cross reference matrix

- 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





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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.

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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.

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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.

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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.

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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).

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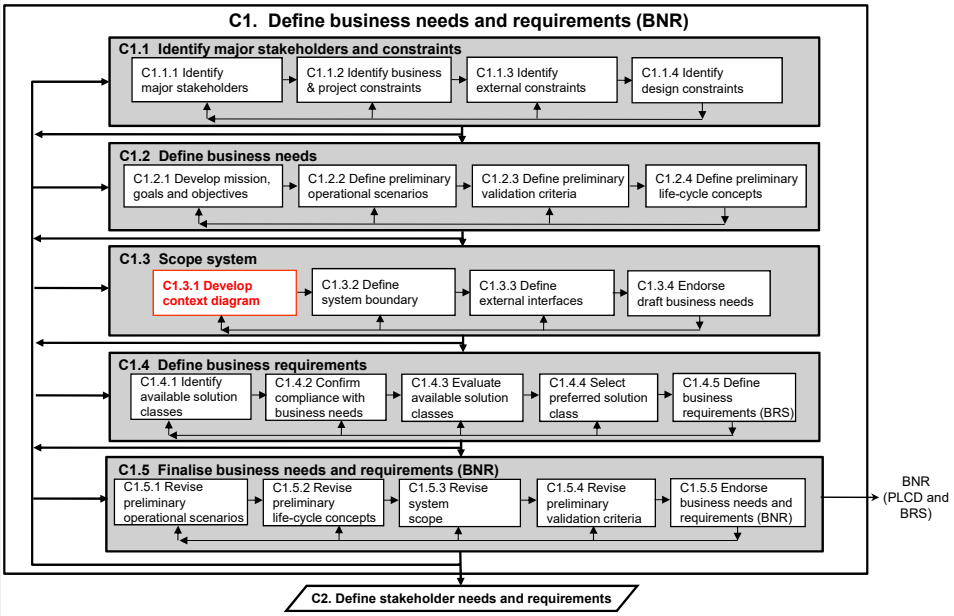
Preliminary Retirement Concept

- 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.



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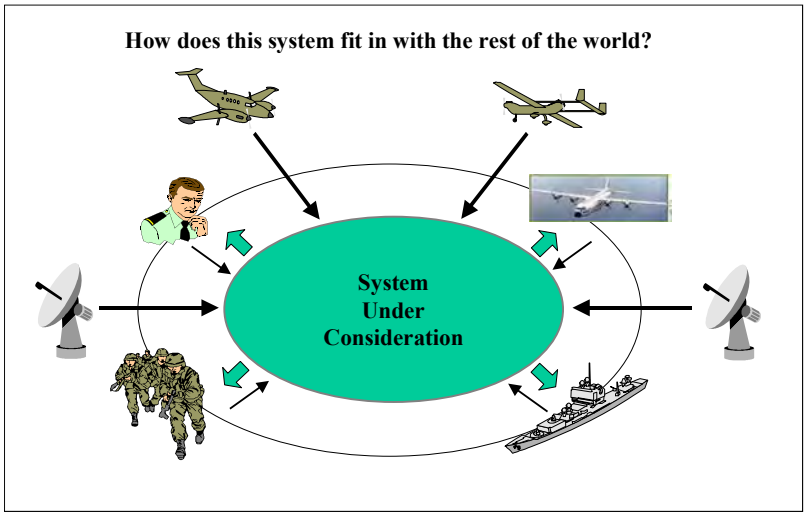
Context diagram

- 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



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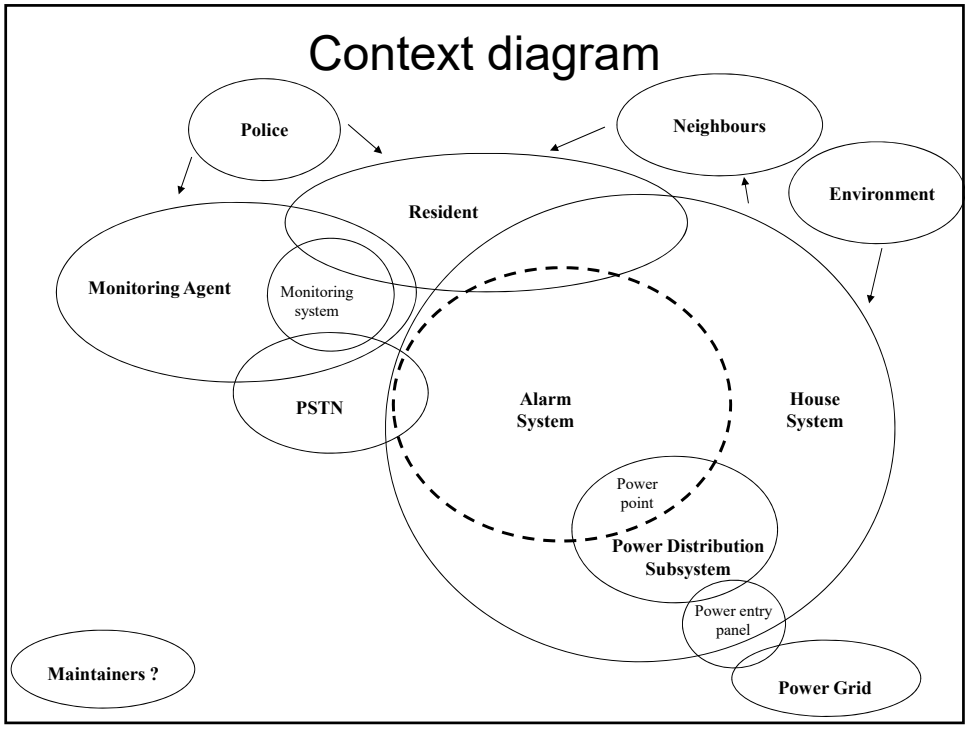

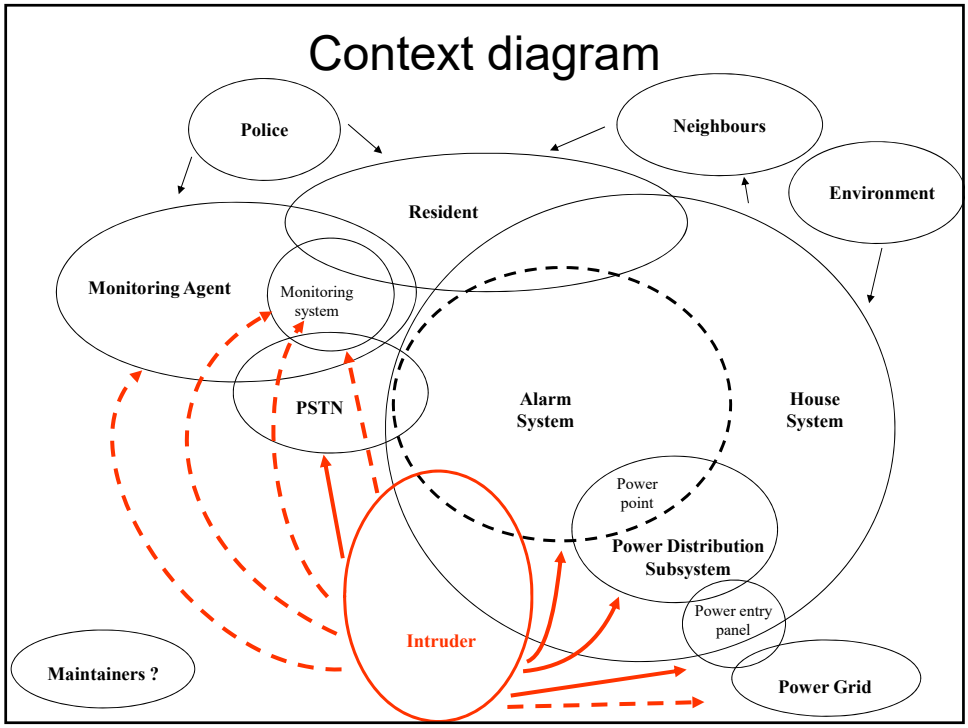

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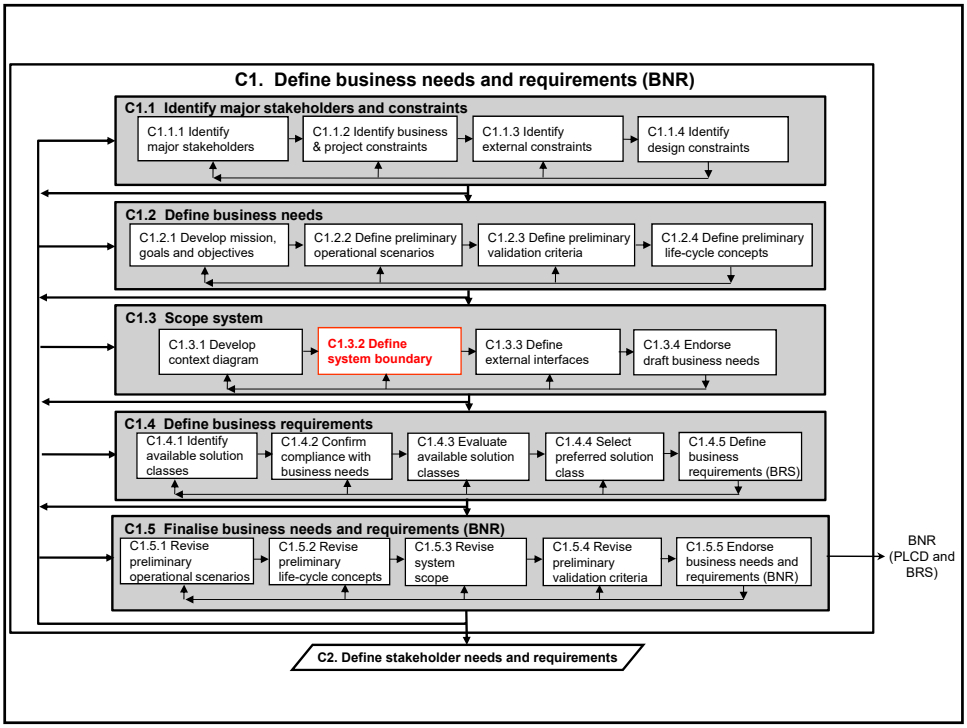
Guidance for context diagrams

- 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.



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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.

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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.

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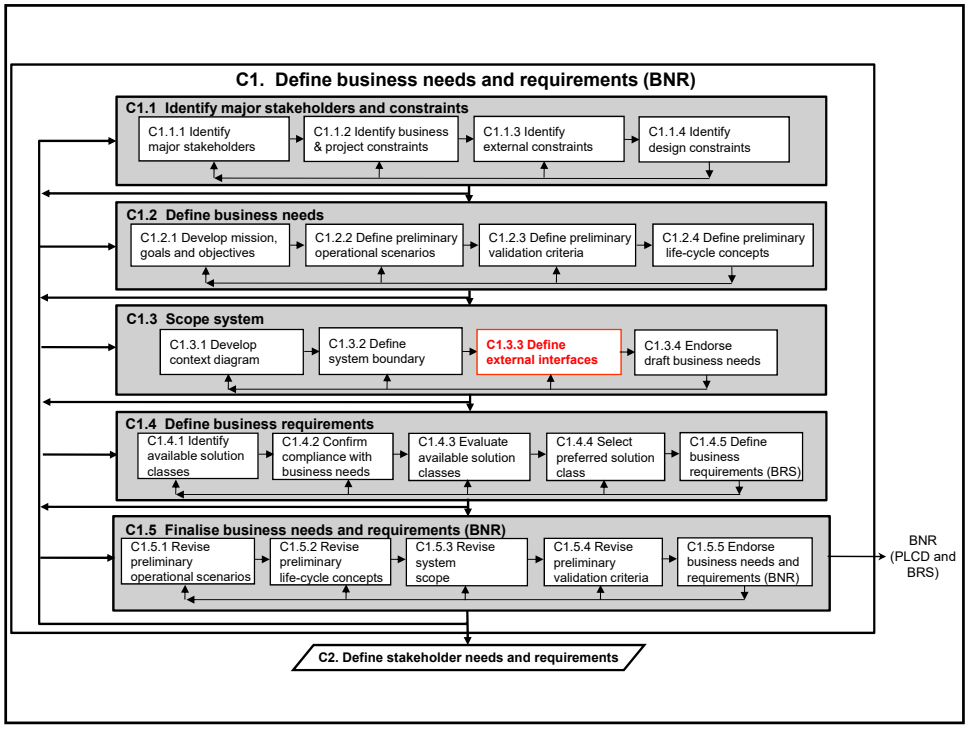

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Define external interfaces

- 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.

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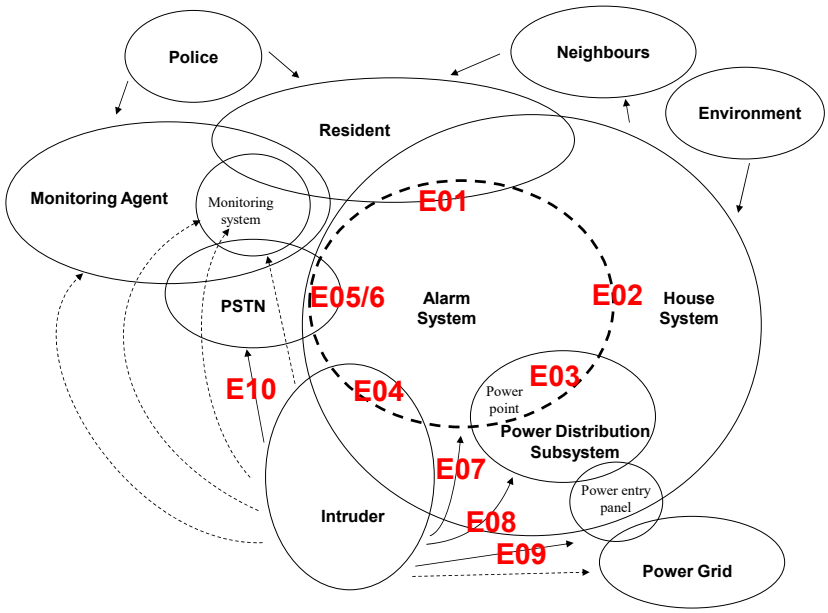
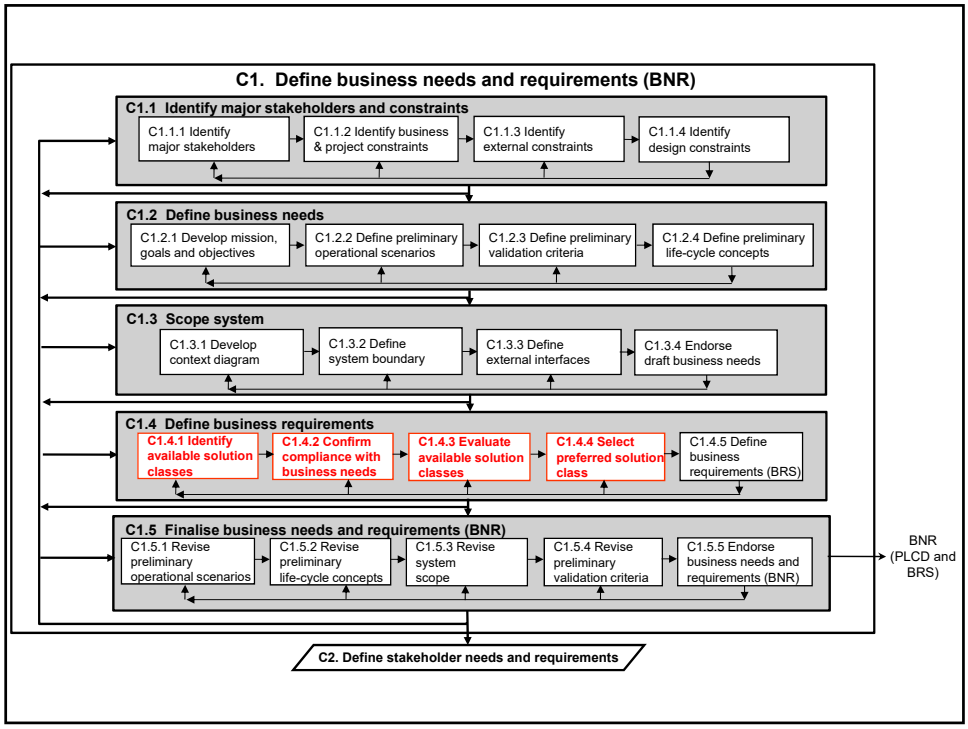
Consider external interfaces

- 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.

External interfaces





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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?

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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)

Long-range Communications

- Cable
- Microwave radio relay
- HF Communications
- Satellite

Surveillance of air-sea gap

- Sky-wave radar
- Surface-wave radar
- Airborne sensors
- Satellite sensors

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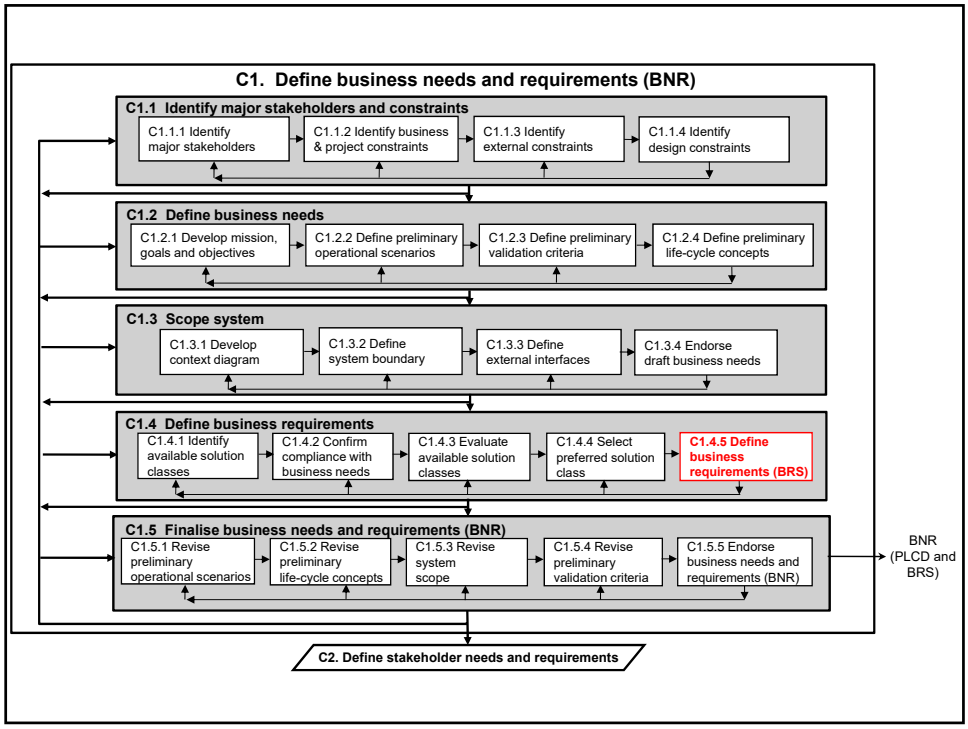
ACME Aircraft feasibility analysis

- 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.



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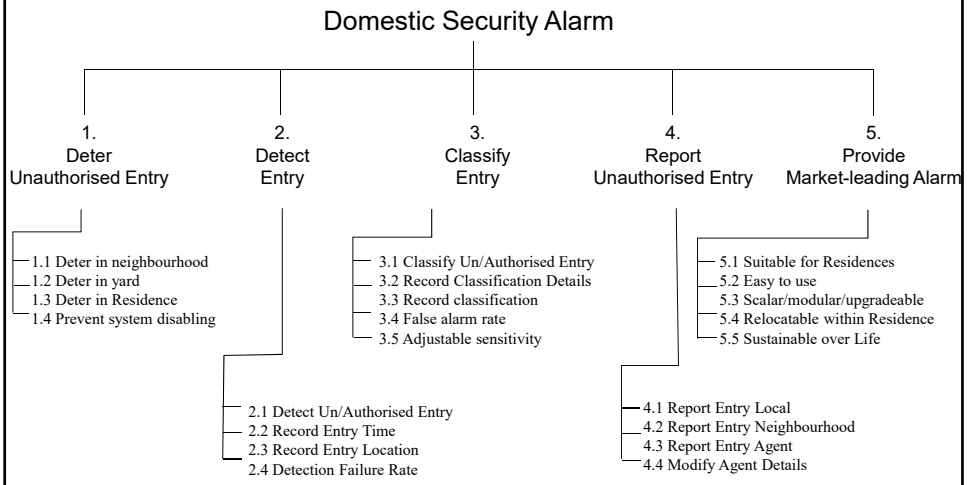
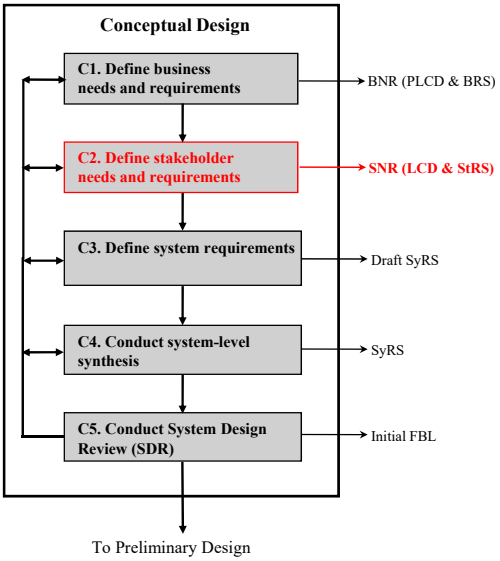
Define business requirements

- 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.

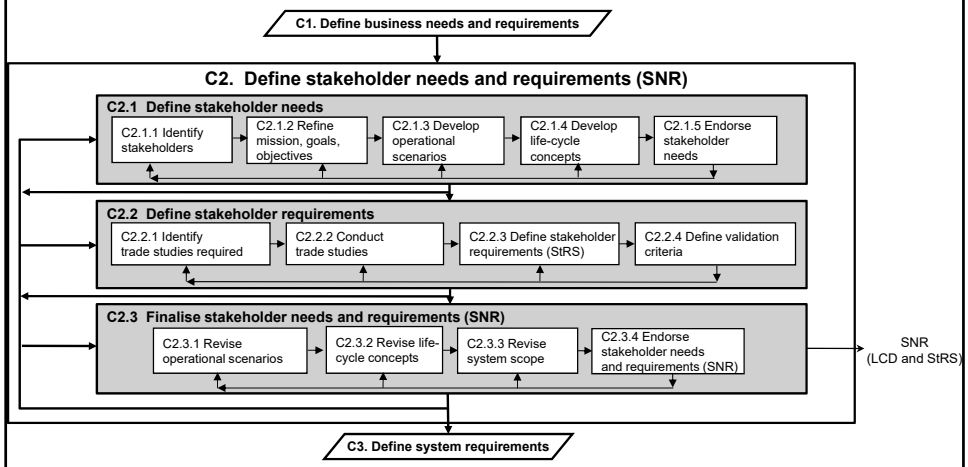
RBS for the security alarm example



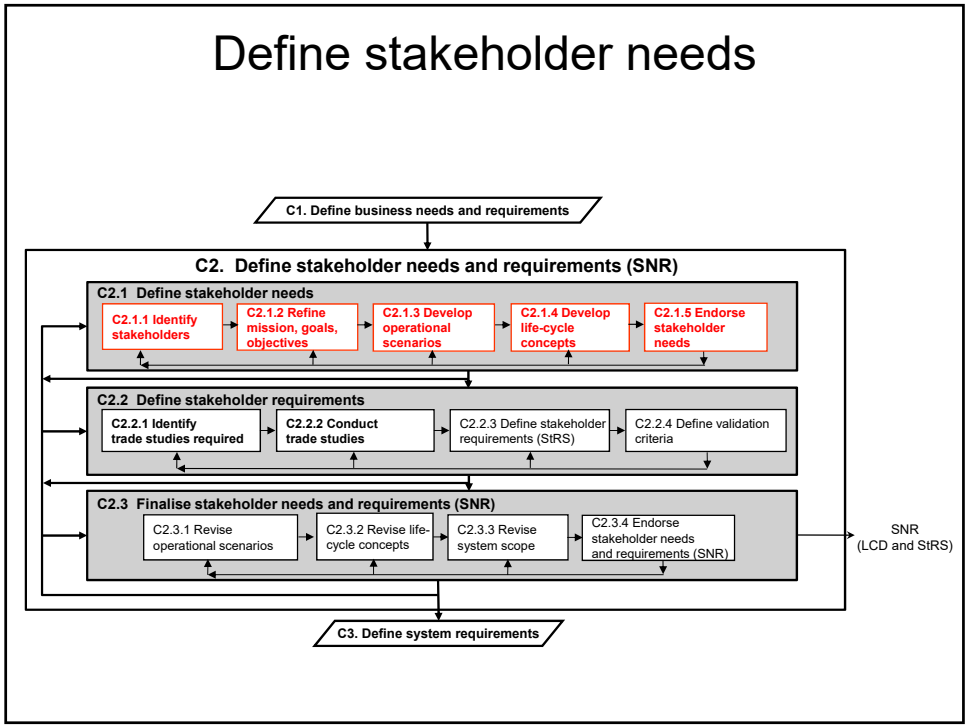
Conceptual Design



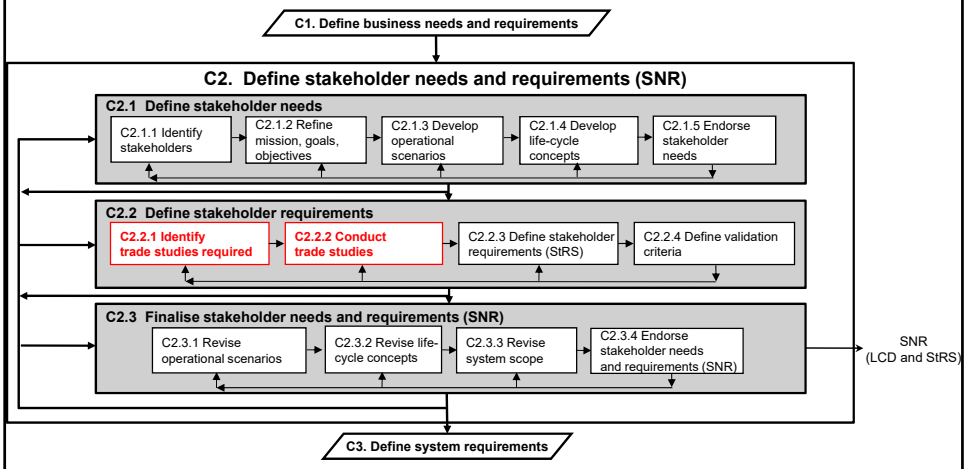
Define stakeholder needs and reqts



Define stakeholder needs



Trade studies



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.

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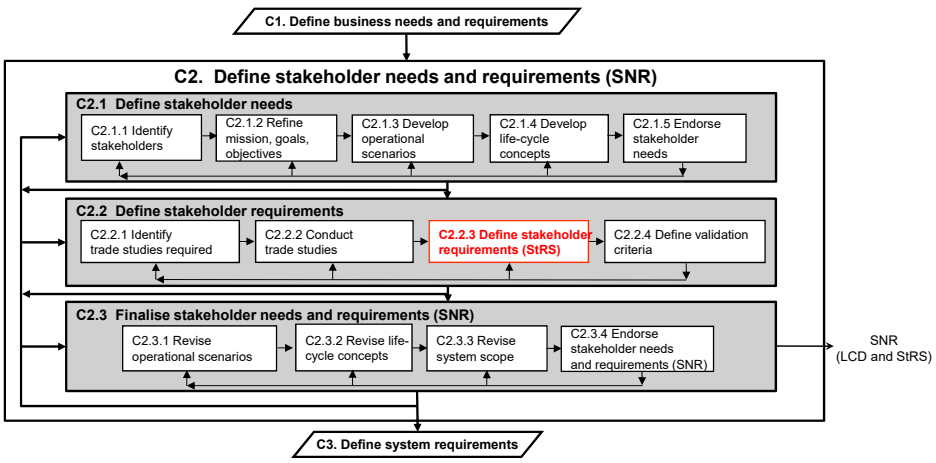
Trade study process

- 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



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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.

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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.*

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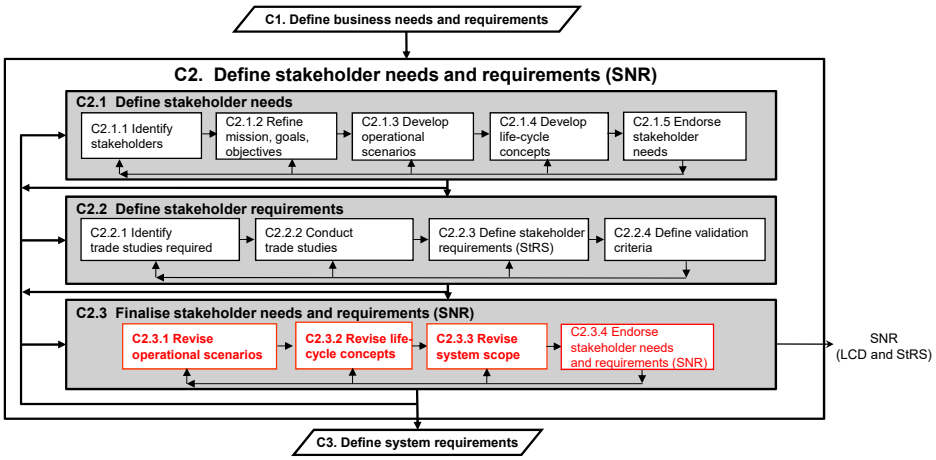
StRS example for ACME Air

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



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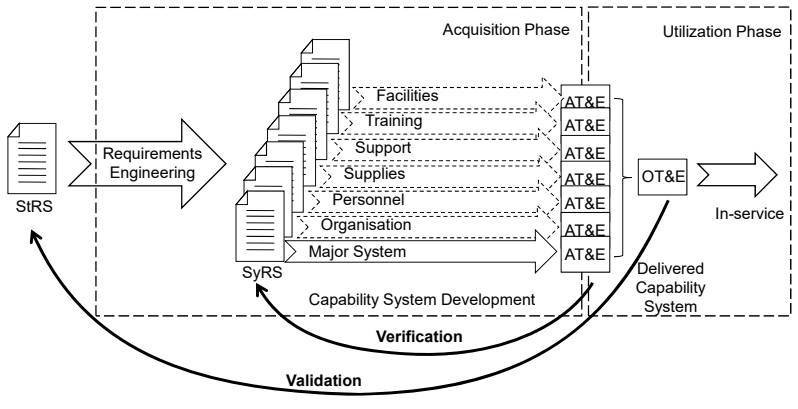
Capability system

- 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.

Capability system



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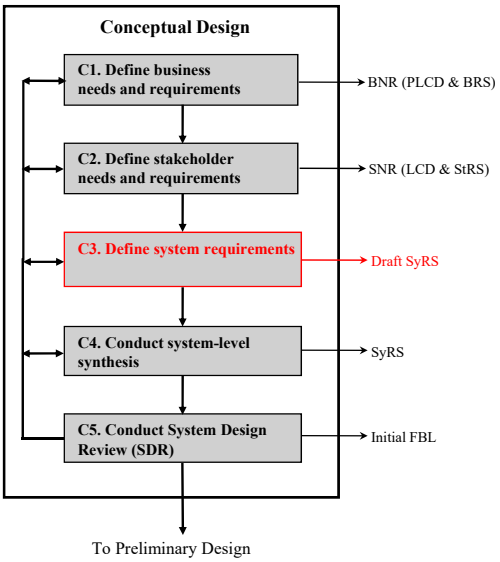
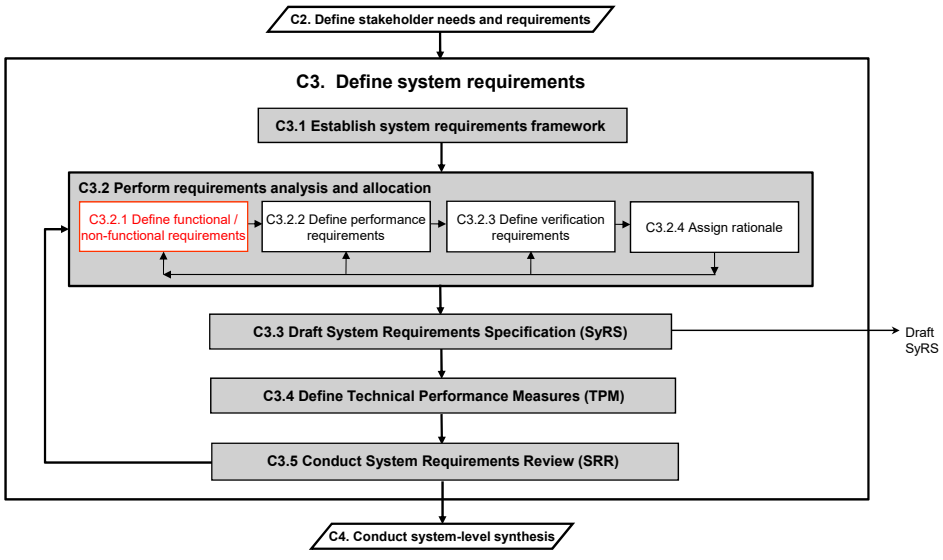
Conceptual Design



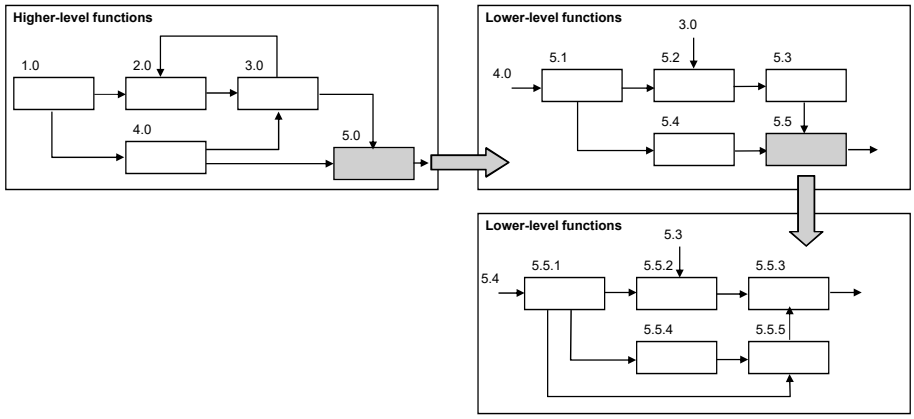
Define requirements



401

System Requirements Analysis

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



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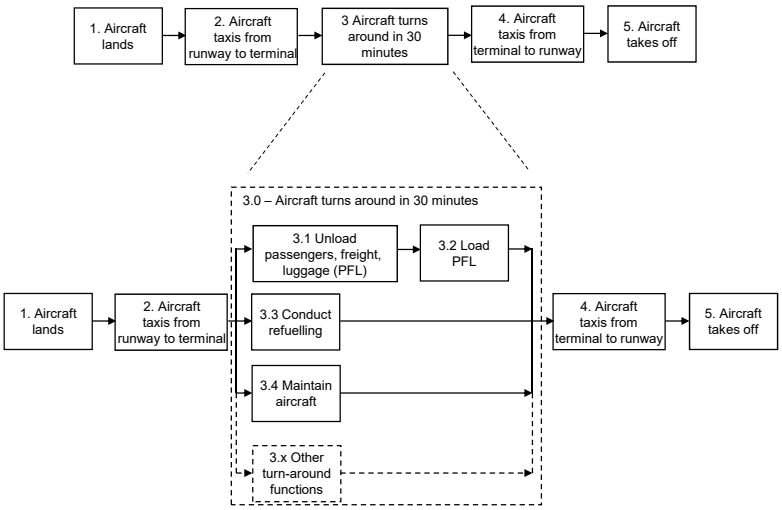
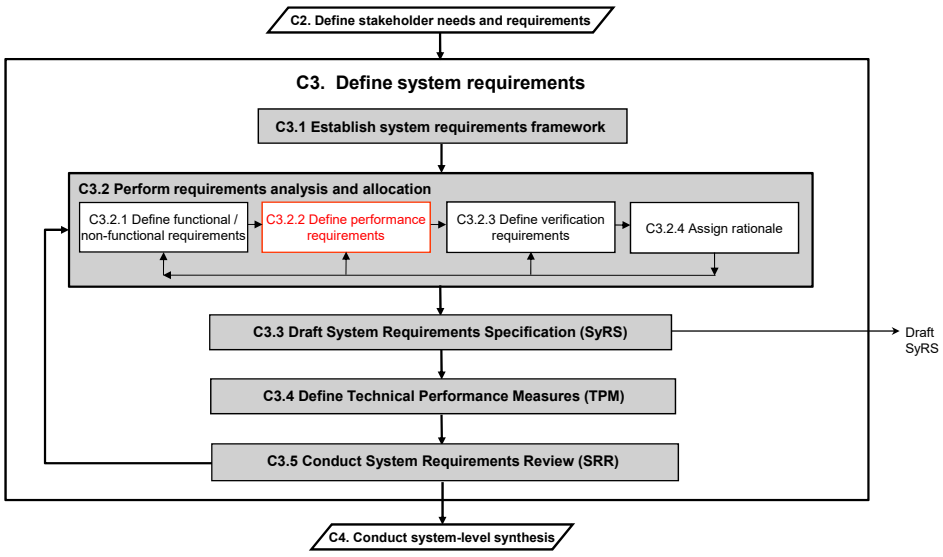
Example functional requirements

Turning around in 30 minutes:



Define performance requirements



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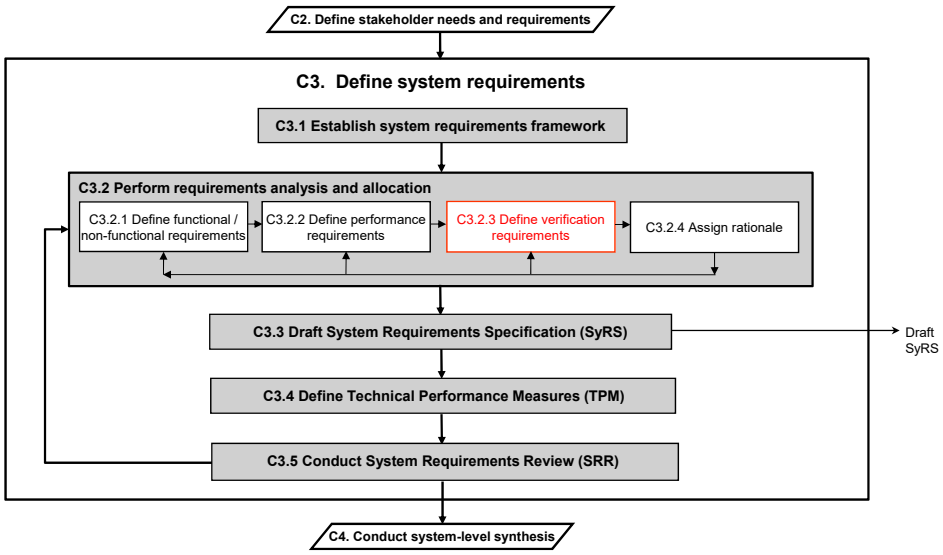
Define performance requirements

- 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



406

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.

407

Define verification requirements

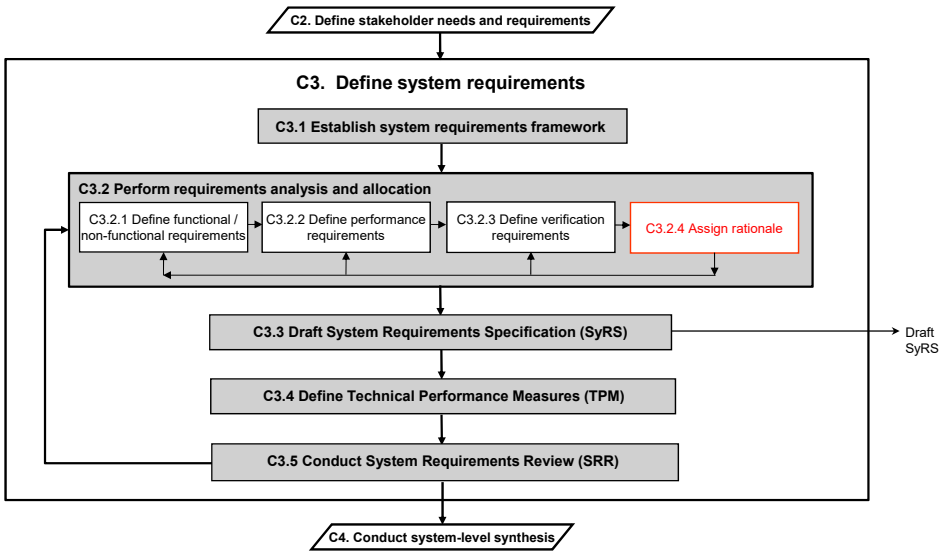
- It is not common to include verification statements in the SyRS. In many instances, the function and performance statements are included in the SyRS and the verification requirements are included in a separate document—such as a test concept document, or through a verification cross reference matrix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

408

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

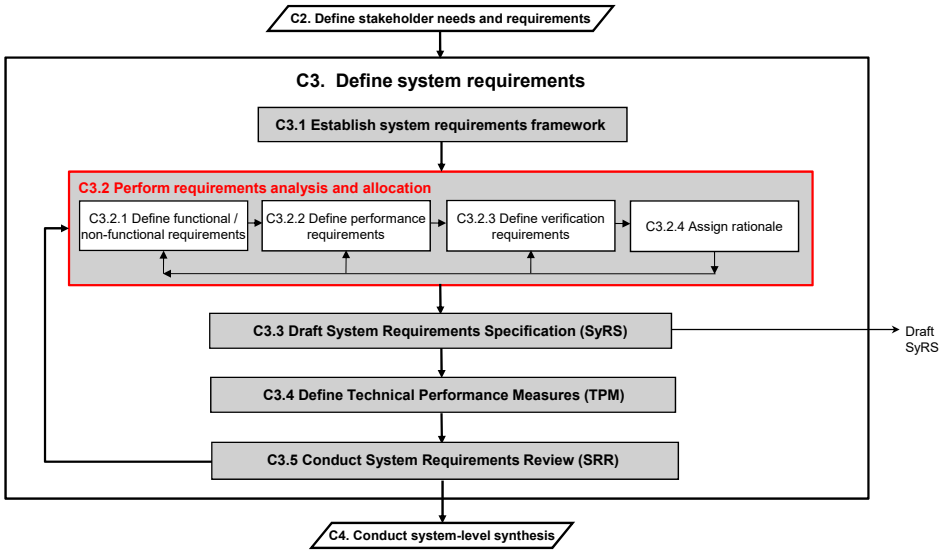


410

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



412

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.

413

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.

414

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

415

Analysis and allocation example

3. Turn the aircraft around in less than 30 minutes

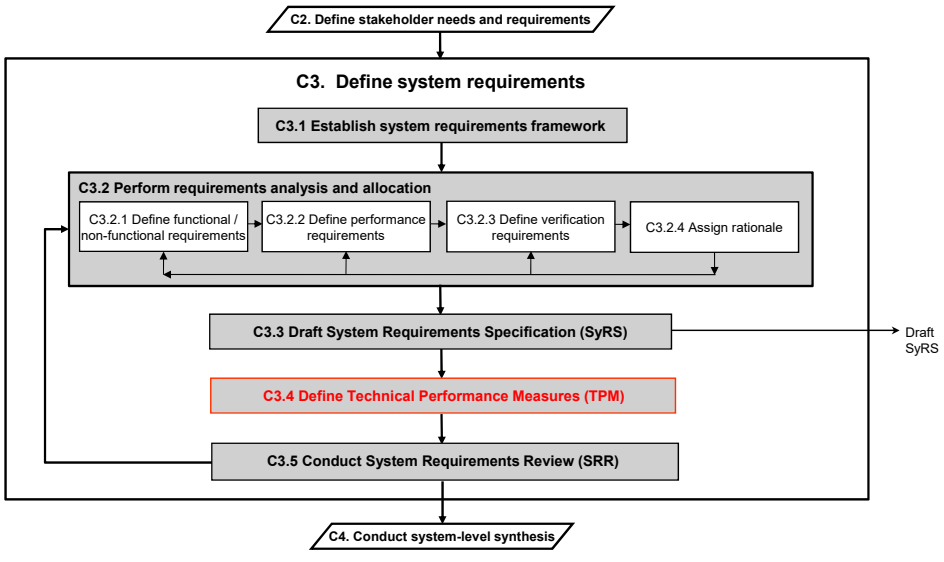
3.1 Load passengers, cargo and catering in < 30 minutes

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*

Define TPM



417

Technical Performance Measures (TPM)

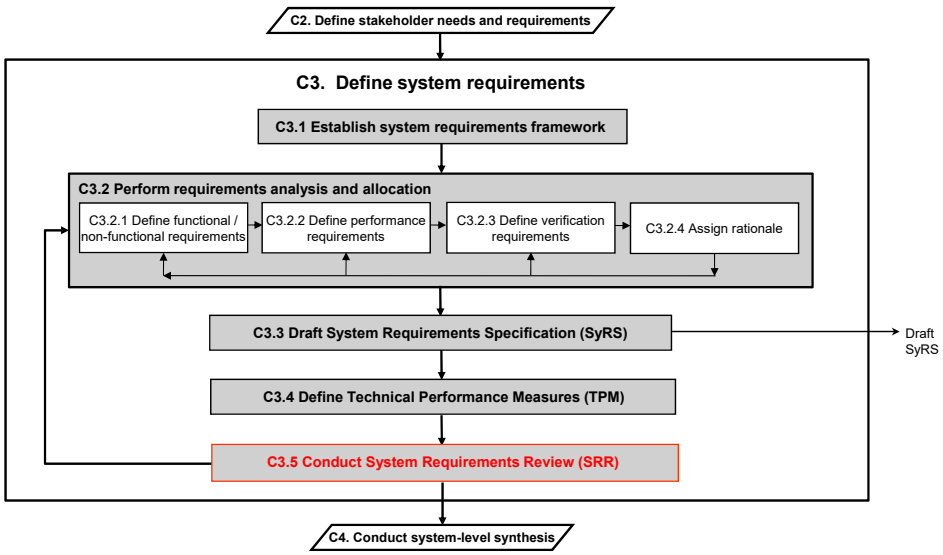
- TPMs are identified early in the system development effort and are continually monitored and tracked throughout the system development as a means of managing the risks associated with system development.
- The first step in identifying TPMs is to identify the quantitative parameters that require tracking 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.

418

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.

Conduct System Requirements Reviews (SRR)

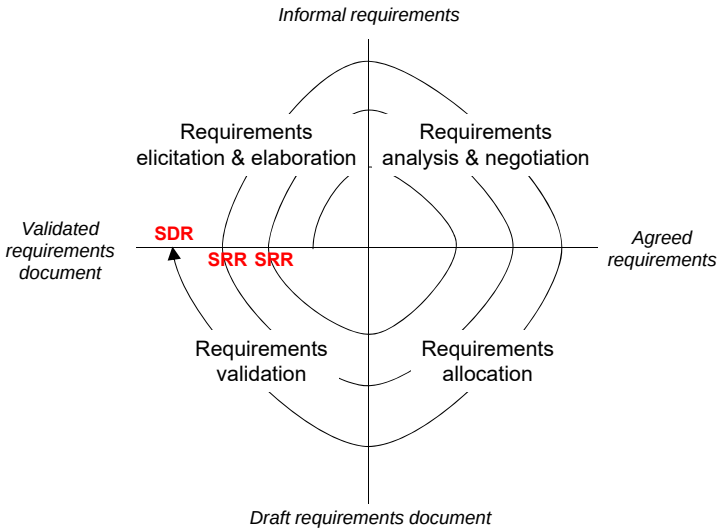


420

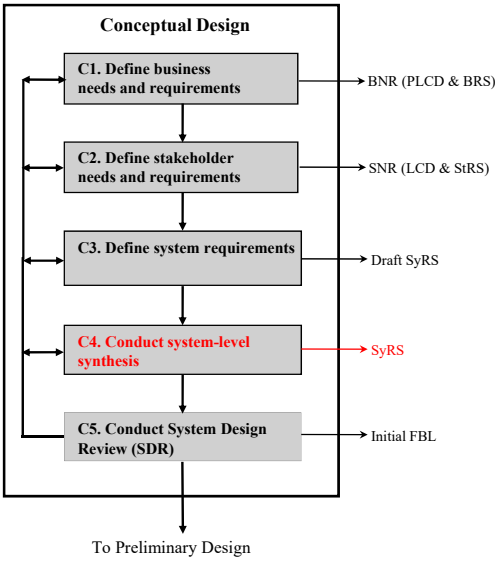
System Requirements Reviews (SRR)

- 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 Requirements Reviews (SRR)



Conceptual Design



423

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.

424

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.

425

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.

426

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.

427

System-level synthesis

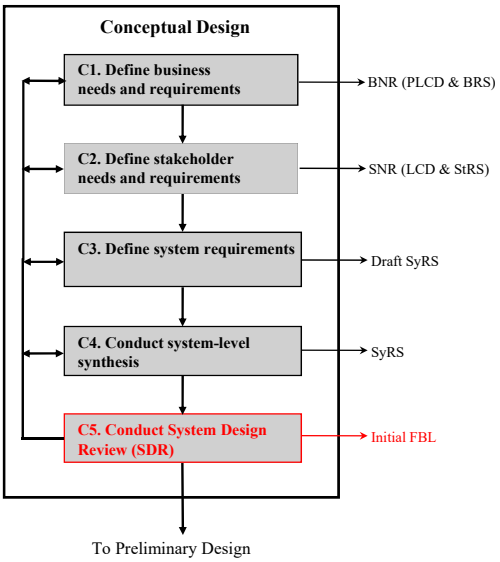
- A few words on the refined SyRS:
  - The refined SyRS is perhaps the most important of all systems engineering documents.
  - It is the source of reference for all future work and documentation.
  - If solid, it stands the remaining effort in good stead.
  - Errors, omissions, conflicts and so on will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

428

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.

Conceptual Design



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.

431

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

433

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.

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

434

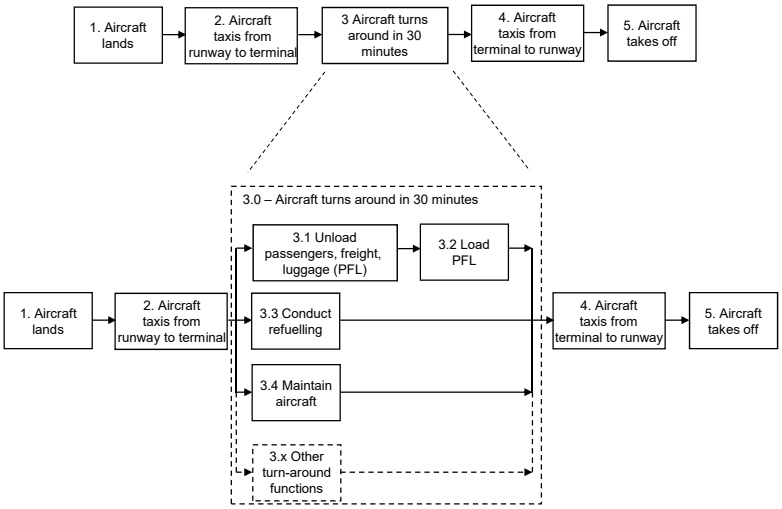
Preliminary Design

- 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).

435

Subsystem requirement analysis

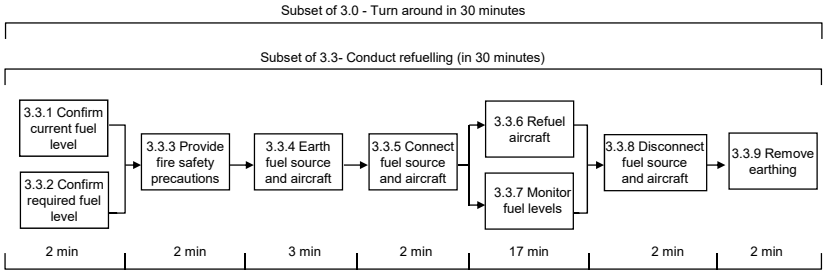
Remember our example FFBD for turning around in 30 minutes:



436

Subsystem requirement analysis

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



437

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.

438

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.

439

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

440

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.

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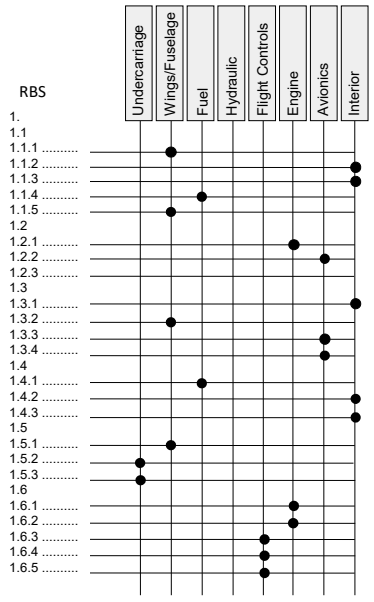
Requirements allocation

- 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.

Requirements allocation



443

RBS vs WBS (an aside)

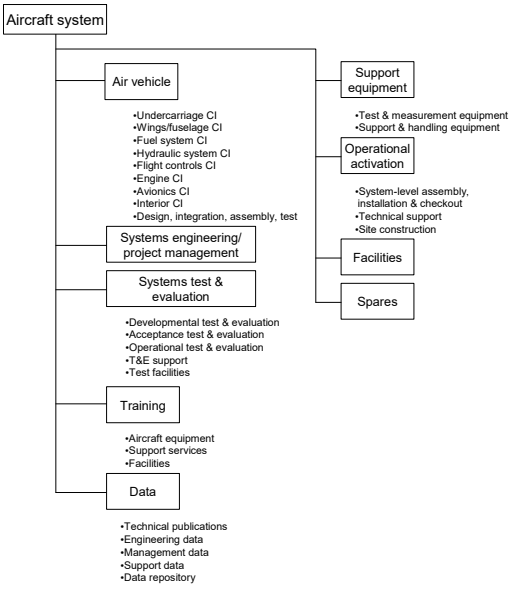
- Early on, we justified the invention of a new term (RBS) by stating that the term was used to different it from a well-known project management term (WBS).
- We are now in a position to investigate the relationship between the RBS and the WBS in order to emphasise the differences between the two structures.
- 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.

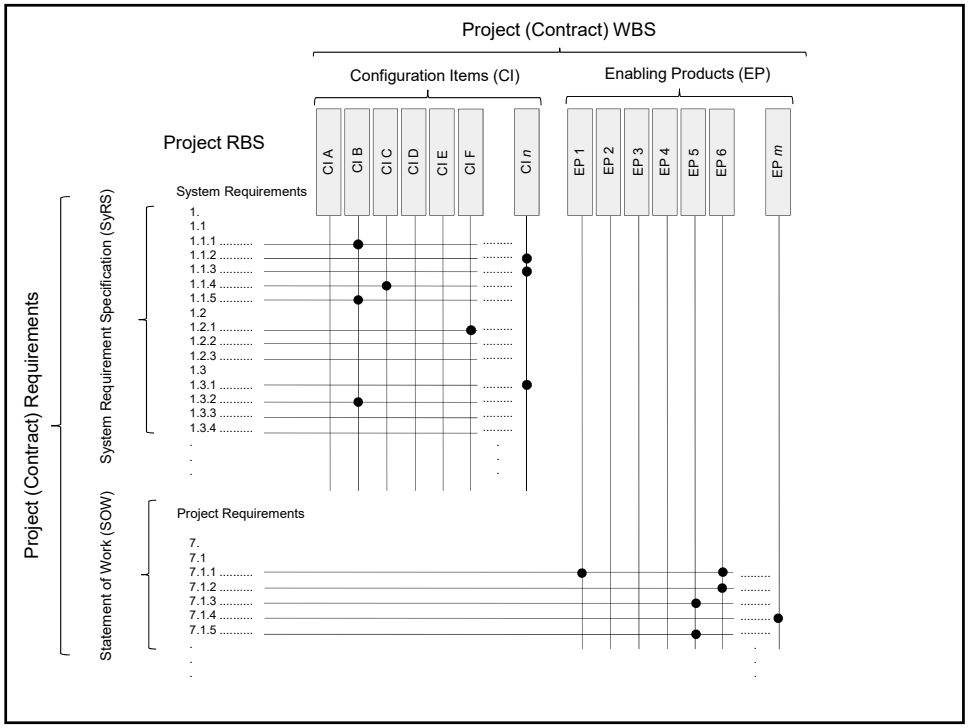
444

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

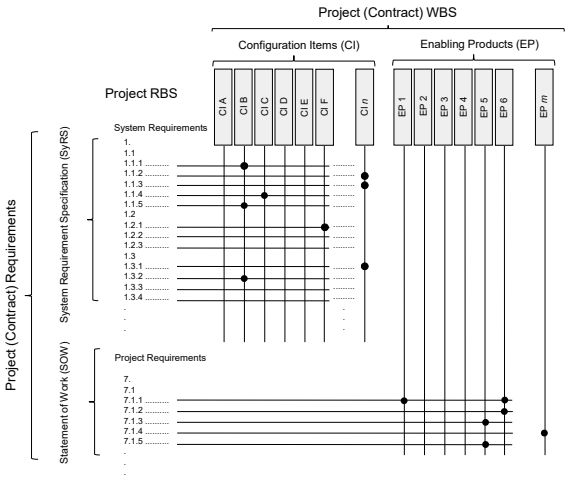




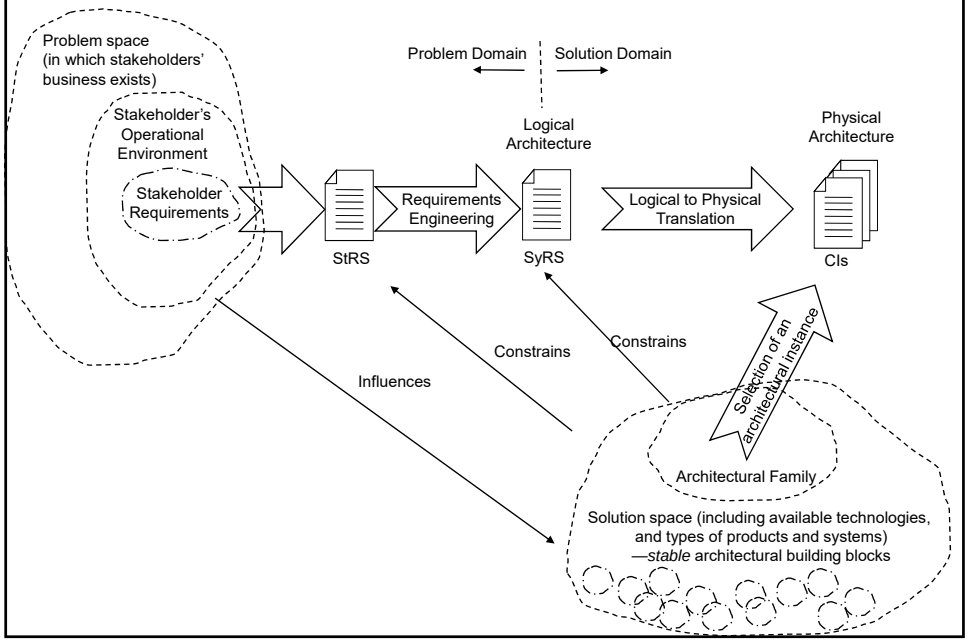
447

Revision

19. Explain the relationship between an *RBS* and a *WBS*.



Use of architectures



449

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.

450

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.

451

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

453

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

454

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.

455

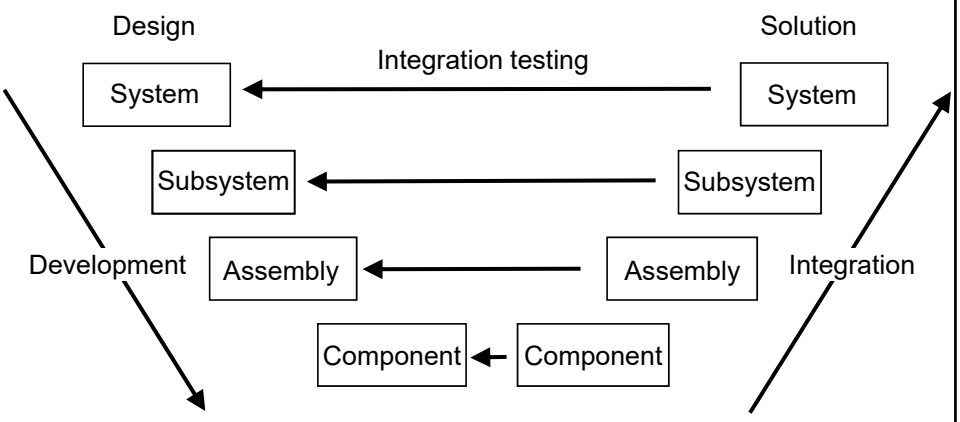
Integration

- 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.

456

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.



457

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

459

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.

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

460

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.

461

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.

462

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)

463

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.

464

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

466

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

Pre-acquisition Phase	Acquisition Phase	**Utilization Phase**	Retirement Phase

467

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

468

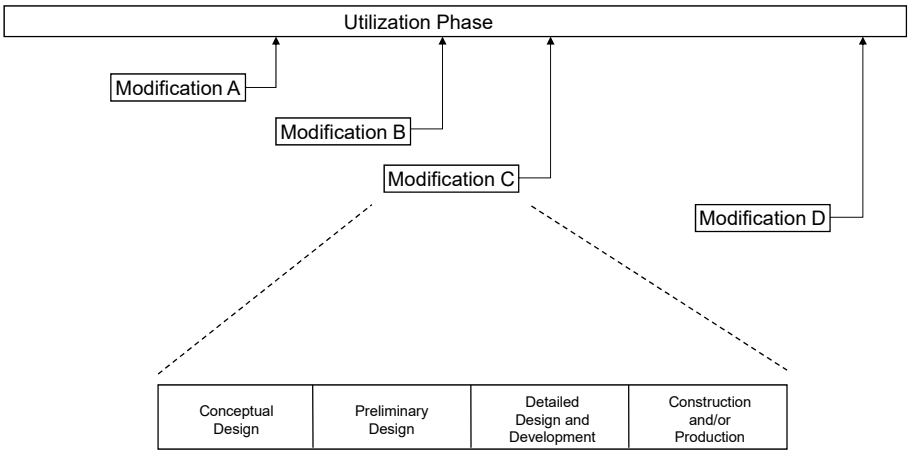
Operational Use and System Support

- 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.

469

Modifications

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



470

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.

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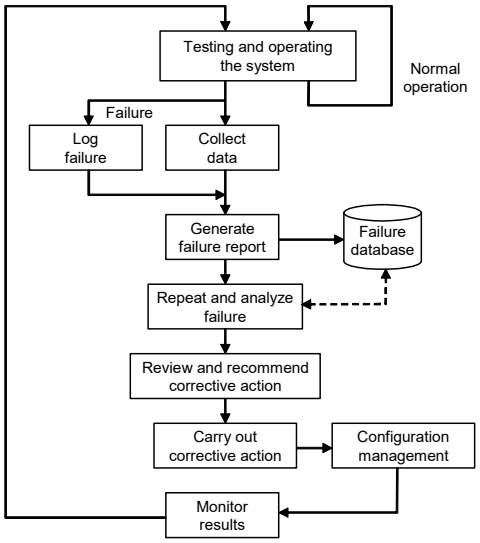
FRACAS

- 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



MIL-STD-2155(AS)

473

Retirement Phase

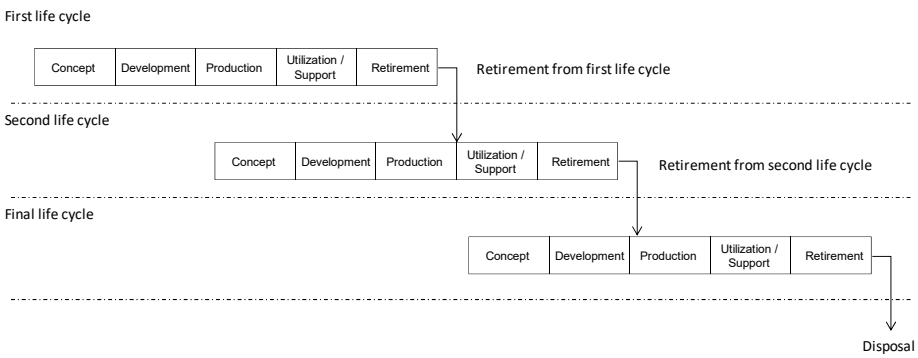
- Final stage in the life cycle.
- Activities include:
  - Transportation
  - Handling
  - Decomposition
  - Processing
- Disposal can be costly and time consuming and the Retirement Concept should be considered early.
- User must ultimately pay for disposal.

Pre-acquisition Phase	Acquisition Phase	Utilization Phase	**Retirement Phase**

474

Retirement from life cycle

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



Systems Engineering Management

476

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

477

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.

478

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.

479

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

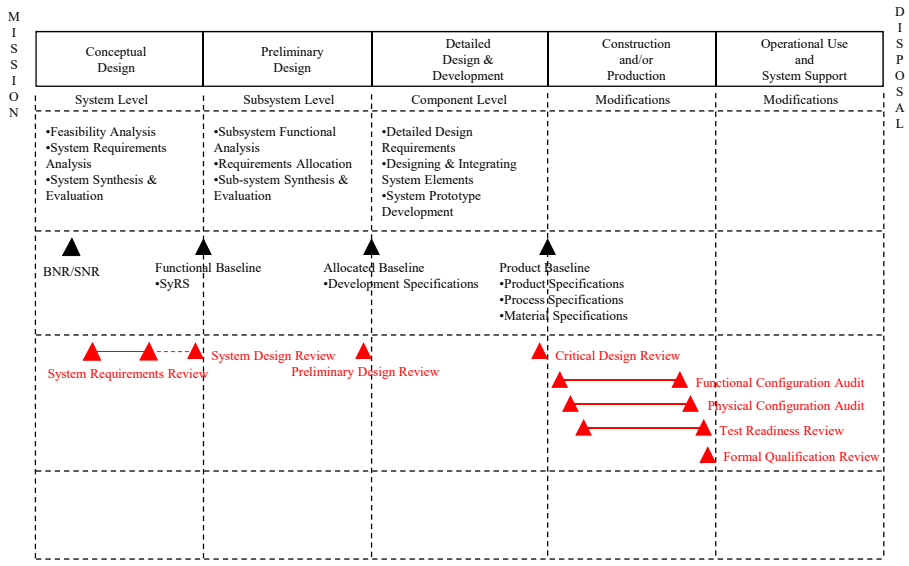
Conceptual Design

Preliminary Design

Detailed Design & Develop

Construction and/or Produc

Technical reviews and audits



481

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).

482

Technical Review and Audit Plan (TRAP)

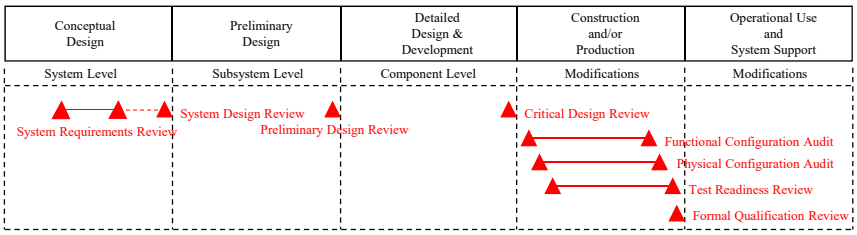
- The principal way of managing the technical review and audit effort is via a Technical Reviews and Audits Plan (TRAP).
- The TRAP documents all formal reviews, detailing the entry criteria that must be met prior to the commencement of the review or audit and the exit criteria that must be demonstrated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

483

Revision

20. Explain why *Technical Reviews and Audits* are vital to Systems Engineering Management and describe the major formal reviews that may occur prior to Construction and/or Production.

- Technical reviews and audits measure progress and reduce technical risk.



Test and Evaluation

485

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.

486

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).

487

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.

488

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.

489

Revision

21. List and describe the three categories of *Test and Evaluation (T&E)* and describe the primary focus of each.

- 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.
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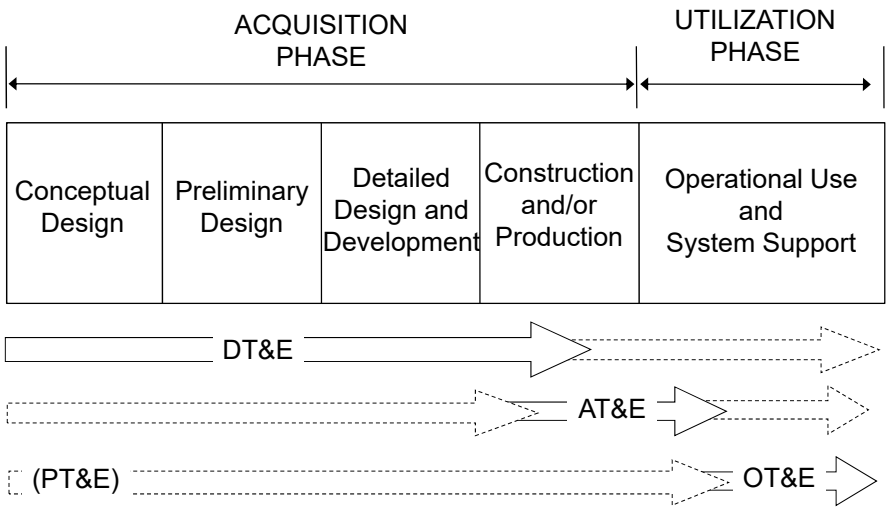
T&E categories



491

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).

492

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.

493

Operational Test and Evaluation (OT&E)

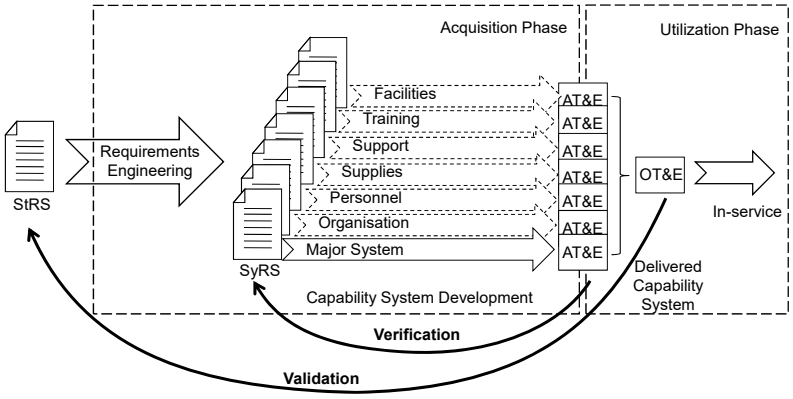
- After AT&E, OT&E is used by the customer to assess the ability of the system to meet the original needs.
- Can be conducted early in Conceptual Design, in which case it is called Preview T&E (PT&E).
- Testing focused on operational functionality rather than design issues.
- Normally, testing agency 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).

494

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.

OT&E



496

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.

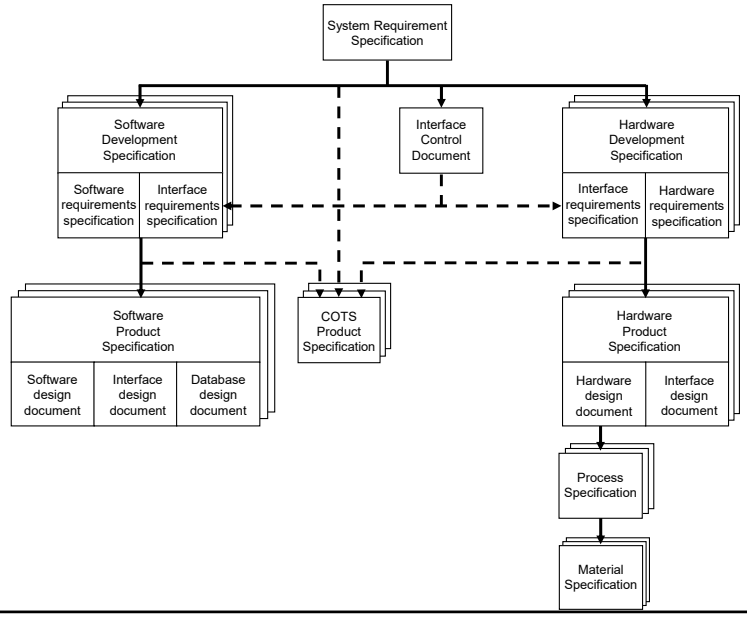
497

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.

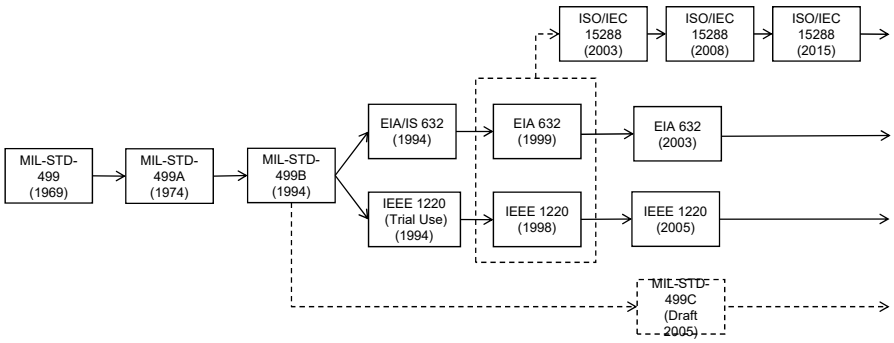
Specifications & Standards

Specification tree



500

SE Standards Evolution



Integration & Planning

502

Integration Management

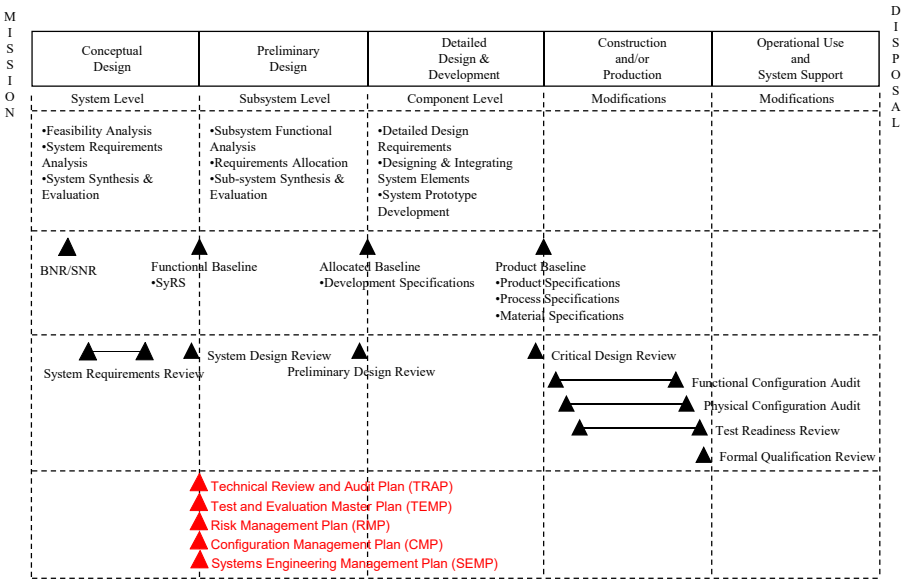
- The Interface Control Document (ICD) will completely define the interfaces between two CIs.
- Interface types include: physical, electronic, electrical, hydraulic, pneumatic, software, and environmental.
- Integration management is all about communications.
- Interface problems are usually blamed on 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.

503

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.

Major Plans



Introduction to Project Management

506

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©)*.

* *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, Project Management Institute, Upper Darby, PA, 2013.

507

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.*

* *A Guide to the Project Management Body of Knowledge (PMBOK)*, Project Management Institute, Upper Darby, PA, 2013.

508

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.

509

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.

510

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.

511

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

* R. Burke, *Project Management: Planning and Control Techniques*, Burke Publishing, 2003.

512

What is project management?

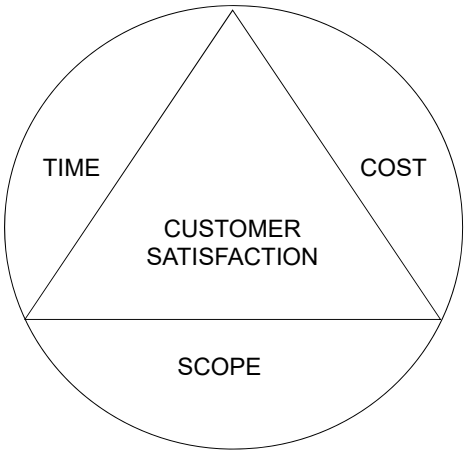
- Project management is:

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.

* *A Guide to the Project Management Body of Knowledge (PMBOK)*, Project Management Institute, Upper Darby, PA, 2013.

What is project management?



514

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.

* *A Guide to the Project Management Body of Knowledge (PMBOK)*, Project Management Institute, Upper Darby, PA, 2013.

515

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

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PMBOK knowledge areas

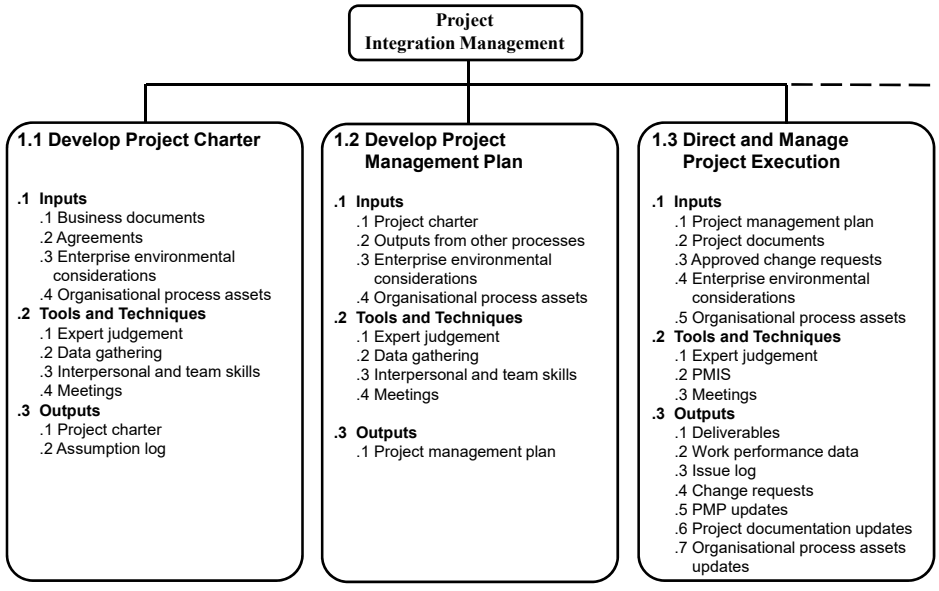
- Integration Management
- Scope Management
- Schedule Management
- Cost Management
- Quality Management
- Resource Management
- Communications Management
- Risk Management
- Procurement Management
- Stakeholder Management

517

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



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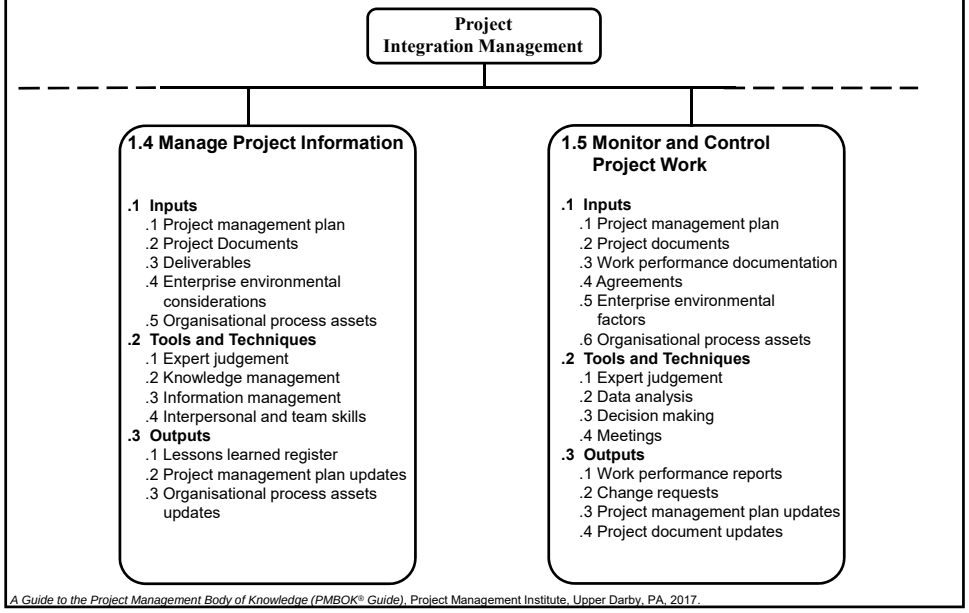
Project Integration Management



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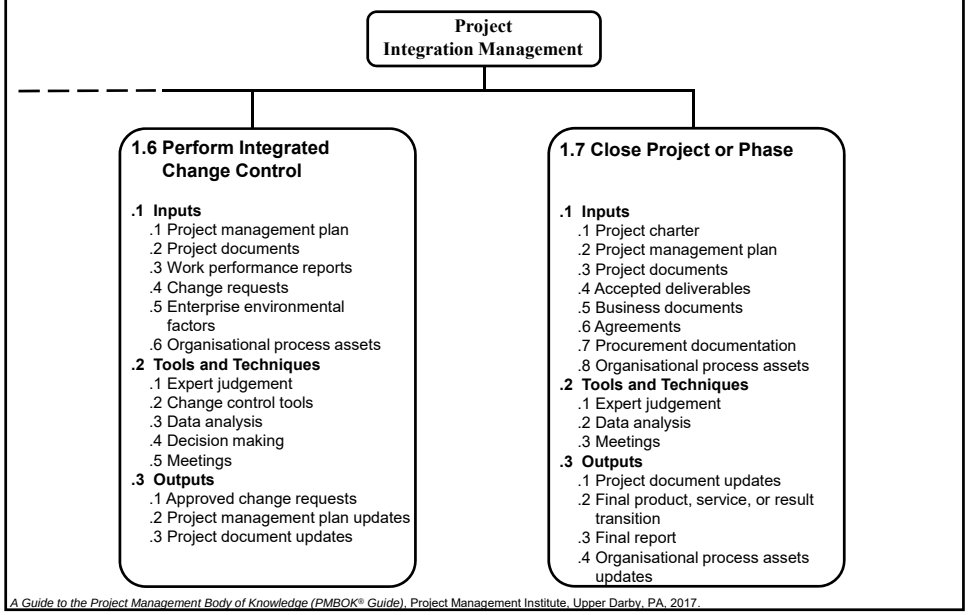

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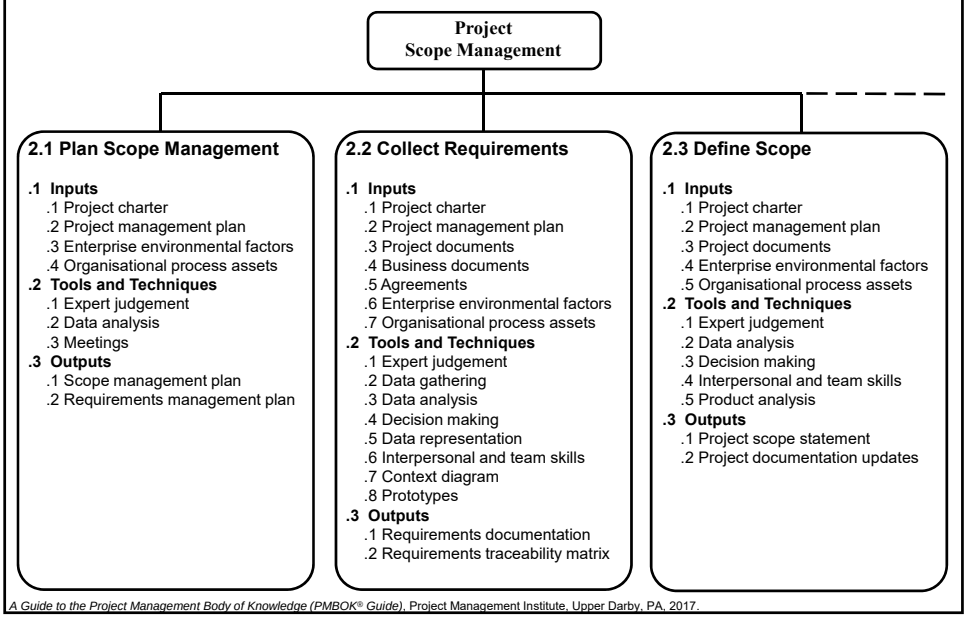
521

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



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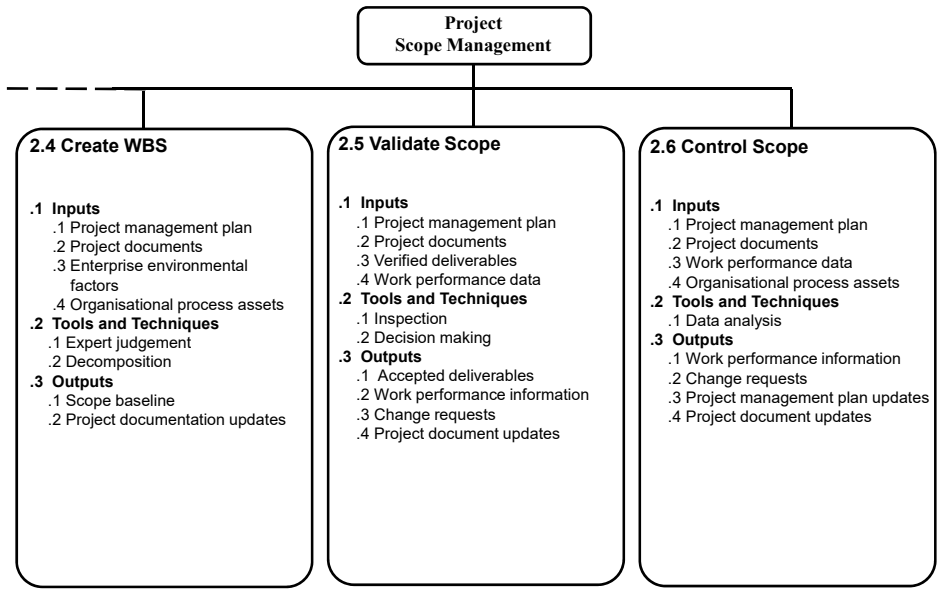
Project Scope Management



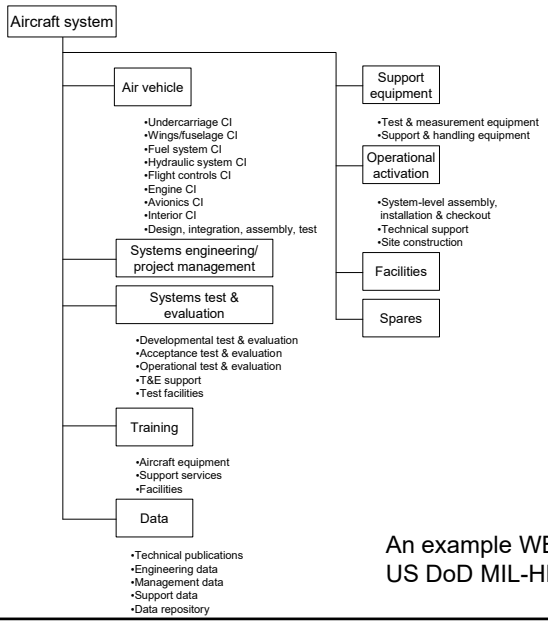
A Guide to the Project Management Body of Knowledge (PMBOK® Guide), Project Management Institute, Upper Darby, PA, 2017.

524

Work Breakdown Structures (WBS)

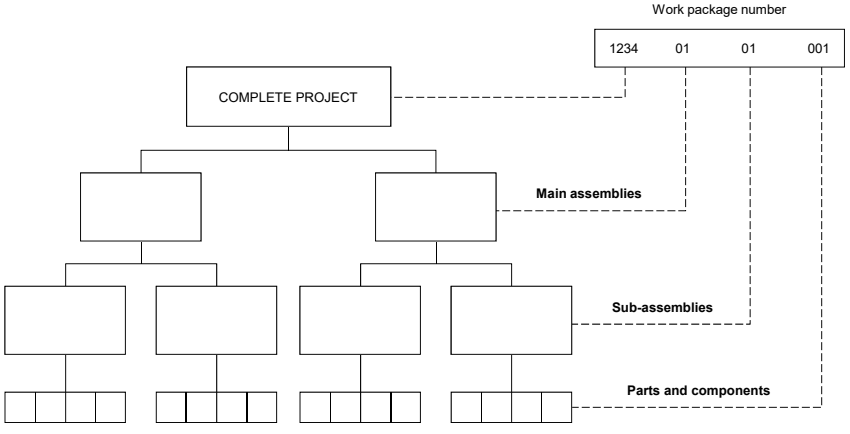
- A WBS is a deliverable-oriented grouping of project components that provides a hierarchical description of the whole project—if it isn't in the WBS, it isn't in the project's scope.
- The WBS is therefore a graphical overview of the project that helps verify as well as communicate the project scope.
- 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*.

Work Breakdown Structures (WBS)



An example WBS—
US DoD MIL-HDBK-881 format

Work Breakdown Structures (WBS)



WBS numbering system

R. Burke, *Project Management: Planning and Control Techniques*, Burke Publishing, 2003.

527

Project Schedule Management

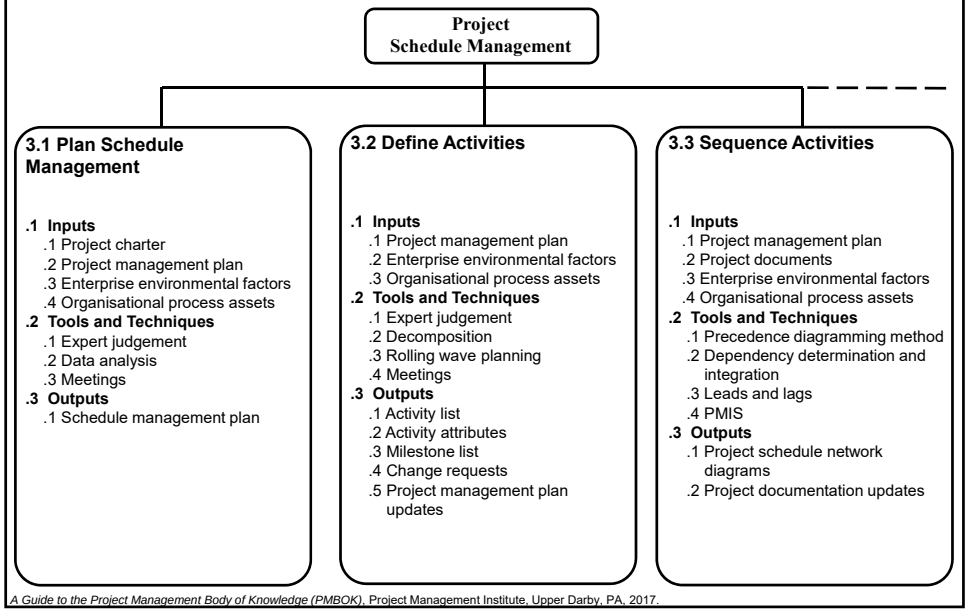
- Includes processes required to ensure the timely completion of the project.
- Also called *time management:*
  - Starts with activity definition where all project activities are identified.
  - The sequence that these activities will be conducted is then identified (including parallel).
  - The duration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

528

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



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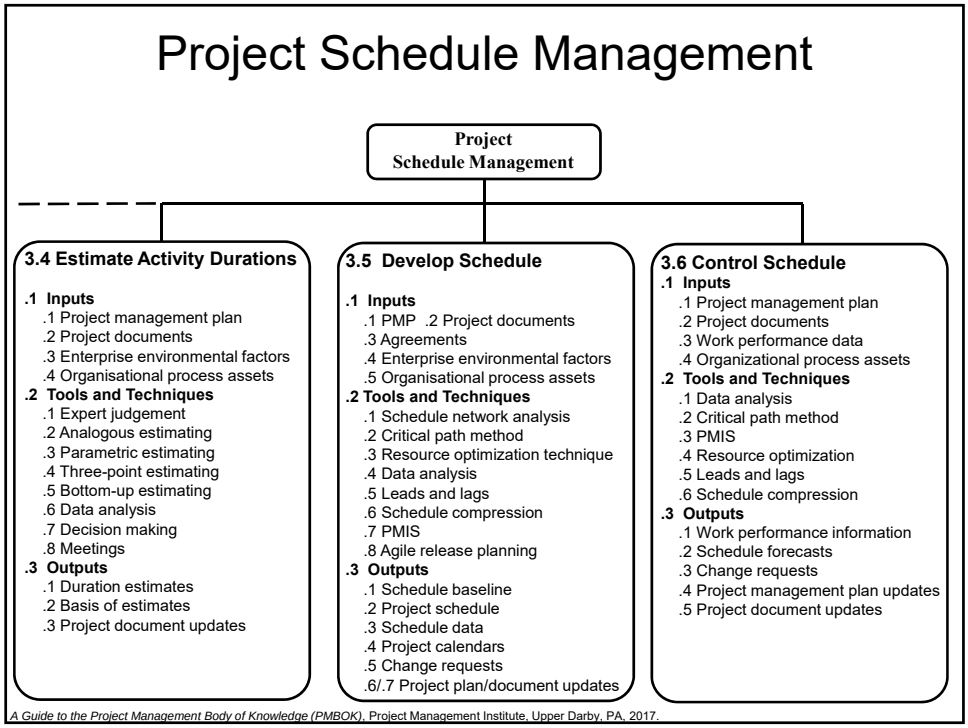
Project Schedule Management



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531

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.

532

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

533

Importance of Good Costing Practice

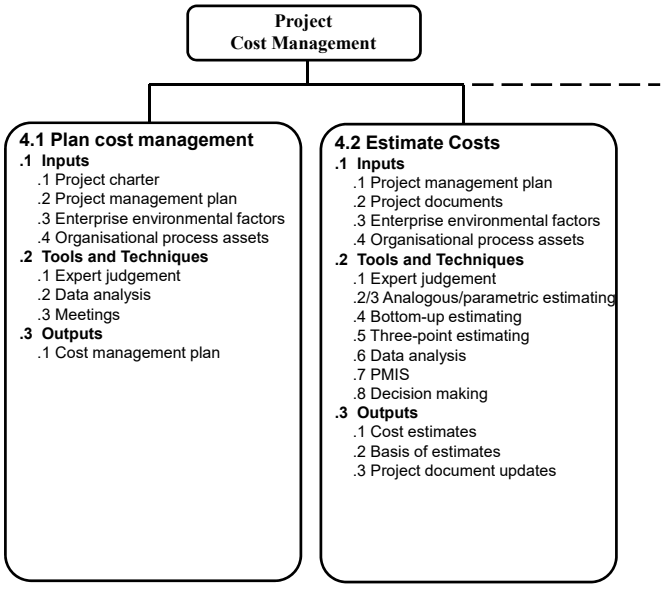
- Supports consideration of Options for Gate decisions
- Fundamental part of the Business Case and Government submissions
- Budgeting
- Particular aspects have proven to be difficult eg estimating developmental and/or integration projects

534

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



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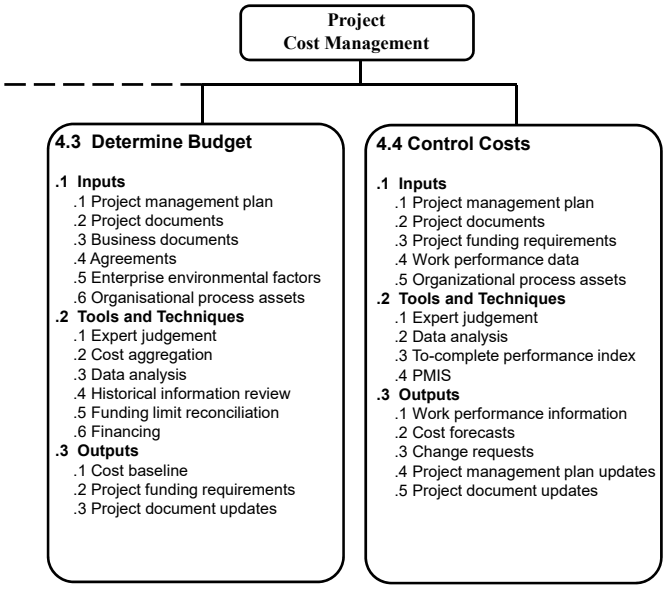
Project Cost Management



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537

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 Quality Management

Project Quality Management

5.1 Plan Quality Management

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

.2 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

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

5.2 Manage Quality

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

.2 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

.3 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

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

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

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

* *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, Project Management Institute, Upper Darby, PA, 2017.

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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

Project Resource Management

6.1 Plan Resource Management

.1 Inputs
.1 Project charter
.2 Project management plan
.3 Project documents
.3 Enterprise environmental factors
.4 Organisational process assets
.2 Tools and Techniques
.1 Expert judgment
.2 Data representation
.3 Organizational theory
.4 Meetings
.3 Outputs
.1 Resource management plan
.2 Team charter
.3 Project documents updates

6.2 Estimate Activity Resources

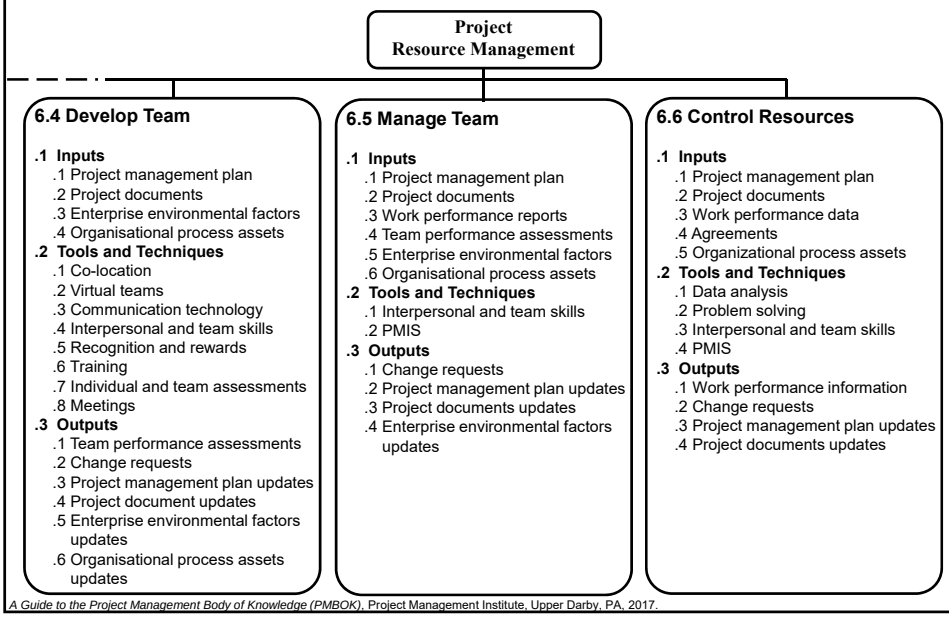
.1 Inputs
.1 Project management plan
.2 Project documents
.3 Enterprise environmental factors
.4 Organisational process assets
.2 Tools and Techniques
.1 Expert judgement
.2 Bottom-up estimating
.3 Analogous estimating
.4 Parametric estimating
.5 Data analysis
.6 PMIS
.7 Meetings
.3 Outputs
.1 Resource requirements
.2 Basis of estimates
.3 Resource breakdown structure
.4 Project management plan updates

6.3 Acquire Resources

.1 Inputs
.1 Project management plan
.2 Project documents
.3 Enterprise environmental factors
.4 Organisational process assets
.2 Tools and Techniques
.1 Decision making
.2 Interpersonal and team skills
.3 Pre-assignment
.4 Virtual teams
.3 Outputs
.1 Physical resource assignments
.2 Project team assignments
.3 Resource calendars
.4 Change requests
.5 Project management plan updates
.6 Project documents updates
.7 Enterprise environmental factors updates
.8 Organisational process assets updates

A Guide to the Project Management Body of Knowledge (PMBOK), Project Management Institute, Upper Darby, PA, 2017.

Project Resource Management



A Guide to the Project Management Body of Knowledge (PMBOK), Project Management Institute, Upper Darby, PA, 2017.

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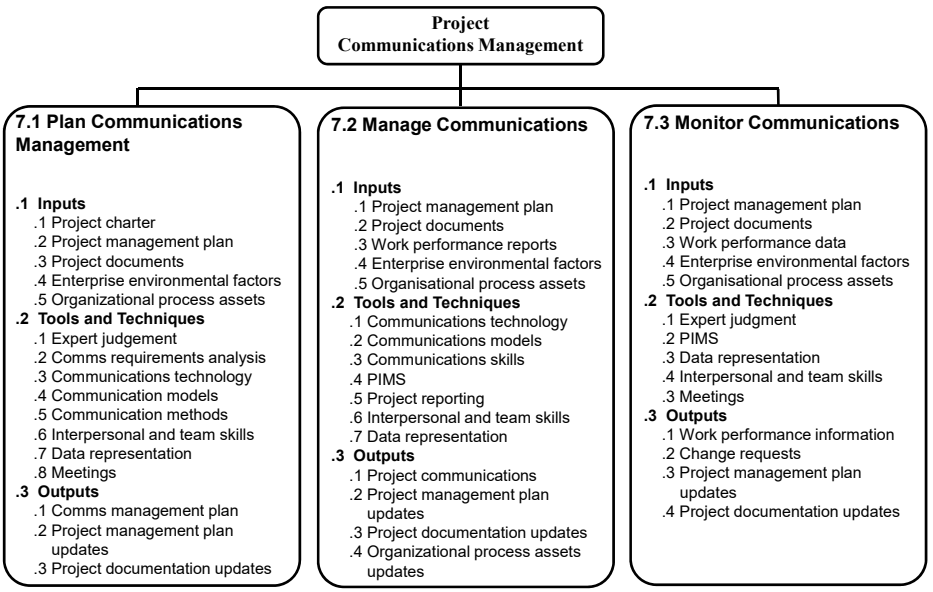
Communications Management

- 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.

Project Communications Management



A Guide to the Project Management Body of Knowledge (PMBOK), Project Management Institute, Upper Darby, PA, 2017.

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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

Project Risk Management

8.1 Plan Risk Management

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

.2 Tools and Techniques
- .1 Expert judgment
- .2 Data analysis
- .3 Meetings

.3 Outputs
- .1 Risk management plan

8.2 Identify Risks

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

.2 Tools and Techniques
- .1 Expert judgment
- .2 Data gathering
- .3 Data analysis
- .4 Interpersonal and team skills
- .5 Prompt lists
- .6 Meetings

.3 Outputs
- .1 Risk register
- .2 Risk reports
- .3 Project documents updates

8.3 Perform Qualitative Risk Analysis

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

.2 Tools and Techniques
- .1 Expert judgment
- .2 Data gathering
- .3 Data analysis
- .4 Interpersonal and team skills
- .5 Risk categorisation
- .6 Data representation
- .7 Meeting

.3 Outputs
- .1 Project documents updates

A Guide to the Project Management Body of Knowledge (PMBOK), Project Management Institute, Upper Darby, PA, 2017.

Project Risk Management

Project Risk Management

8.4 Perform Quantitative Risk Analysis

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

.2 Tools and Techniques
- .1 Expert judgment
- .2 Data gathering
- .3 Interpersonal and team skills
- .4 Representation of uncertainty
- .5 Data analysis

.3 Outputs
- .1 Project documents updates

8.5 Plan Risk Responses

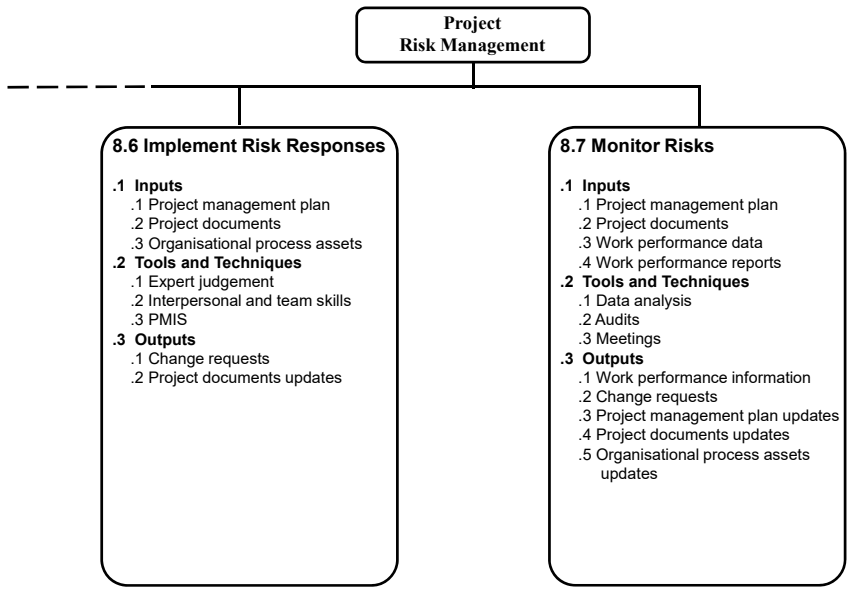
.1 Inputs
- .1 Project management plan
- .2 Project documents
- .3 Enterprise environmental factors
- .4 Organisational process assets

.2 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

.3 Outputs
- .1 Change requests
- .2 Project management plan updates
- .3 Project document updates

A Guide to the Project Management Body of Knowledge (PMBOK), Project Management Institute, Upper Darby, PA, 2017.

Project Risk Management



A Guide to the Project Management Body of Knowledge (PMBOK), Project Management Institute, Upper Darby, PA, 2017.

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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

Project Procurement Management

9.1 Plan Procurements
.1 Inputs
.1 Project charter
.2 Business documents
.3 Project management plan
.4 Project documents
.5 Enterprise environmental factors
.6 Organisational process assets
.2 Tools and Techniques
.1 Expert judgment
.2 Data gathering
.3 Data analysis
.4 Source selection analysis
.5 Meetings
.3 Outputs
.1 Procurement management plan
.2 Procurement strategy
.3 Bid documents
.4 Procurement SOW
.5 Source selection criteria
.6 Make-or-buy decisions
.7 Independent cost estimates
.8 Change requests
.9 Project documents updates
.10 Org process assets updates

9.2 Conduct Procurements
.1 Inputs
.1 Project management plan
.2 Project documents
.3 Procurement documents
.4 Seller proposals
.5 Enterprise environmental factors
.6 Organizational process assets
.2 Tools and Techniques
.1 Expert judgement
.2 Advertising
.3 Bidder conferences
.4 Data analysis
.5 Interpersonal and team skills
.3 Outputs
.1 Selected sellers
.2 Agreements
.3 Resource calendars
.4 Change requests
.5 Project management plan updates
.6 Project documents updates
.7 Organisational process assets updates

9.3 Control Procurements
.1 Inputs
.1 Project management plan
.2 Project documents
.3 Agreements
.4 Procurement documentation
.5 Approved change requests
.6 Work performance data
.7 Enterprise environmental factors
.8 Organizational process assets
.2 Tools and Techniques
.1 Expert judgement
.2 Claims administration
.3 Data analysis
.4 Inspection
.5 Audits
.3 Outputs
.1 Closed procurements
.2 Work performance information
.3 Procurement documents updates
.4 Change requests
.5 Project management plan updates
.6 project documents updates
.7 Org process assets updates

A Guide to the Project Management Body of Knowledge (PMBOK), Project Management Institute, Upper Darby, PA, 2017.

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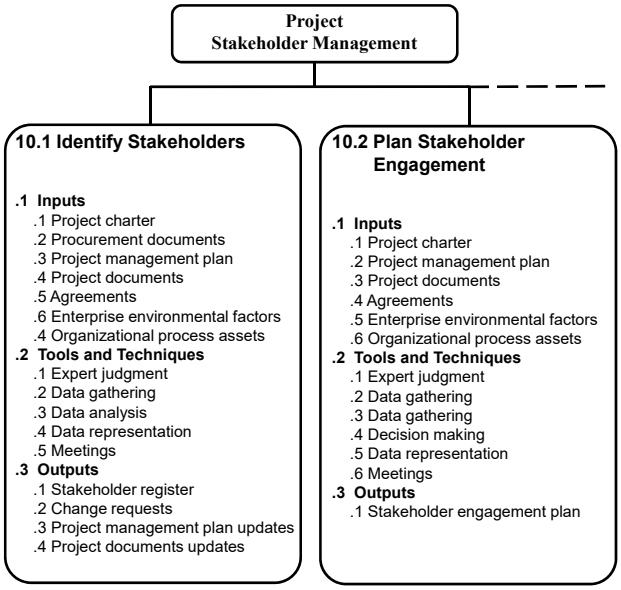
Stakeholder Management

- 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.

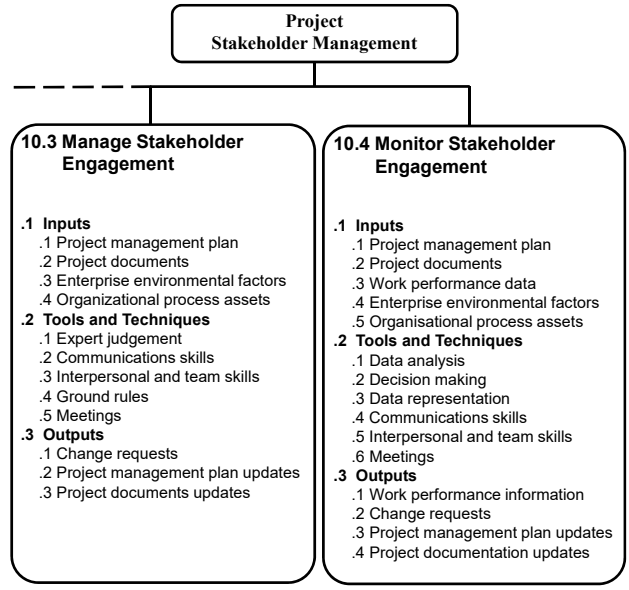
A Guide to the Project Management Body of Knowledge (PMBOK), Project Management Institute, Upper Darby, PA, 2013.

Project Stakeholder Management



A Guide to the Project Management Body of Knowledge (PMBOK), Project Management Institute, Upper Darby, PA, 2017.

Project Stakeholder Management



A Guide to the Project Management Body of Knowledge (PMBOK), Project Management Institute, Upper Darby, PA, 2017.

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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.

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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.

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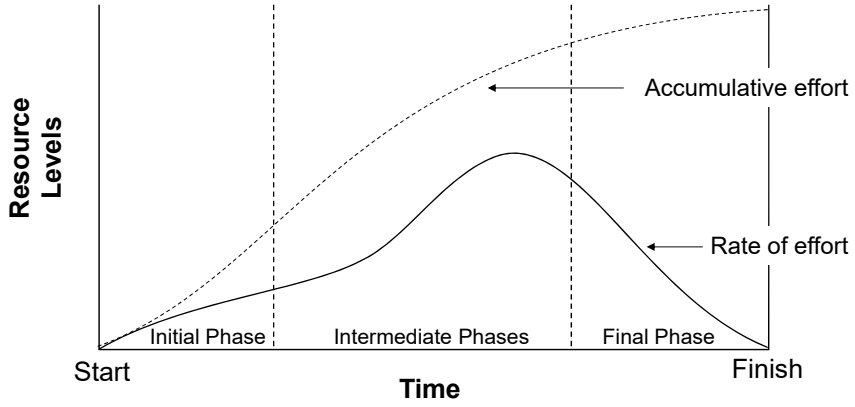
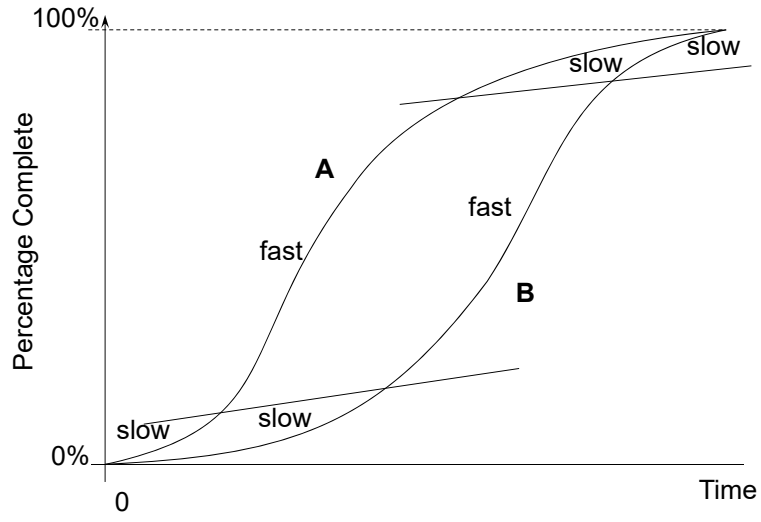
Project Life Cycle

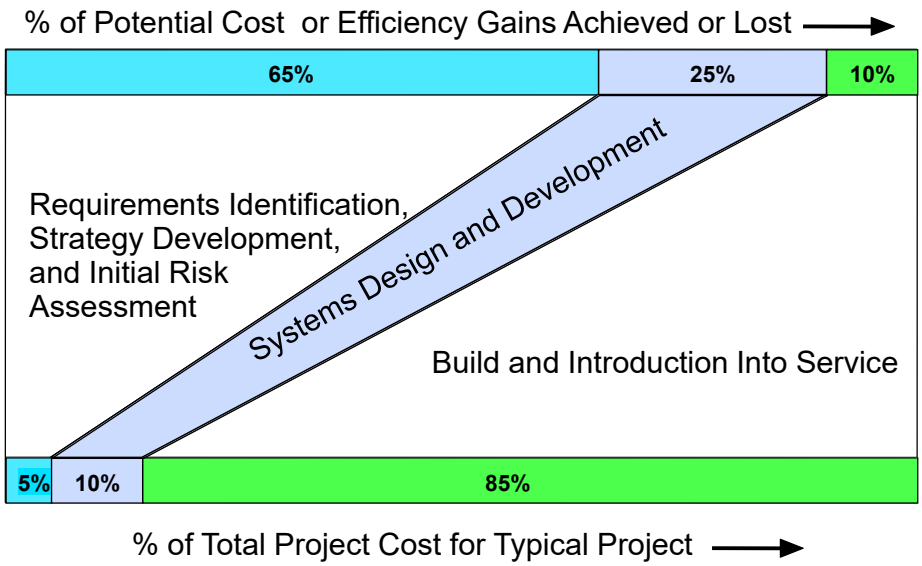
- *Resource usage.* At the start, the levels of staffing, finance and other resources are relatively low. As the project progresses, the utilisation increases and then diminishes rapidly as the product is completed and delivered.



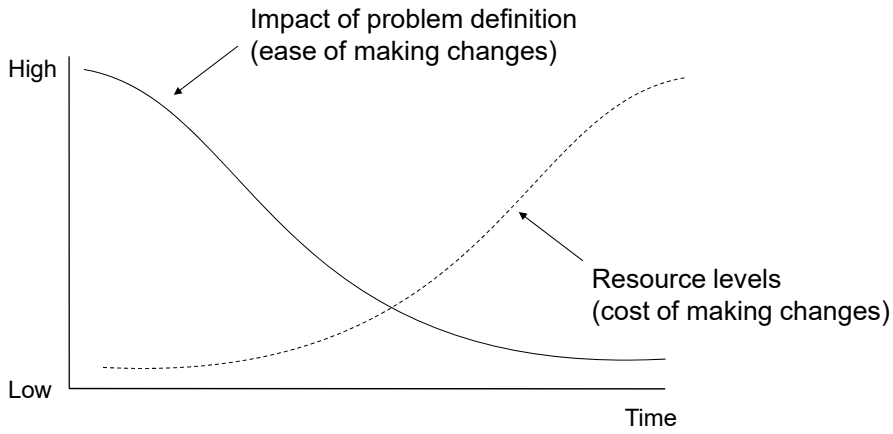
Project Life Cycle



The Importance of Project Definition



The Importance of Project Definition

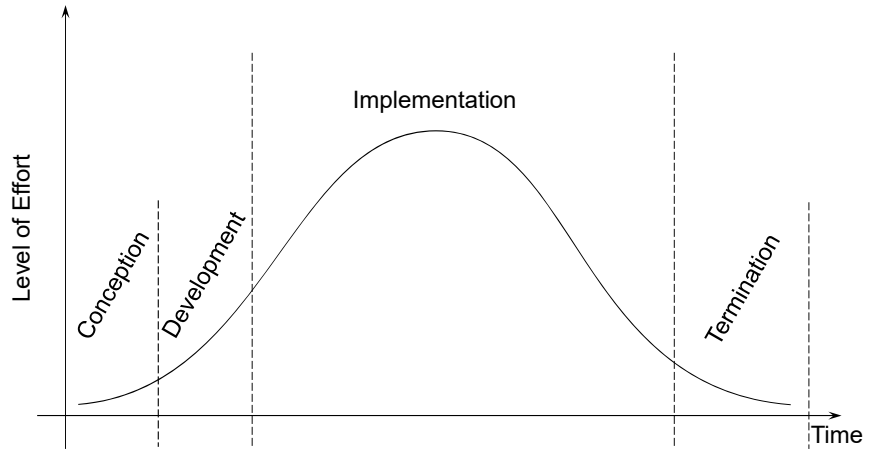


Typical Project Life Cycles

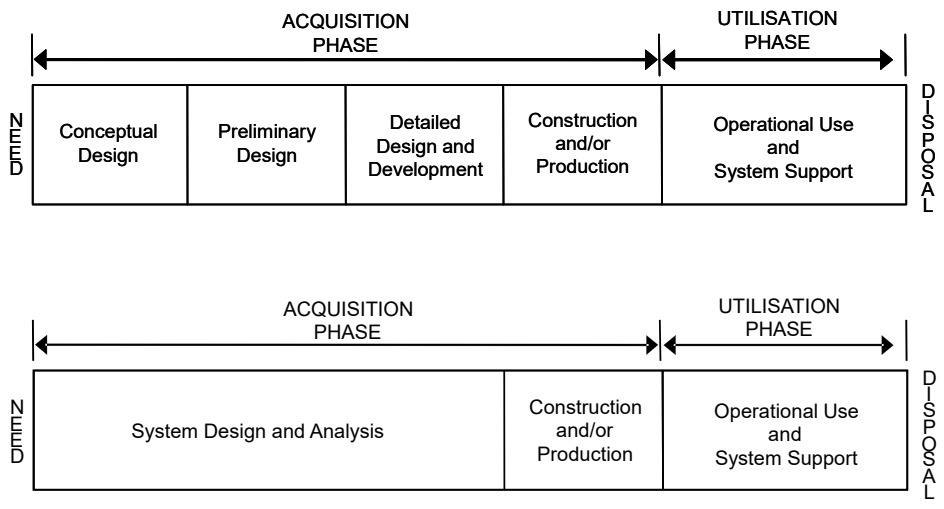
Conceive	Develop	Implement	Terminate
Gather data Identify need Establish: Goals, objectives Basic economics Feasibility Stakeholders Risk level Strategy Team Estimate resources Identify alternatives Present proposal Gain approval	Appoint team Conduct studies Develop scope Establish: Master plan Budget Cash flow WBS Polices Procedures Assess risks Confirm justification Present brief	Set up organisation Set up communications Motivate team Detail technical requirements Establish Work packages Detailed schedule Information control systems Procure goods and services Execute work packages Direct/monitor/forecast/control: Scope Quality Time Cost Resolve problems	Finalise products Review and accept Transfer responsibility Evaluate product Document results Release/redirect resources Reassign project team

Simple Project Life-cycle Phases

Typical Project Life Cycles

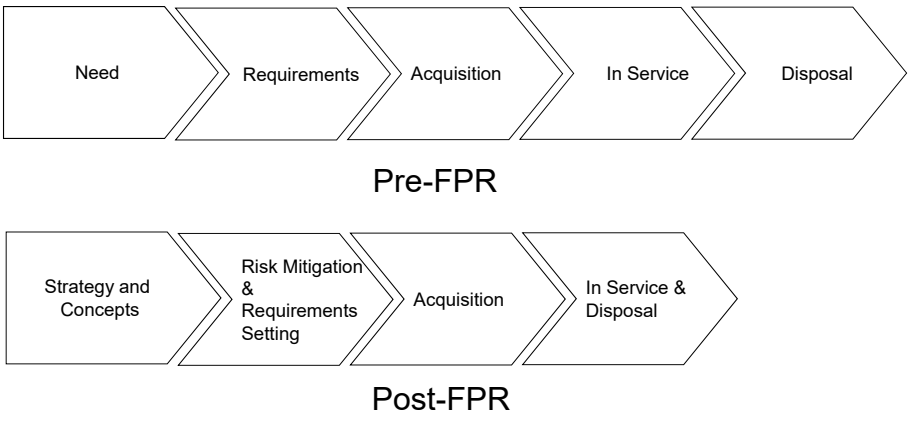


Typical Project Life Cycles



Systems Engineering—Blanchard, et al

Typical Project Life Cycles



Australian Department of Defence

Typical Project Life Cycles

Concept and Technology Development	System Development and Demonstration	Production and Deployment	Support

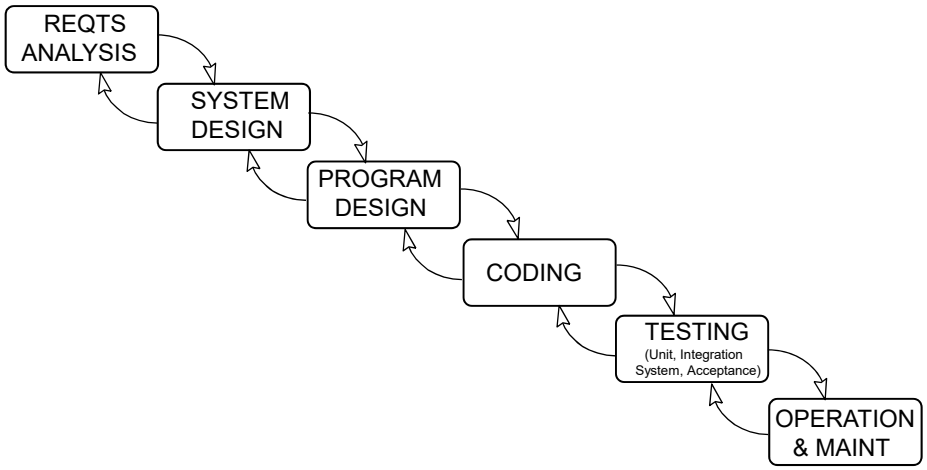
Pre-Systems Acquisition

Systems Acquisition (Engineering Development, Demonstration, Production, and Deployment)

Sustainment and Maintenance

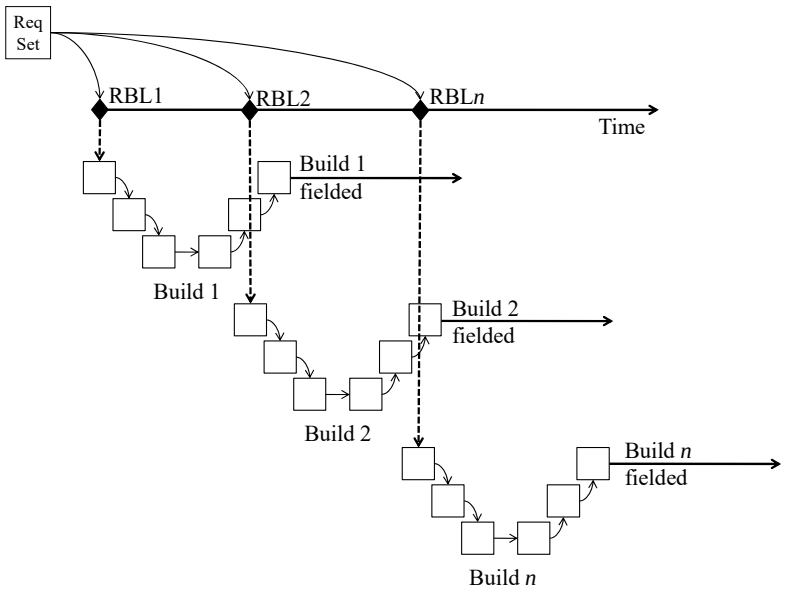
US Department of Defense

Typical Project Life Cycles

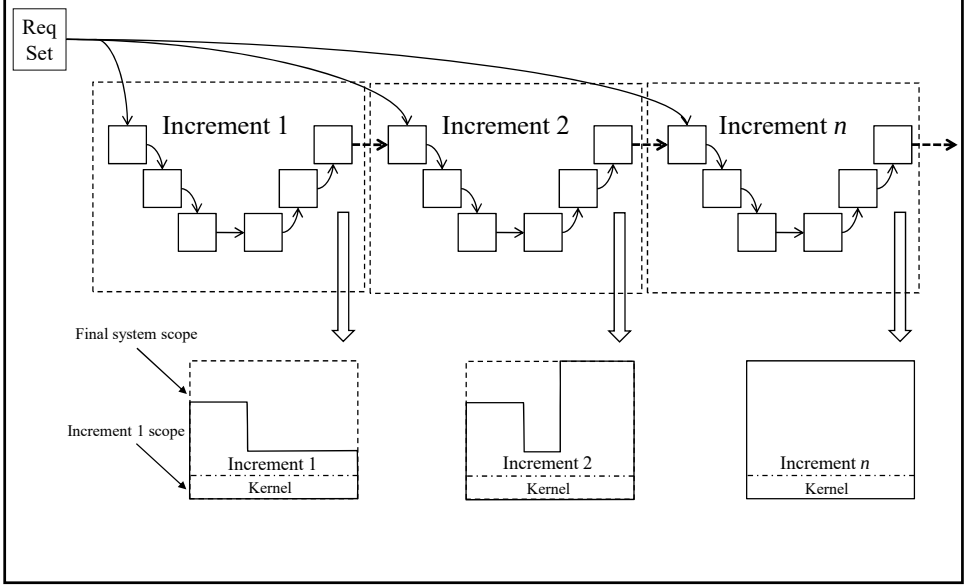


Software Development—Waterfall Model

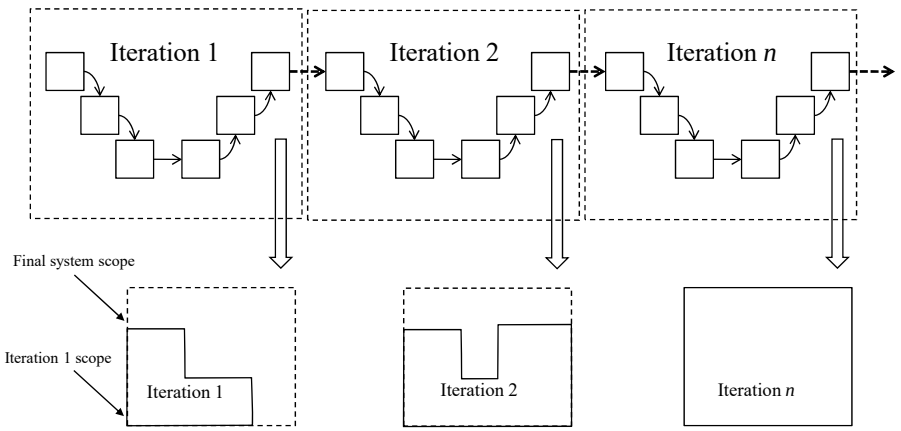
Waterfall—Overlapping builds



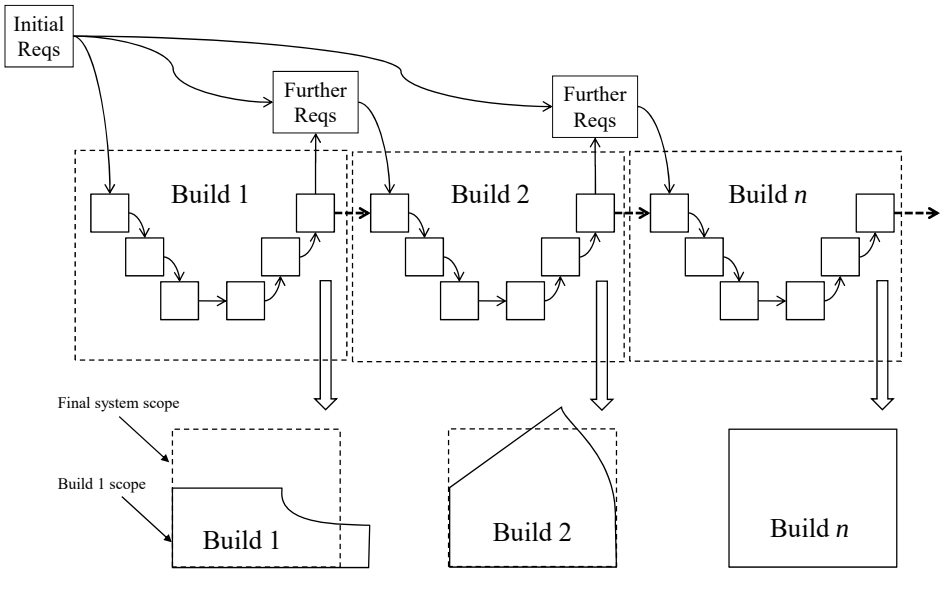
Incremental Approach



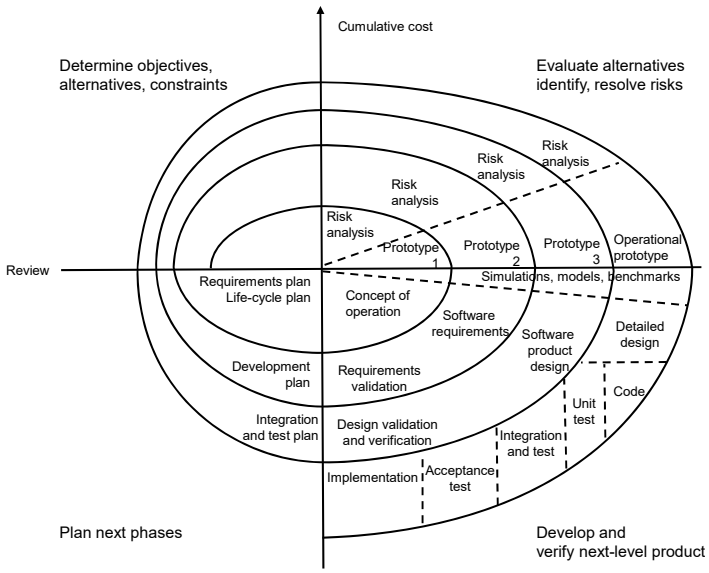
Iterative Approach



Evolutionary Approach



Spiral Development



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Revision

22. List the ten *knowledge areas* of the Project Management Body of Knowledge (PMBOK).

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

Introduction to Program Management

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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

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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

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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.

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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

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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

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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

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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)

Integrated Logistics Support

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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.

10 support elements of ILS

Source: DEFLOGMAN Part 2 Vol 10 Chapter 3

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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

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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.

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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.

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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.

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ILS Analyses

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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

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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.

DMH (LOG) 04-01-002

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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

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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.

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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

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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.

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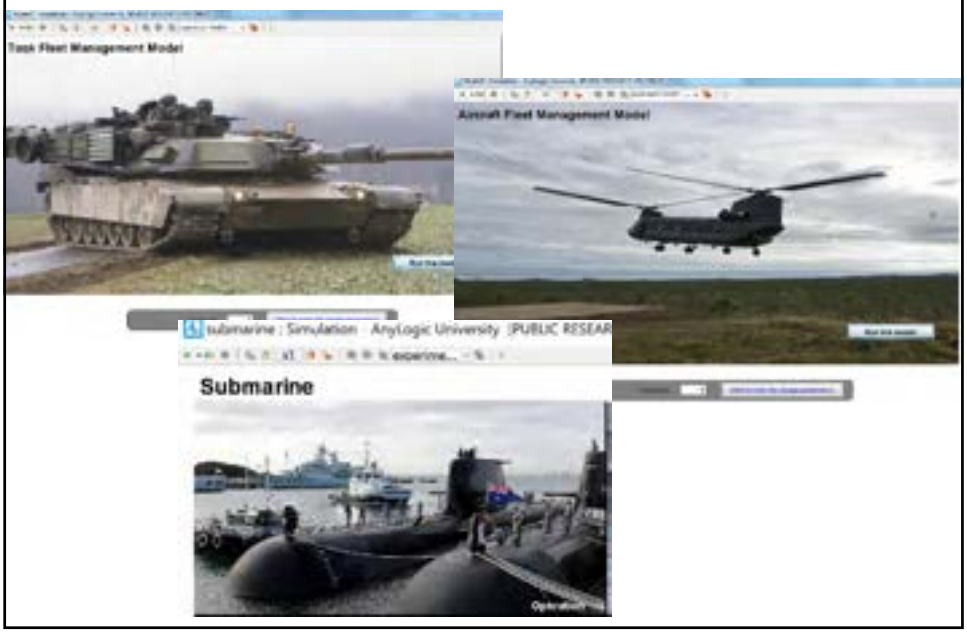
Benefits of Modelling and Simulation

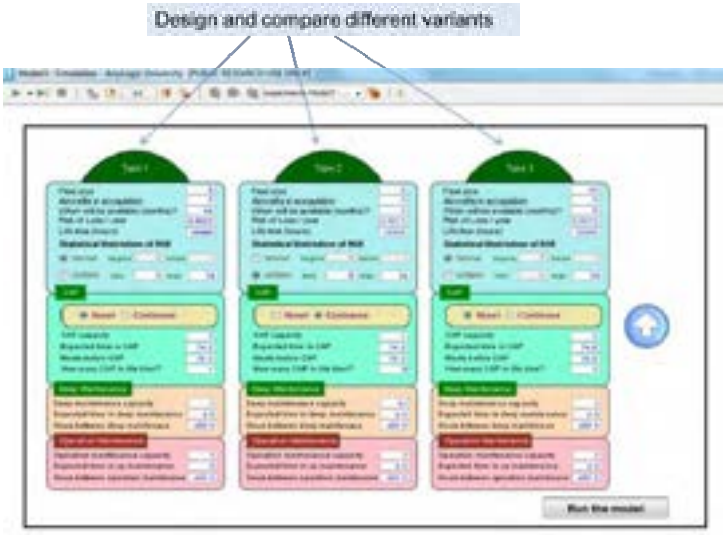
- Gain insight into the operation of a system.
- Develop operating or resource policies to improve system performance.
- Test new concepts and/or systems before implementation.
- Gain information without disturbing the actual system.

Modelling for Force Design



Modelling for Force Design

Modelling for Force Design



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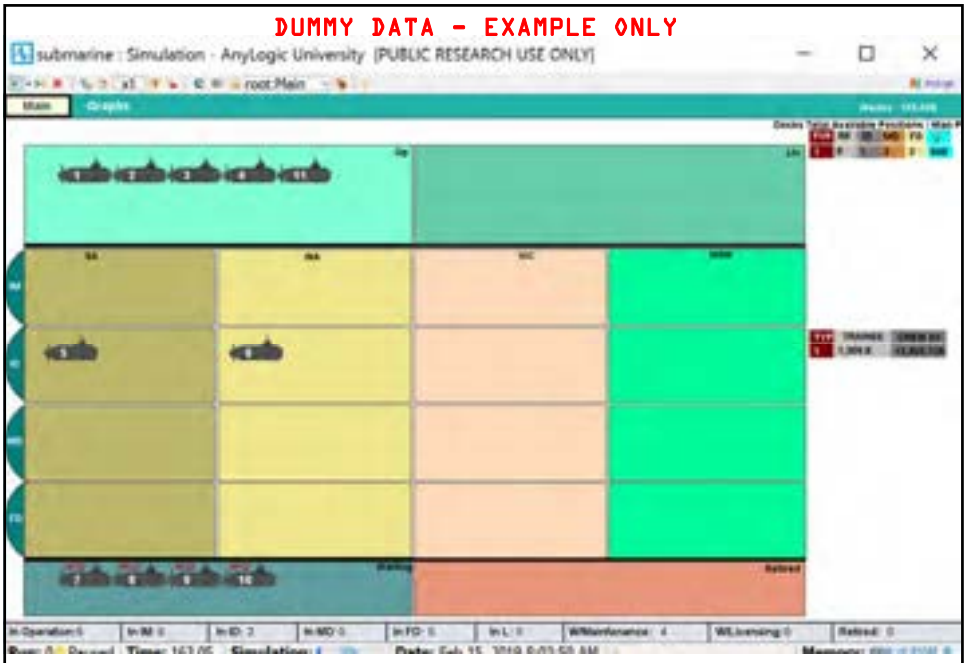
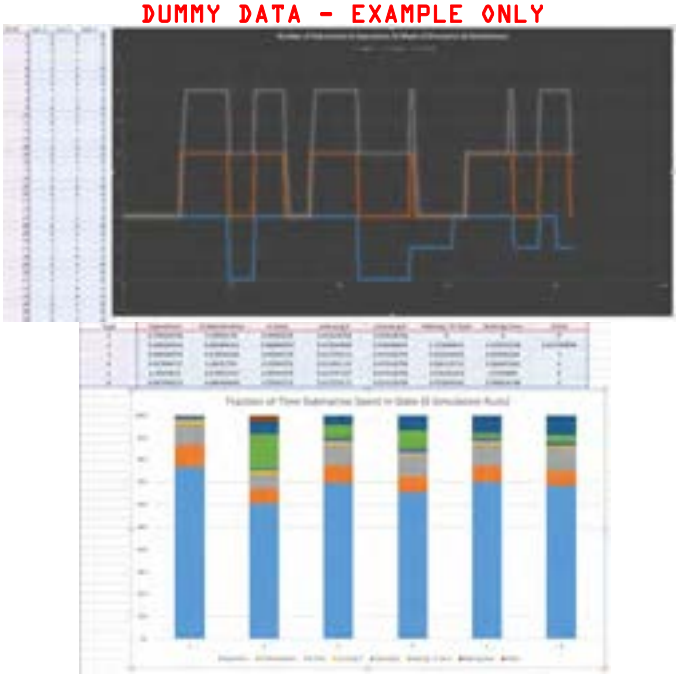
DUMMY DATA - EXAMPLE ONLY



UNCLASSIFIED

DUMMY DATA - EXAMPLE ONLY



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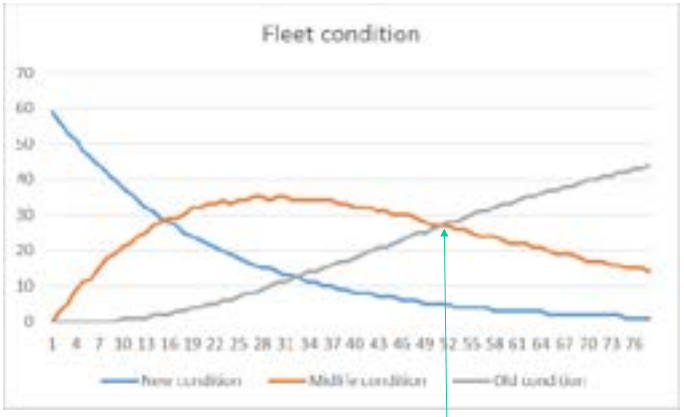
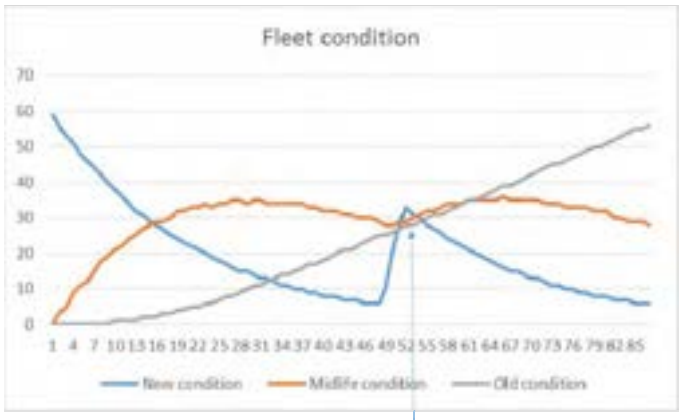
LCCA



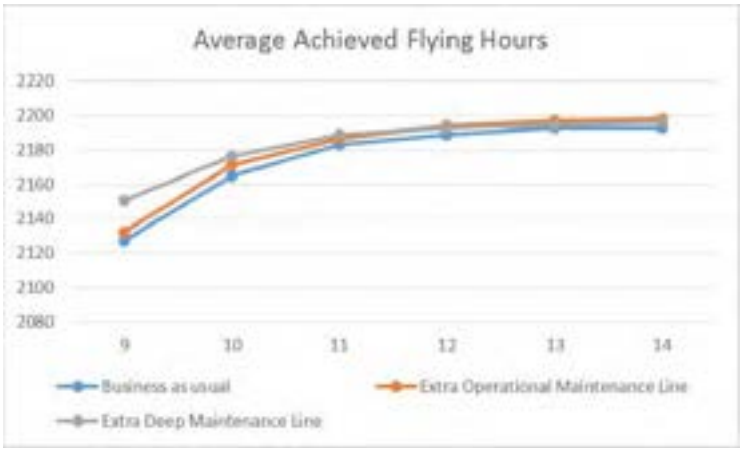
Lifetime extension decision

LCCA

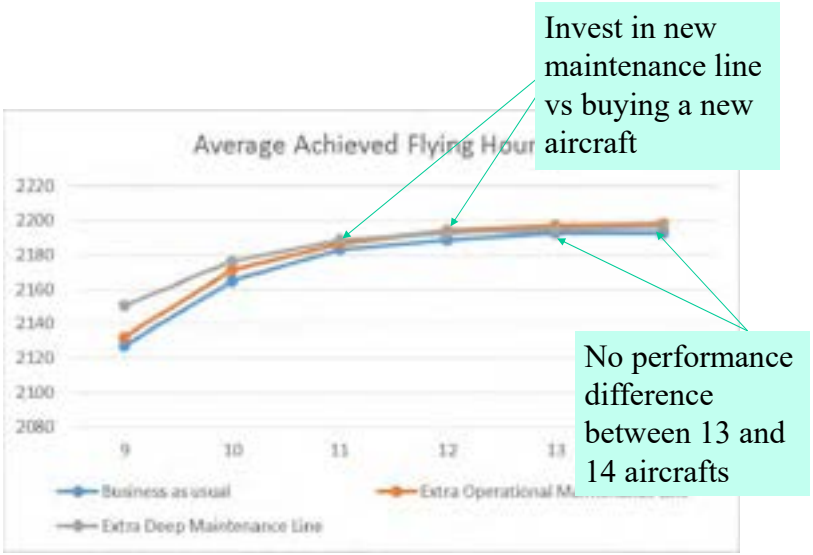


Effect on acquisition of boosting of the fleet condition

Trade-off analysis

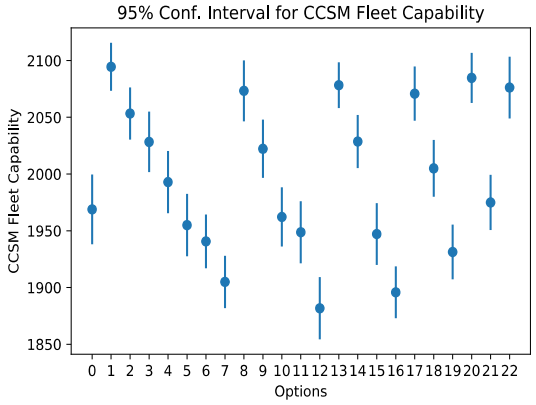


Trade-off analysis



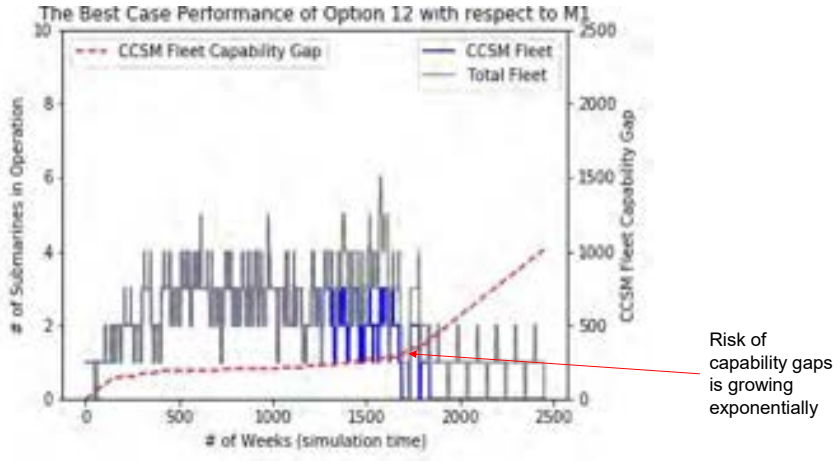
Model use: Options evaluation

- Fleet capability is the total number of weeks where the fleet size is less than 2.



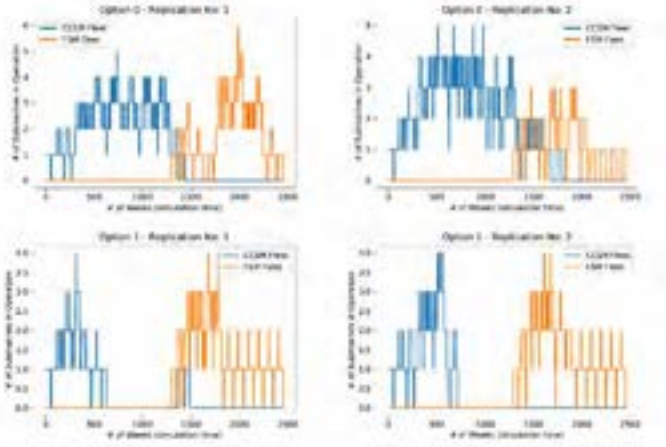
Model use: Options evaluation

- Investigation of options performance over time.



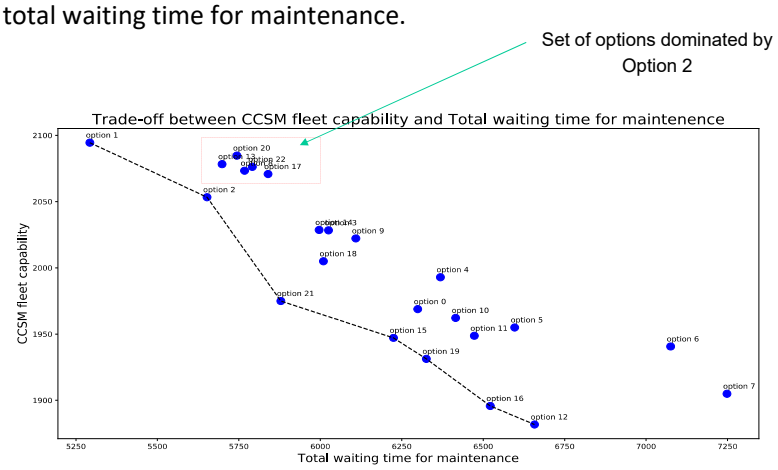
Model use: Options evaluation

- Investigate and quantify the effects of uncertainty about resource availability, and vulnerability of options to this uncertainty.



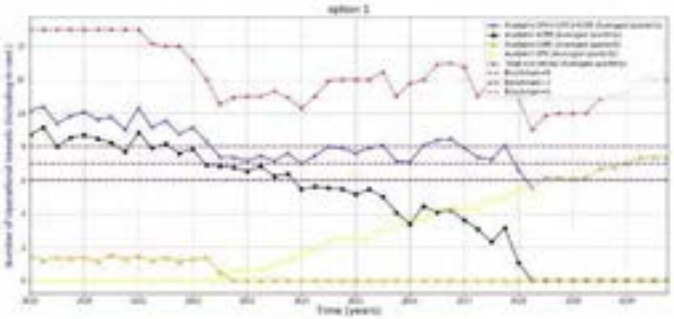
Model use: Options comparison and trade-off

- Options are compared with respect to two metrics: fleet capability and the total waiting time for maintenance.



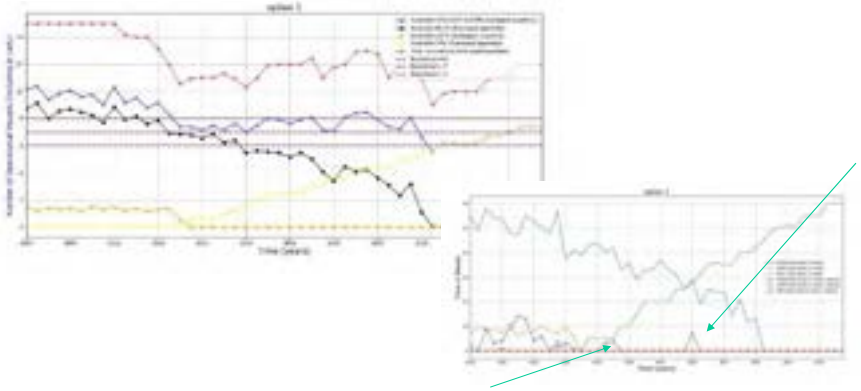
Example of option analysis

Minimum number of hulls is 10 PV with Lease for the CAPE (till 2022)	The ship lift is in place until the last ACPB is decommissioned (in 02/02/2028)

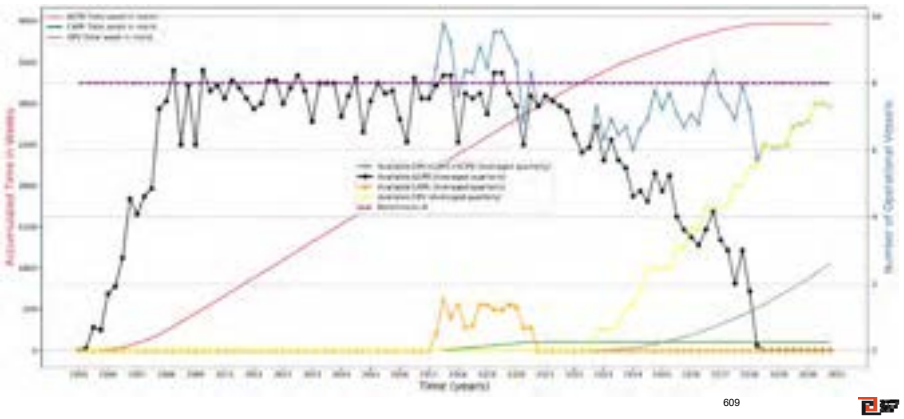


Using the model to identify bottlenecks

Minimum number of hulls is 10 PV with Lease for the CAPE (till 2022)	The ship lift is in place until the last ACPB is decommissioned (in 02/02/2028)



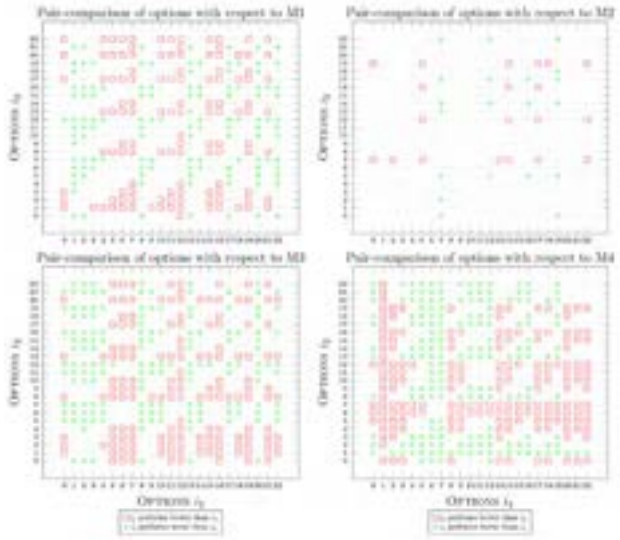
Waiting Time vs Availability



609

Model use: baseline comparison

- Options are compared to each other based on four metrics.



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Dynamic lifecycle analysis

Spare management policy need to consider:
- The changes in MTBF through the lifecycle
- Uncertainty about MTBF

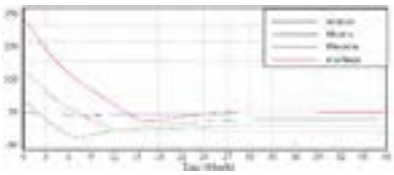

Fig A. Stock regulation strategy based on predicted (baseline) MTBF

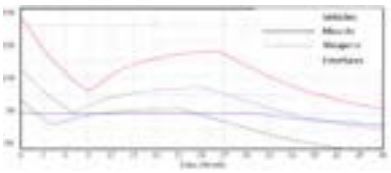

Fig B. Failure replacement strategy

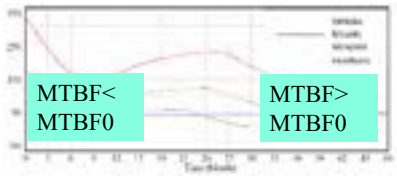

Fig C. Adaptive replacement strategy

Dynamic lifecycle analysis

Spare management policy need to consider:
- The changes in MTBF through the lifecycle
- Uncertainty about MTBF

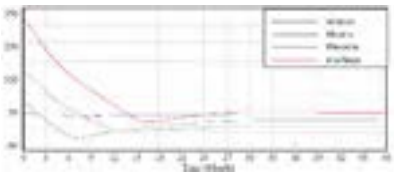

Fig A. Stock regulation strategy based on predicted (baseline) MTBF

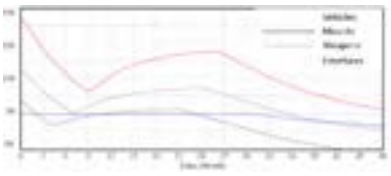

Fig B. Failure replacement strategy

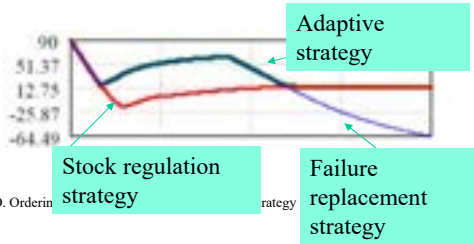

Fig D. Orderin rategy

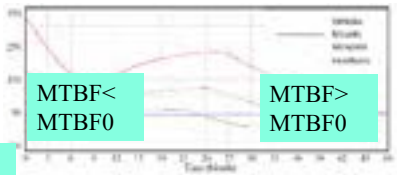

Fig C. Adaptive replacement strategy

613

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

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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

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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.

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PHASES OF THE CLC

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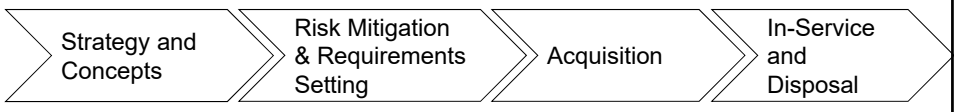
Overview: Phases of the CLC

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.

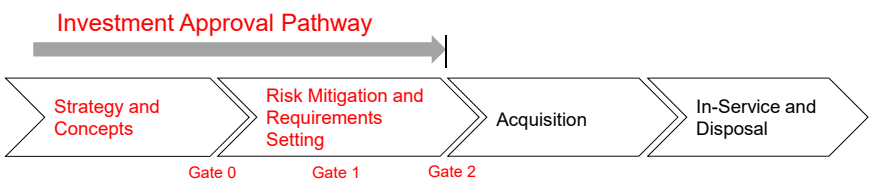


618

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.



STRATEGY AND CONCEPTS

Strategy and Concepts Phase: Force Design

620

621

Strategy and Concepts Phase

- Draws on force design cycle (DCAP) to:
  - evolve joint capability concepts, and
  - identify capability needs.
- Identifies current, forecast or potential:
  - capability gaps,
  - risks,
  - issues, and
  - opportunities that may need further investment.
- Develops capability options.
- Basis for a CM to develop the Gate 0 Proposal.
- Emphasis on 'Joint force by Design'.

Strategy and Concepts Phase: Force Design

Force Design Framework (DCAP)

- Force Design:
  - Centralised.
  - Core function of Strategy & Concepts.
  - 'Joint Force by Design': integration and interoperability.
- Defence Capability Assessment Program (DCAP):
  - Annual, Agile, Fundamental modes.
  - Prioritised capability investment recommendations for IIP.

623

Force Design

- Identifies force design options.
- Force Design Division uses combination of activities:
  - experimentation,
  - war-gaming,
  - simulation and modelling,
  - operations analysis, and
  - options development and analysis.

Source: https://www.dst.defence.gov.au/research-area/operations-analysis

Source: Adeladian (Researchers working in the Defence, Science & Technology Organisation's (DSTO) Future Operations Centre Analysis Laboratory (FOCAL) Photo courtesy of DSTO

624

Strategy and Concepts Phase: Force Design

Force Design Framework (DCAP)

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

Need defined: What?

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Strategy and Concepts Phase: Smart Buyer

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

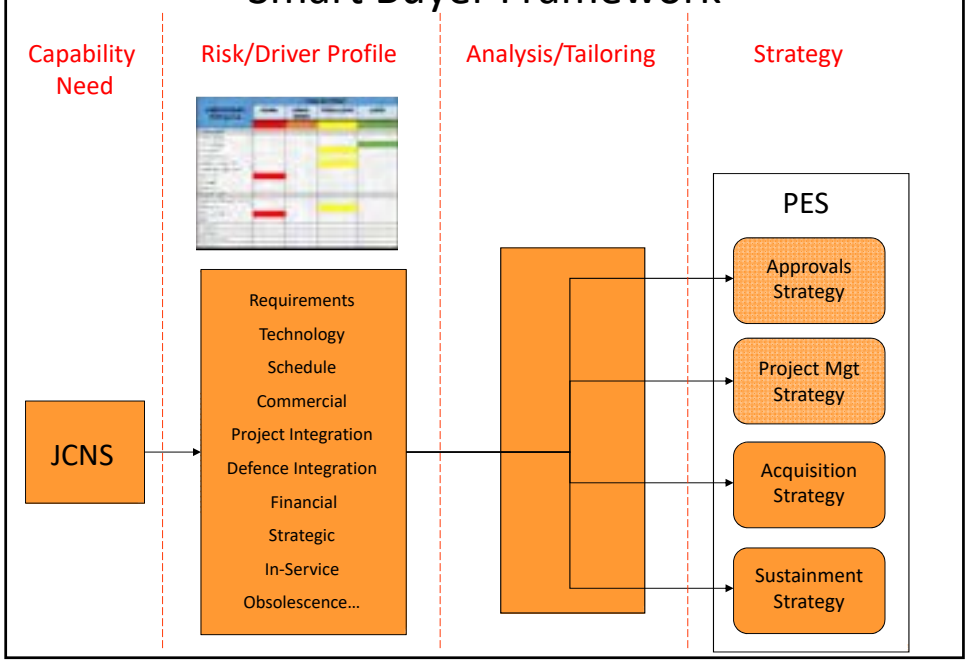
Gate 0 Gate 1 Gate 2

Force Design Framework (DCAP)

Smart Buyer Framework

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

Smart Buyer Framework



Strategy and Concepts Phase: Smart Buyer

627

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

Gate 0 Gate 1 Gate 2

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

Strategy defined: How?

Strategy and Concepts Phase: Contestability

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

Gate 0 Gate 1 Gate 2

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

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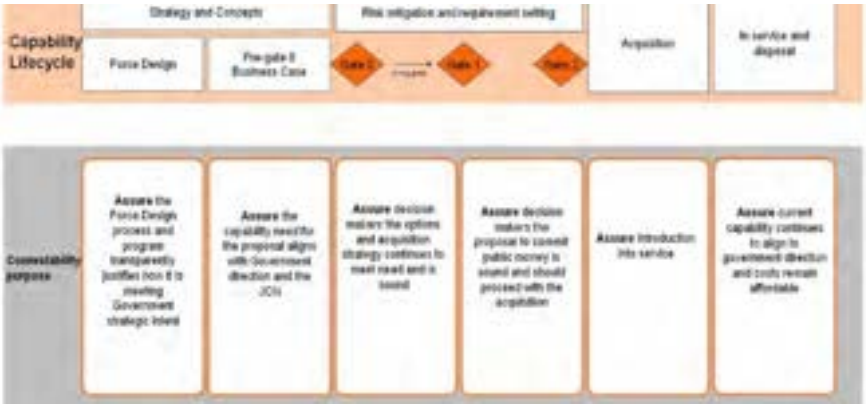
Contestability Model across the CLC



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

Source: Department of Defence

630

Strategy and Concepts Phase: Contestability

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

Gate 0 Gate 1 Gate 2

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

Assurance: Is proposal OK?

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Strategy and Concepts Phase: Gate 0

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

Gate 0 | Gate 1 | Gate 2

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

Project Proposal

Gate 0 Proposal

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Gate 0 Proposal: Features

- Sufficiency: sufficient argument to make a decision.
- Discipline in Documentation: appropriate level of detail.
- Tailored: approach appropriate to risk, complexity.

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Gate 0 Proposal: Components

Why?

What?

How?

Sponsor Paper

+

Joint Capability Needs Statement (JCNS)

+

Project Execution Strategy (PES)

634

Gate 0 Proposal: Components

Why?

What?

How?

Sponsor Paper

Overarching business argument for investment

+

Joint Capability Needs Statement (JCNS)

+

Project Execution Strategy (PES)

635

Gate 0 Proposal: Components

Why?

What?

How?

Sponsor Paper

Overarching business argument for investment

+

Joint Capability Needs Statement (JCNS)

What is the capability need (gap)

+

Project Execution Strategy (PES)

636

Gate 0 Proposal: Components

Why?

What?

How?

Sponsor Paper

Overarching business argument for investment

+

Joint Capability Needs Statement (JCNS)

What is the capability need (gap)

+

Project Execution Strategy (PES)

How will investment (Project) be undertaken

637

Gate 0 Proposal: Components

- Sponsor Paper:
  - Business Case argument.
  - Contestability Statement.
  - Total Cost of Ownership (TCO).
  - Industry considerations.
- Joint Capability Needs Statement (JCNS).
- Project Execution Strategy (PES):
  - must be based on Smart Buyer analysis;
  - must not use templated content; and
  - must not be a 'cookie cutter' application of other efforts.

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PES: Tailored Strategy

- Approval Strategy:
  - Authorities eg National Security Committee (NSC), One/Two Ministers.
  - Pathway eg:
    - fast track from Gate 0 to Gate 2; and
    - significant risk reduction studies Gate 0 to Gate 1.
- Acquisition Strategy
  - stages to acquisition, contracting approach; and
  - approach to down-selecting options.
- Sustainment Strategy
  - support concept and broad support arrangements.
- Project Management Strategy
  - role of Project eg Prime System Integrator.

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Gate 0 Proposal: implementation

Proposes activities and outcomes to next Gate including:

- Risk reduction activities.
- Funding requirements.
- Expected outcomes, such as:
  - requirements definition,
  - down-selection of options,
  - risk profile, and
  - costings.
- Industry engagement.

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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.

Strategy and Concepts Phase: Gate 0

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

Gate 0 | Gate 1 | Gate 2

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: Business Case

Strategy and Concepts Phase: IC consideration

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

Gate 0 | Gate 1 | Gate 2

Force Design Framework (DCAP)

- Output: Joint Capability Narrative (JCN)
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- Output: Project Execution Strategy

Contestability Framework

- Contestability Division engaged
- Output: Assurance statement

Project Proposal

Gate 0 Proposal

- Output: Gate 0 Proposal comprising: Submission; JCNS; PES

Investment Committee

Investment Committee consideration

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Gate 0 – Overview

- Internal Defence decision.
- Proposal sponsored by Capability Manager (CM)
- Approves further development of feasible and achievable options with agreed requirements, timeframes, and funding:
  - to Gate 1; or
  - directly to Gate 2.
- Gate 0 approval is issued by the VCDF.
- Gate 0 Proposal evolves for Gate 1 and Gate 2.

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Gate 0 - Outcomes

- Project Direction:
  - Expected outcomes for next Gate.
  - Resources allocated.
  - Key issues and risks for next business case/proposal.
- Formal endorsement of PES,
- If going straight to Gate 2 can initiate entry into IIP through higher delegation.

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Strategy and Concepts Phase: IC consideration

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

Gate 0 Gate 1 Gate 2

Force Design Framework (DCAP)

- Output: Joint Capability Narrative (JCN)
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Smart Buyer Framework

- Delivery Group assigned
- IPM assigned and IPMT initiated
- Output: Project Execution Strategy

Contestability Framework

- Contestability Division engaged
- Output: Assurance statement

Project Proposal

Gate 0 Proposal

- Output: Gate 0 Proposal comprising: Submission; JCNS; PES

Investment Committee

Investment Committee consideration

- Output: Project Direction
- Output: Product Delivery Agreement

Approved/ Not Approved

RISK MITIGATION AND REQUIREMENTS SETTING

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

Gate 0 Gate 1 Gate 2

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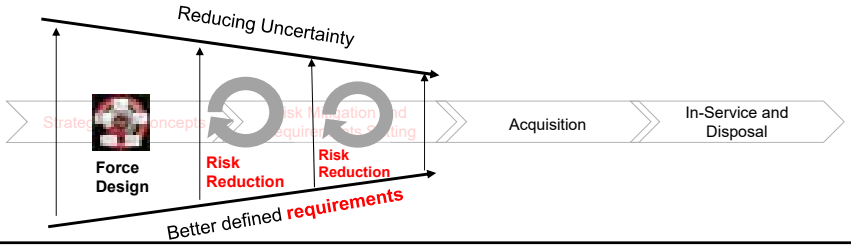
Risk Mitigation and Requirements Setting

- Objective:
  - reduce risk and define requirements:
    - sufficient basis for government approval to acquire;
    - establish a firm contractable position to proceed with the acquisition; and
    - Project prepared for Acquisition Phase.
- Activities include:
  - develop and down-select capability options;
  - solicitation; and
  - preferred supplier identified (generally).

648

RM & RS Activities - Purpose

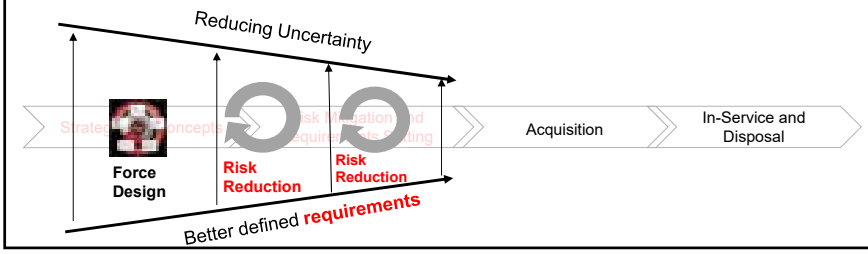
- Risk reduction needed so that:
  - approvals to spend public monies: based on confidence and are defendable; and
  - less likelihood that the Project will fail.



649

RM & RS Activities - Purpose

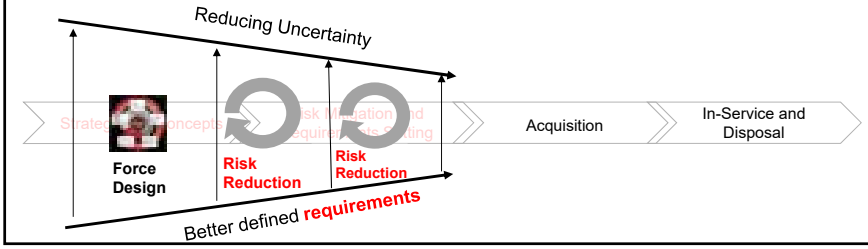
- Risk reduction needed so that:
  - approvals to spend public monies: based on confidence and are defendable; and
  - less likelihood that the Project will fail.
- Requirements definition needed so that there is:
  - clear understanding of what is being acquired; and
  - sound basis to seek tenders and contract.



650

RM & RS Activities - Actions

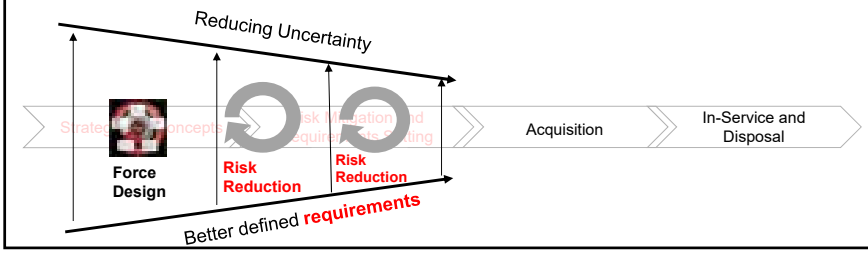
- Risk reduction:
  - based on the Smart Buyer risk profile, and
  - activities approved at Gate 0.



651

RM & RS Activities - Actions

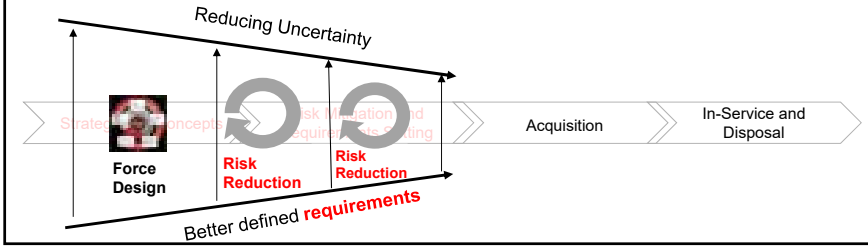
- Risk reduction:
  - based on the Smart Buyer risk profile, and
  - activities approved at Gate 0.
- Requirements definition:
  - derived from needs documents (JCN and JCNS);
  - captured in requirements suite OCD, FPS, and TEMP; and
  - used for tendering/solicitation and contract.



652

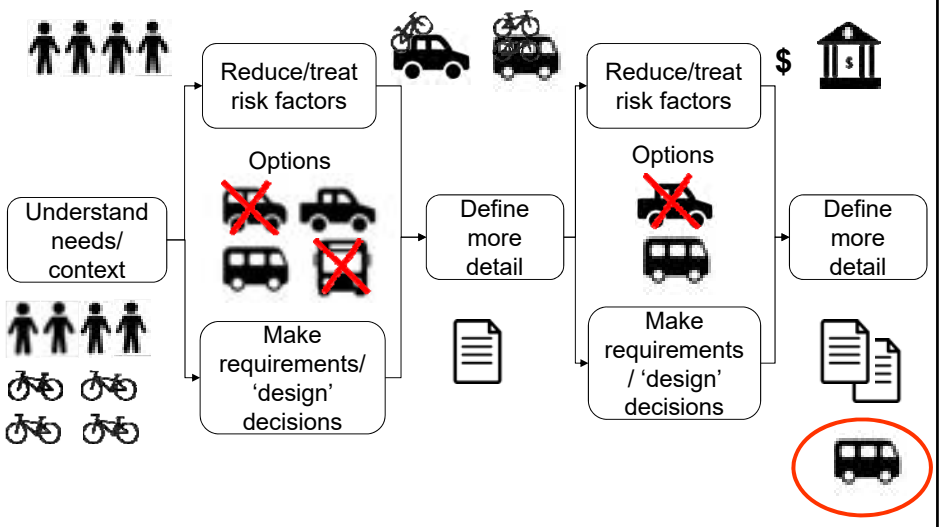
RM & RS Activities are Interdependent

- Interdependent activities (broadly a cycle):
  - improve understanding of what is needed;
  - reduce or eliminate risky aspects;
  - make choices (eg 'design' decisions, options); and
  - define requirements in greater detail.



653

RM&RS Activities are Interdependent

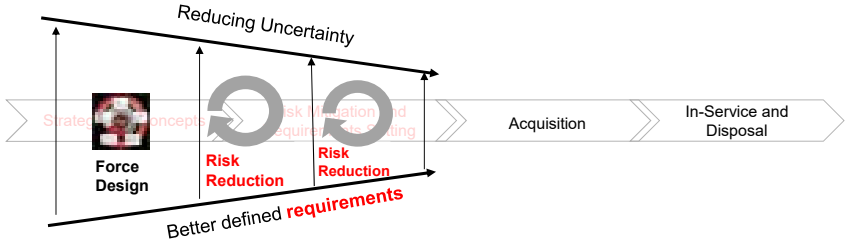


654

RM&RS Activities are Interdependent

Lower Risk + More specific requirements = Greater certainty ⇨

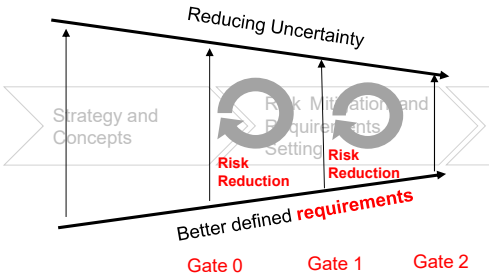
- Confidence to spend
- Defendable



RM&RS – Progressive Commitment

655

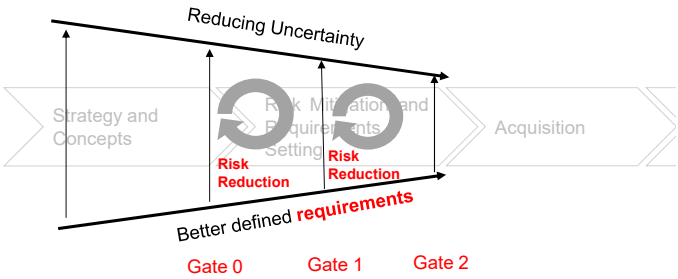
- Progress achieved as more definitive proposals are presented at each decision point (Gates 0, 1, 2).
- Level of risk and definition of requirements corresponds to level of commitment (spending) by Defence.



RM&RS – Progressive Commitment

656

- Gate 0: higher uncertainty is acceptable when less funding is being committed (eg just for risk reduction activities).

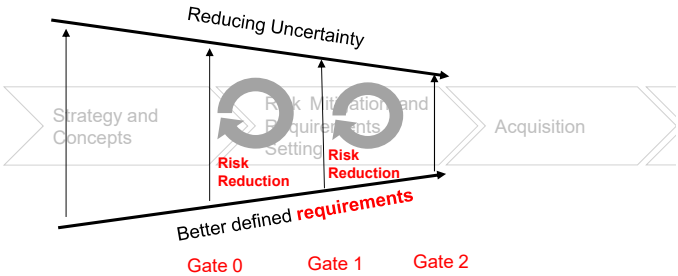


Commit funds for risk reduction activities

RM&RS – Progressive Commitment

657

- Gate 1: risk or uncertainty must be reduced so that there is confidence to approve funds in IIP.



Gate 0 Gate 1 Gate 2

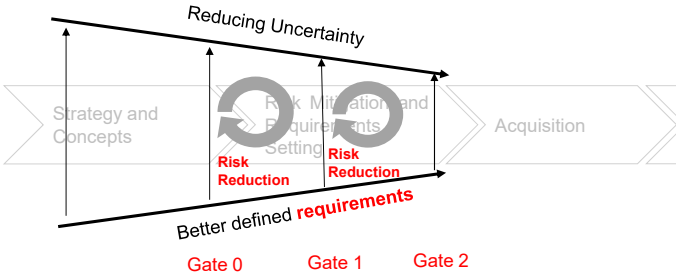
Commit funds for risk reduction activities

Commit funds for Project (IIP)

RM&RS – Progressive Commitment

658

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



Gate 0 Gate 1 Gate 2

Commit funds for risk reduction activities

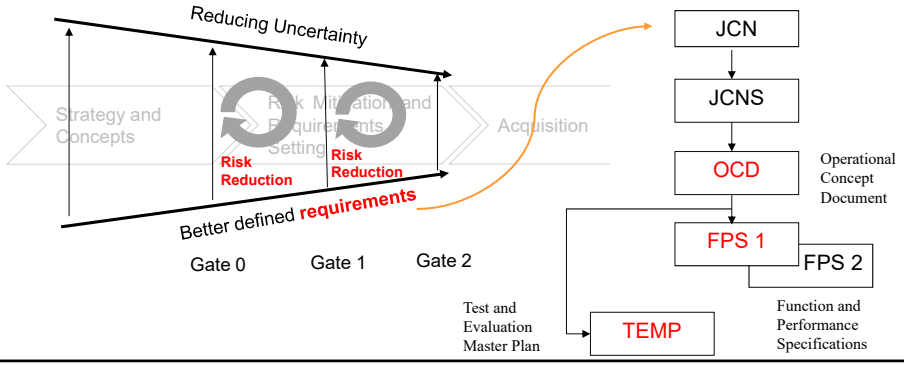
Commit funds for Project (IIP)

Enter into major acquisition contract/s

RM&RS – Sufficient Definition to Contract

659

- Requirements derived so tenders can be sought and contract established.



RISK MITIGATION

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 Projects?

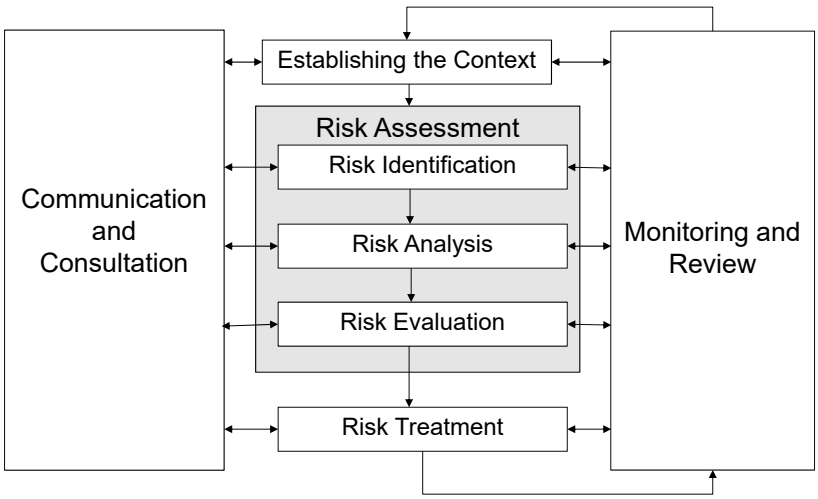
"Risks are possible events or occurrences that prevent a program from achieving its cost, schedule, or performance objectives".

What is Risk in the context of the CLC?

- 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.

ISO 31000: Risk Management Process

664



Reference: AS/NZS ISO 31000:2018

665

Risk Management in the CLC

General risk management process:

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

Risk Mitigation and Smart Buyer

Smart Buyer is a structured approach for this process:

1. Define risk and drivers categories for Project & Product

667

Smart Buyer 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.

Risk Mitigation and Smart Buyer

Smart Buyer is a structured approach for this process:

1. Define risk and drivers categories for Project & Product.
2. Identify risk events and impacts (analysis, workshops).

Risk Mitigation and Smart Buyer

Smart Buyer is a structured approach for this process:

1. Define risk and drivers categories for Project & Product.
2. Identify risk events and impacts (analysis, workshops).
3. Capture risk profile:
   - risk rating; and
   - ranking.

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4. Plan risk reduction (PES and IPMP).

Risk Mitigation and Smart Buyer

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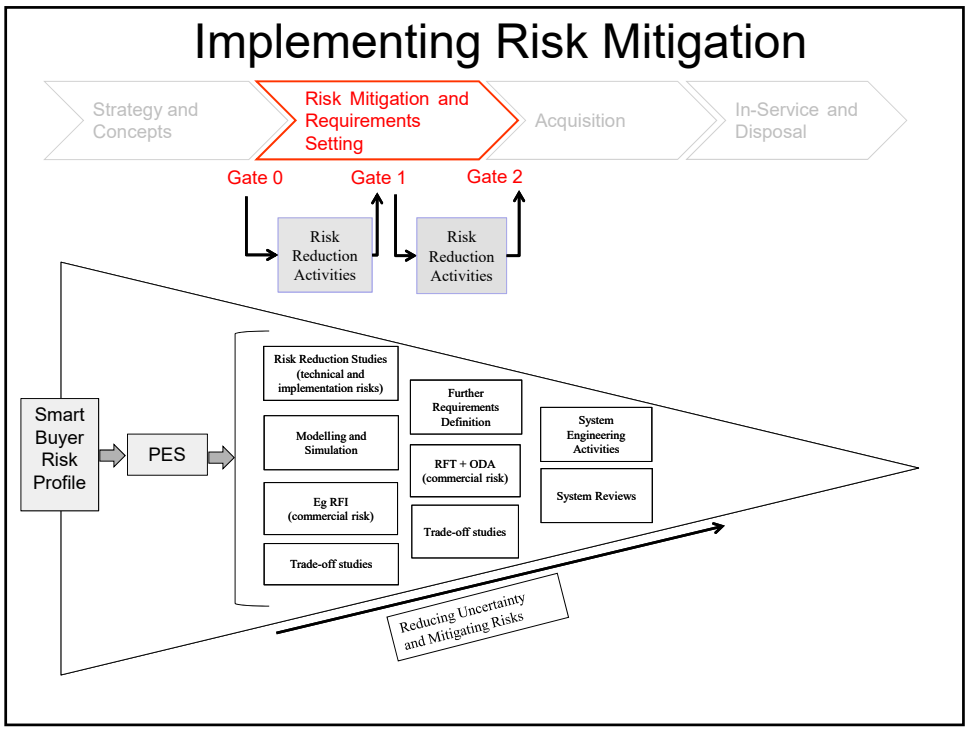
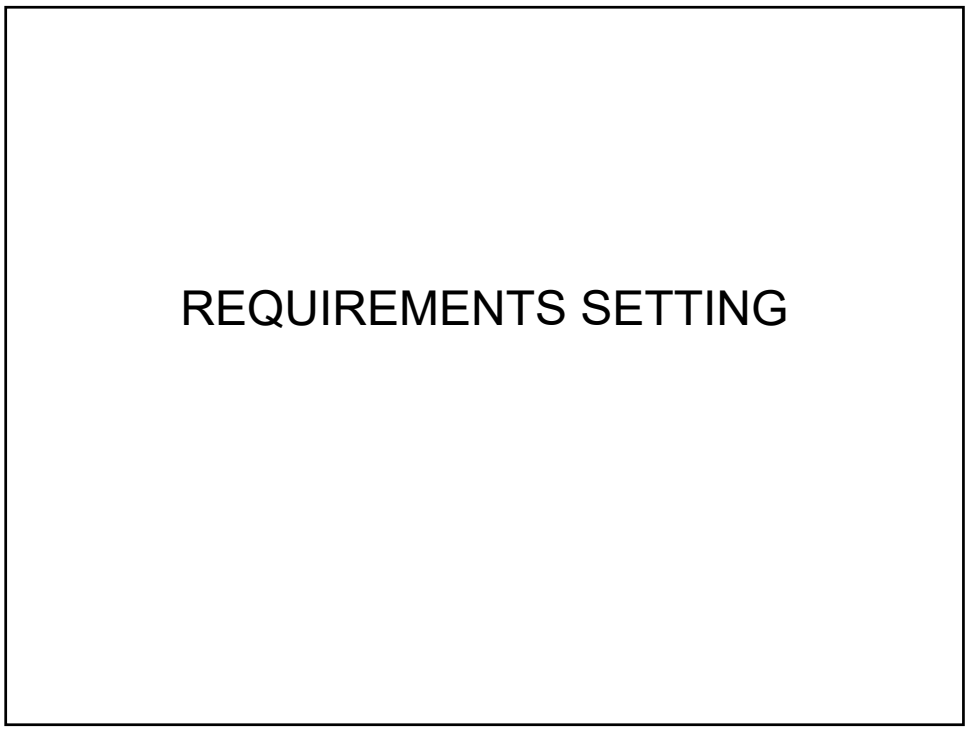
1. Define risk and drivers categories for Project & Product.
2. Identify risk events and impacts (analysis, workshops).
3. Capture risk profile:
   – risk rating;
   – ranking.
4. Plan risk reduction (PES and IPMP).
5. Get approval and funding for risk reduction work.


Implementing Risk Mitigation
Strategy and Concepts
Risk Mitigation and Requirements Setting
Acquisition
In-Service and Disposal
Gate 0
Gate 1
Gate 2
Risk Reduction Activities
Risk Reduction Activities
Smart Buyer Risk Profile
PES
Risk Reduction Studies (technical and implementation risks)
Modelling and Simulation
Eg RFI (commercial risk)
Trade-off studies
Further Requirements Definition
RFT + ODA (commercial risk)
Trade-off studies
System Engineering Activities
System Reviews
Reducing Uncertainty and Mitigating Risks


REQUIREMENTS SETTING

675

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.

676

Requirements Setting Overview

- Activity: Convert approved high level needs (JCN, JCNS) into contractable requirement ie contract docs
- Method: Structured Systems (Requirements) Engineering.
- How much is to be done?: Sufficient to:
  - provide adequate certainty about requirements
  - meet risk appetite of decision-makers and
  - be used to seek tenders and contract.
- Who is involved?: CM, Systems Engineer / Requirements SME, FIC providers, and Delivery Group/s.

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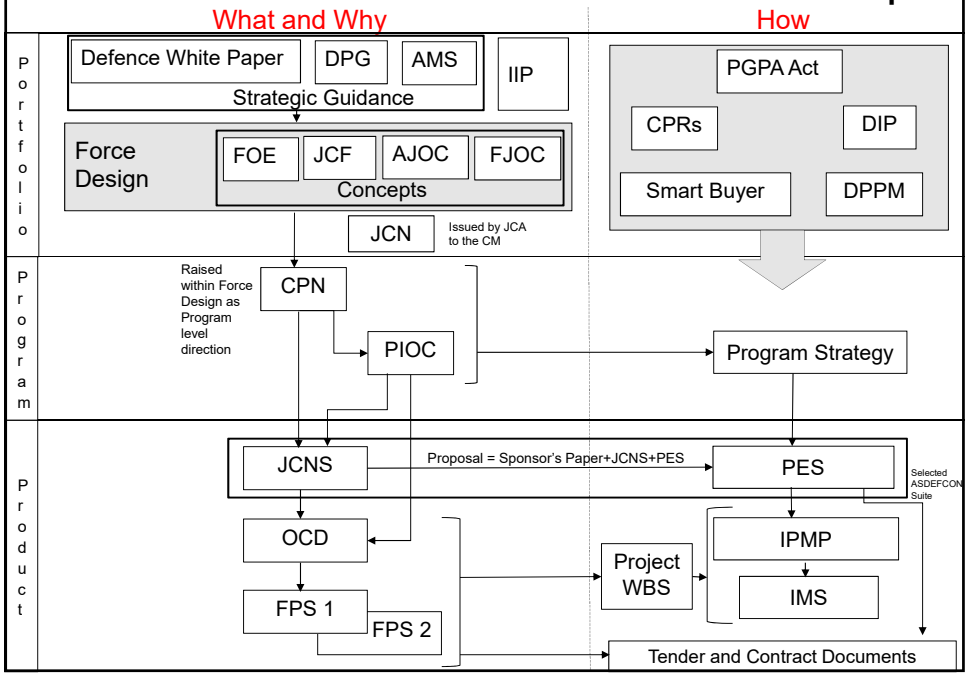
Sufficiency of Requirements

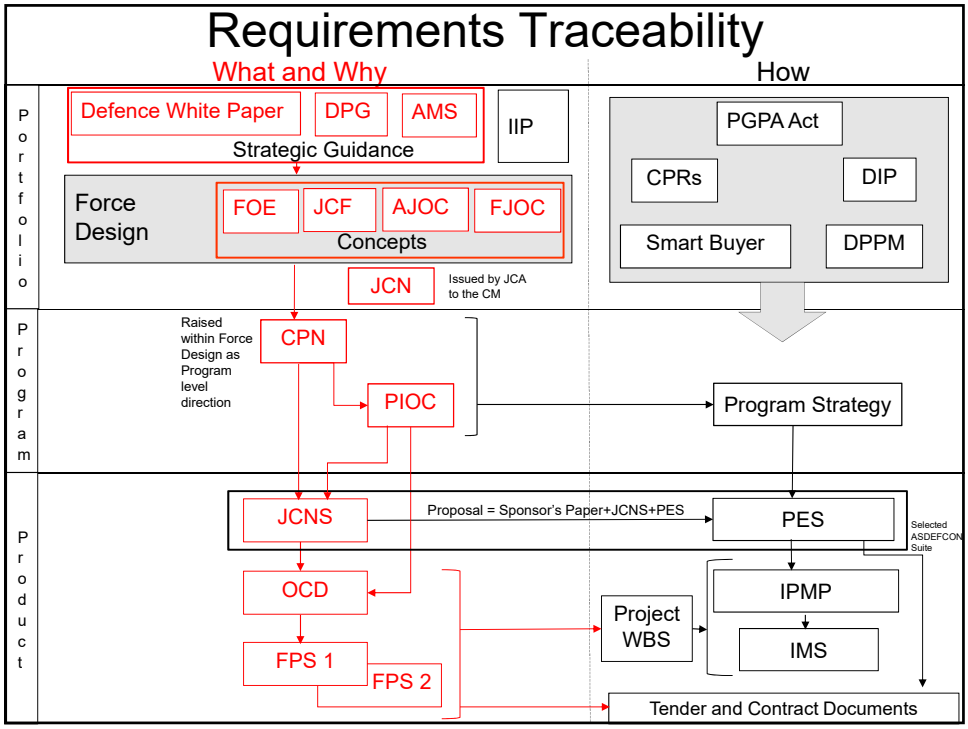
"Requirements need to be developed to a sufficient level of specificity to support industry engagements, capability acceptance, and detailed analysis (particularly of implications for the fundamental inputs to capability) to understand the full scope and broad feasibility and risks of the proposal."

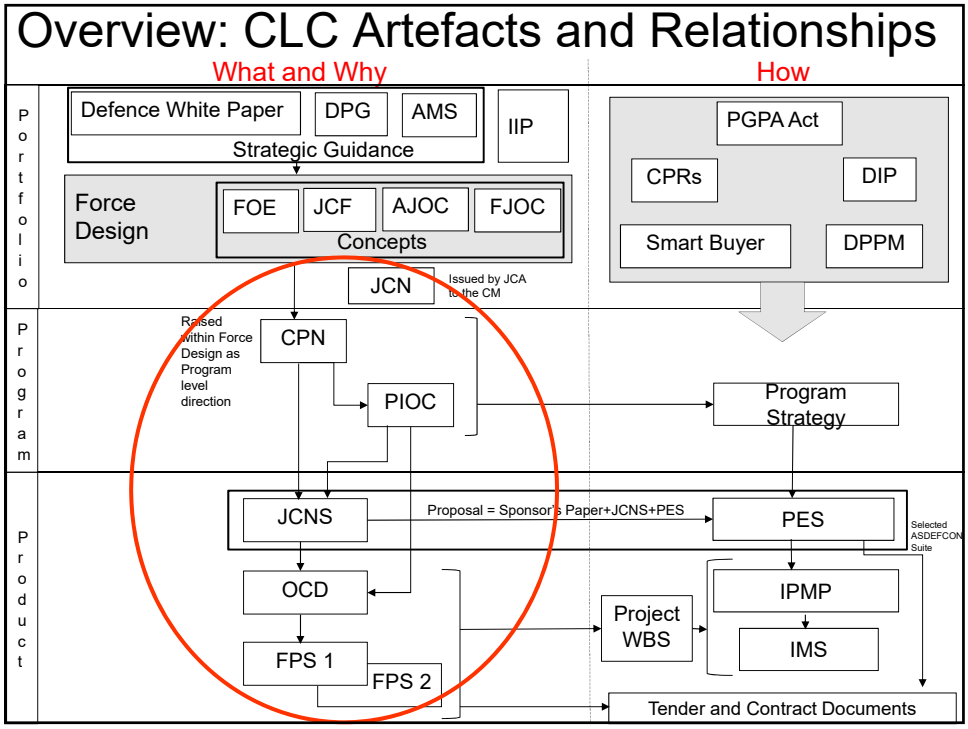
Source: Para 2.69 Updated Interim CLC Manual

Overview: CLC Artefacts and Relationships

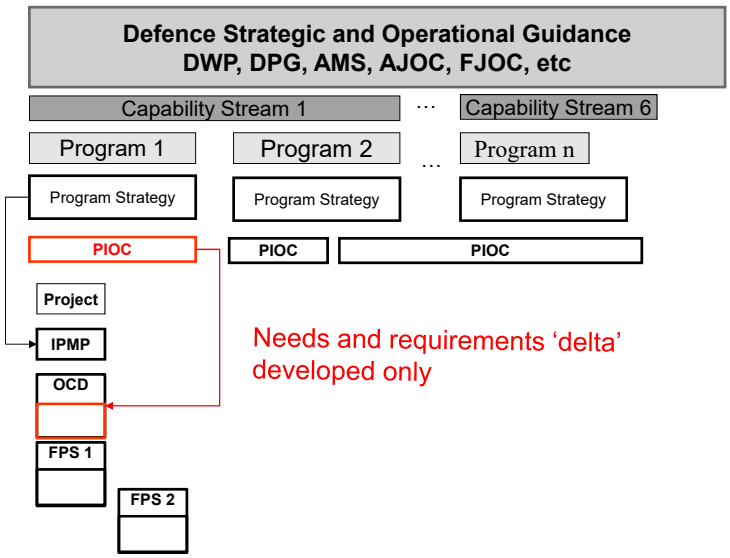


Dr Mike Ryan & Dr Shari Soutberg





Program-level Assists Efficiency



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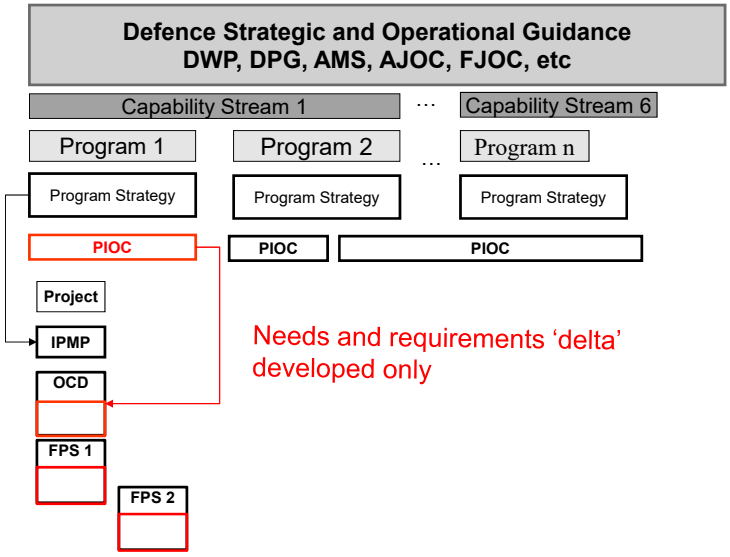

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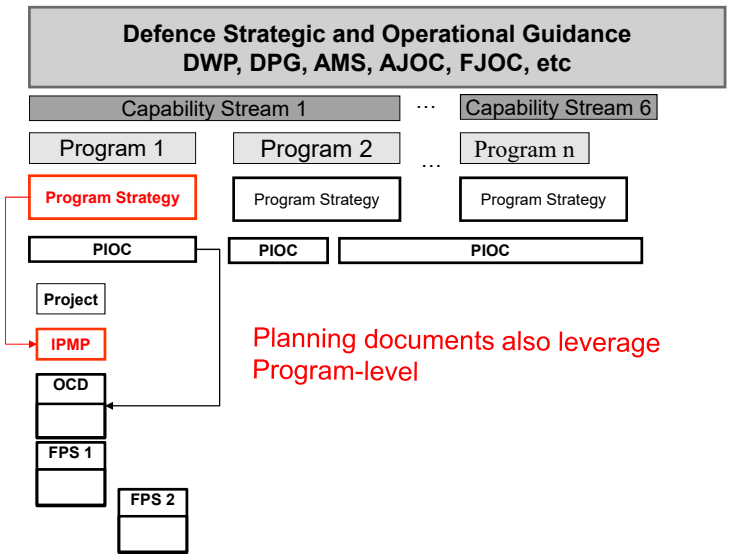
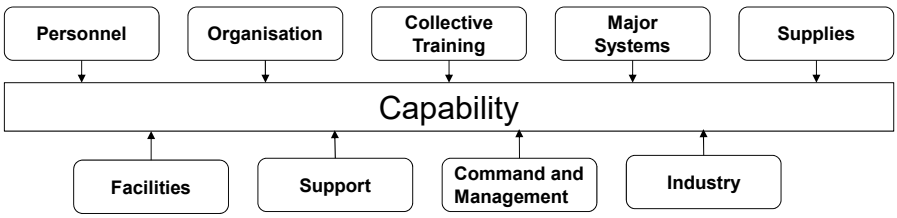


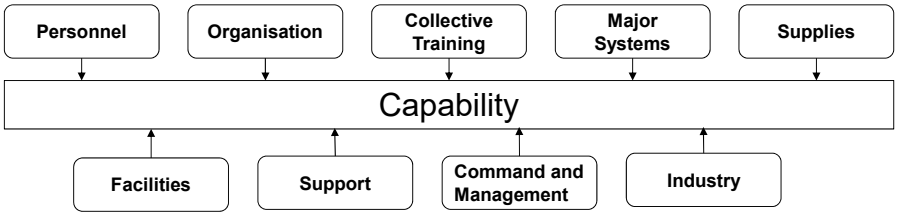
Requirements Scope

- All FIC Elements.

Fundamental Inputs to Capability



Fundamental Inputs to Capability



- FIC must be integrated to 'realise' and sustain a capability.
- A deficiency in any one adversely impacts the whole.

Requirements Scope

- All FIC Elements
- Joint Force: Integration and Interoperability
- Legislative and Regulatory requirements: WHS Act
- Whole of Product Lifecycle
- Must be unambiguous, testable etc

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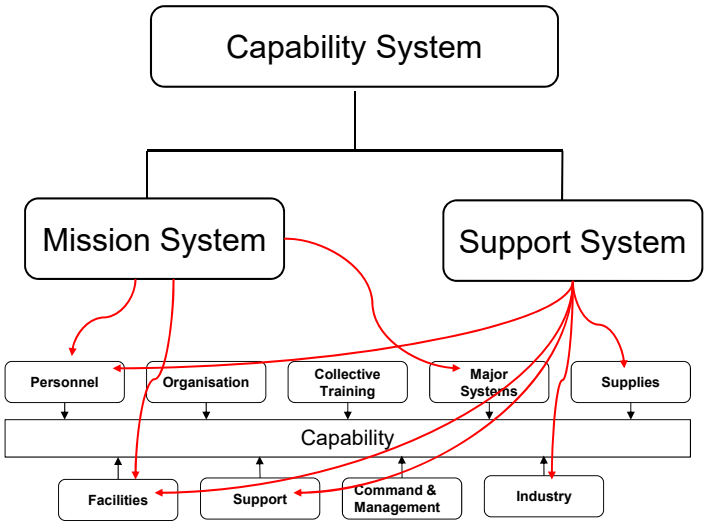
FIC Perspective



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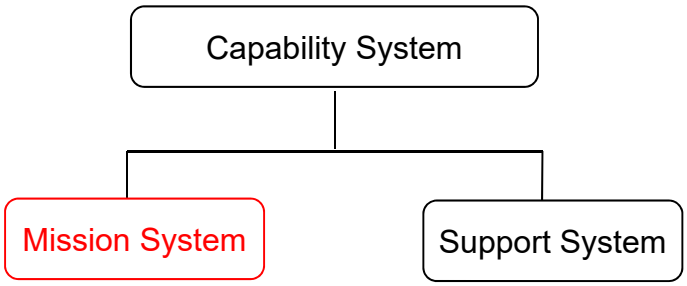
Requirements for Mission System



690

Requirements for Mission Systems

- Capability: operational, function, and performance.
- Integration, Interoperability:
  - C4ISR Interfaces
  - Physical integration on platforms
- Installation
- Materiel Safety (eg WHS, Hazardous Chemicals).
- Security.
- Human factors.
- Reliability, Maintainability, Obsolescence, Supportability.
- Software.
- Electromagnetic Environmental Effects (E3)
- Environmental factors.

691

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- Software.
- Electromagnetic Environmental Effects (E3)
- Environmental factors.

Systems Engineering and Requirements Engineering practice.

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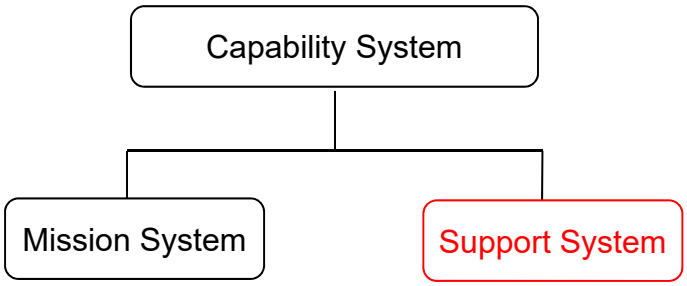
Requirements for Support System



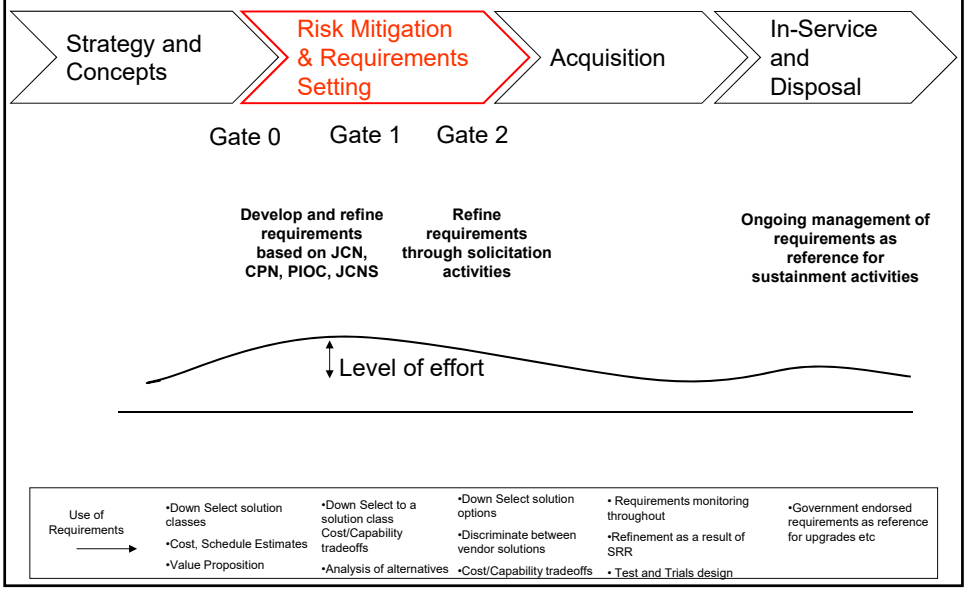
693

Requirements for Support System

- Personnel requirements for maintenance activities;
- Sovereign support capability requirements;
- Technical data requirements (maintenance manuals);
- Location constraints;
- Component packaging;
- Transportability;
- Deployability, fault isolation and maintainability; and
- Disposal requirements.

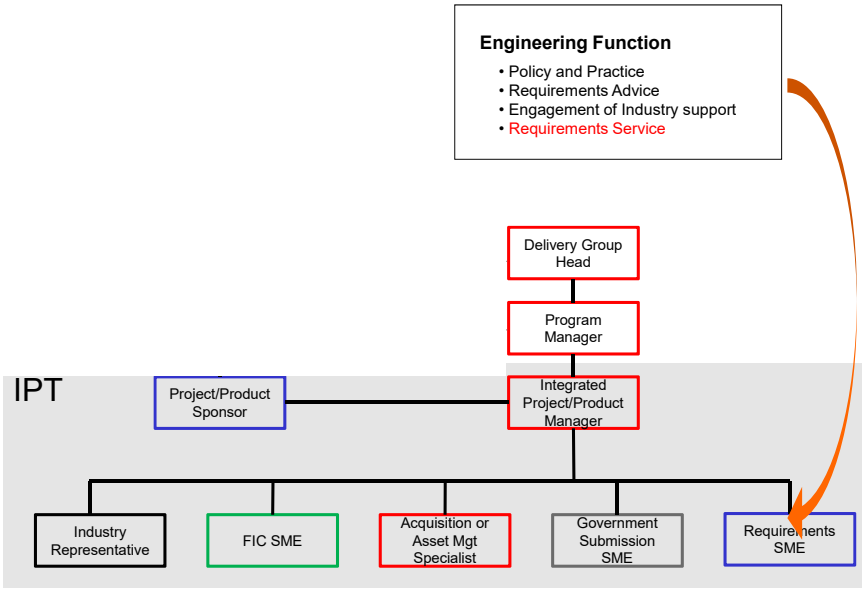
Systems engineering, requirements engineering, Integrated Logistics Support practices apply.

Requirements Effort Across the CLC

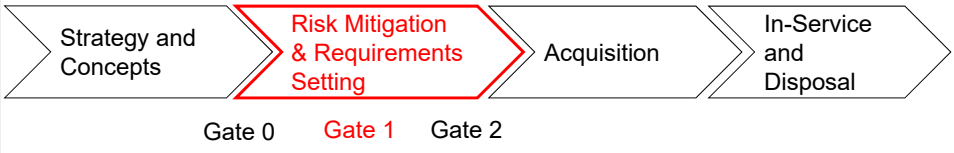


Dr Mike Ryan & Dr Shari Soutberg

Requirements Expertise



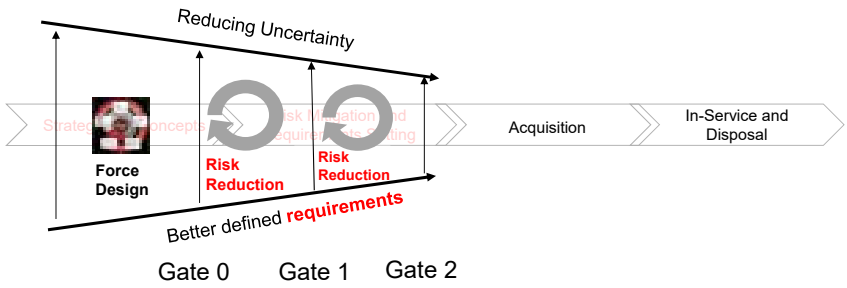
RISK MITIGATION AND REQUIREMENTS SETTING (Gate 1)



697

RM&RS

- Reduced risk profile
- Better defined requirements
- Options selected



Gate 0 Gate 1 Gate 2

698

RM&RS

- Reduced risk profile
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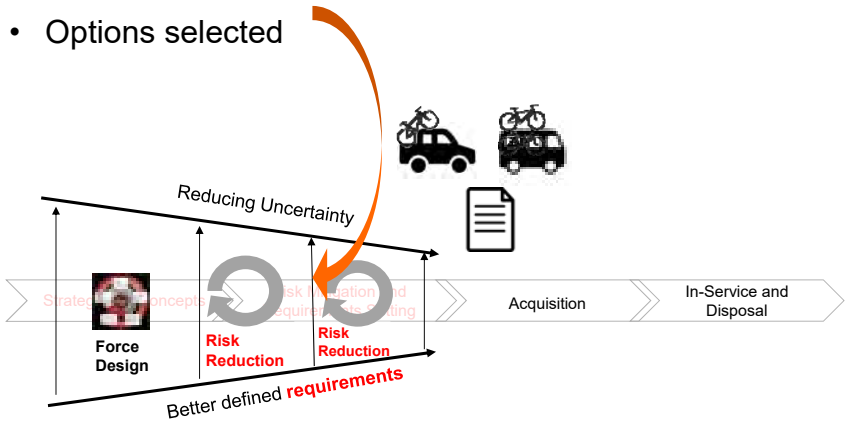
- Options selected



Gate 0 Gate 1 Gate 2

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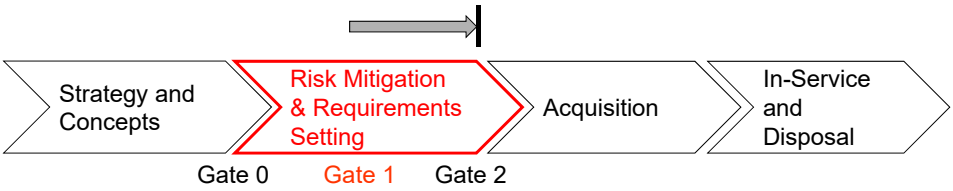
Gate 1 - purpose

- Gate 1 used:
  - complex and high risk proposals
  - government decision required to narrow field of options
- Approve proposals to proceed to Gate 2
- CM is responsible for Gate 1 Proposal.



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Gate 1 Proposal: components may include

Why?	Sponsor Paper
	+
Why?	Draft Submission to Government
	+
What?	Requirements Statement
	+
	Updated PES
How?	+
	Integrated Project Management Plan (IPMP) to Gate 2

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Gate 1 Proposal

Gate 1 Proposal describes:

- results of risk reduction activities since Gate 0;
- progress in reducing options;
- progress in requirements definition,
- progress in cost estimation;
- plans (incl risk mitigation work) to proceed to Gate 2; and
- Industry engagement outcomes.

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Gate 1 Outcomes

- Government decision to:
  - select specific option or options; and
  - proceed with proposal to Gate 2 against agreed plan:
    - timeframes,
    - technical requirements, and
    - financial commitments.
- Approval to engage industry through solicitation activities.
- Update to Project Direction.
- Gate 1 approval not a commitment to acquire.

Gate 0 to Gate 1: Summary

703

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

Gate 0 Gate 1 Gate 2

Risk Reduction Activities

- Output: Achieved reduced risk profile

Requirements Definition

- Output: Requirements Documentation eg Preliminary OCD, FPS, TEMP

- Output: Contestability statement

Gate 1 Proposal

- Output: Gate 1 Proposal including:
  - draft Approval Submission to Govt
  - proposed option/s
  - updated PES
  - cost, schedule estimates
  - IPMP

Investment Committee → Government Approval

- Output:
  - Project in IIP
  - approval to conduct solicitation

SOLICITATION AND SOURCE SELECTION

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

Gate 0 Gate 1 Gate 2

Solicitation and Source Selection

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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.

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Solicitation and Source Selection

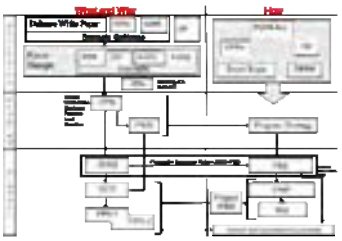
- Flexibility to adapt solicitation to circumstances (within legal and policy obligations):
  - Invitation to Register Interest (ITR).
  - Request for Tender (RFT).
  - Offer Definition Activities (ODA).

707

Sound Requirements are Critical

Requirements used in solicitation must be traceable to government direction through:

- Program Integrating Operational Concept (PIOC)
- Joint Capability Narrative
- Joint Capability Needs Statement (JCN)
- Operational Concept Document (OCD).
- Function and Performance Specification (FPS).



708

Sound Requirements are Critical

Sound Requirements underpin:

- What is to be acquired.
- Work to be done to achieve acquisition and sustainment outcomes.
- Basis of Estimates (BoE): work, cost, schedule.
- Confirming that deliverables are satisfactory.

Verification Cross Reference Matrix

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Defining Work also Key to Solicitation

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

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Solicitation and Source Selection Documents

Defence Documents

ASDEFCON Suite including:

- Conditions of Tender
- Conditions of Contract
- SOW
- OCD, FPS, TEMP
- Data Item Descriptions (DIDs)

Tenderer Responses

Tender documents which details the offer includes:

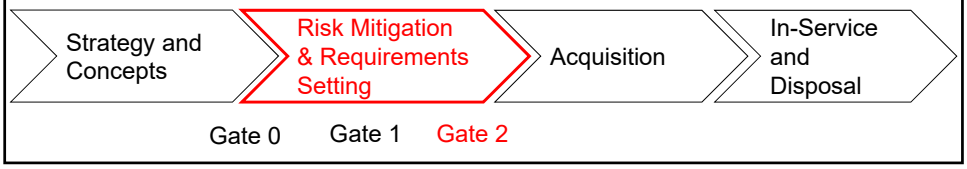
- Compliance Matrix
- Specifications
- Plans
- Costs
- Schedules

Source Evaluation

- Tender Evaluation
- Source Evaluation Report

← *Must be robust and fully defendable*

RISK MITIGATION AND REQUIREMENTS SETTING (Gate 2)



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Summary of pre-Gate 2 Activities

- Risk Reduction.
- Requirements development.
- Options Refinement.
- Cost and Schedule Estimation.
- Industry Solicitation and Evaluation.
- Source Selection report development.
- Initial negotiations (if appropriate).
- Update PES.
- Project Management and Sustainment Planning.

713

Gate 2 Proposal

- Proposal:
  - Final PES.
  - Draft Government Submission.
  - Contestability Statement.
  - Solicitation outcomes: Preferred Contractor.
- IC considers the proposal before Government

714

Gate 2 Outcomes

- 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.
- Government approval:
  - Allows commencement of the Acquisition Phase.
  - Defence has authority, budget and timeframe to acquire a selected Product.

Gate 1 to Gate 2: Summary

715

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

Gate 0 — Gate 1 — Gate 2

Risk Reduction /Requirements Definition

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

Gate 1 to Gate 2: Summary

716

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

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Solicitation

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

Gate 1 to Gate 2: Summary

717

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- Output: Contestability statement

Gate 1 to Gate 2: Summary

718

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  - Negotiating position

- Output: Contestability statement

Gate 2 Proposal

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

Gate 1 to Gate 2: Summary

719

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  - cost, schedule estimates

Investment Committee → Government Approval

- Output: approval to acquire

Gate 1 to Gate 2: Summary

720

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

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  - draft Approval Submission to Govt
  - final PES
  - preferred contractor
  - updated PES
  - cost, schedule estimates

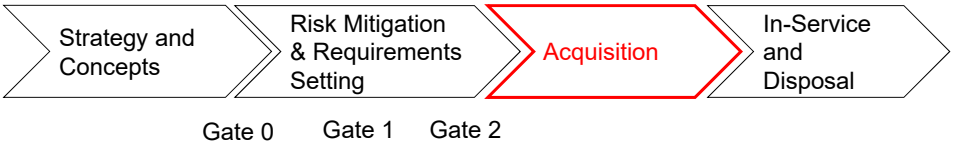
Investment Committee → Government Approval

- Output: approval to acquire

Summary of what to take to the IC

Use	Gate 0	Gate 1	Gate 2
Government		CabSub or MinSub	CabSub or MinSub
Investment Committee	• IC Synopsis • Sponsor Paper: - Business Case argument - Contestability Statement - Total Cost of Ownership (TCO) - Industry considerations • JCNS • PES	• IC Synopsis • Sponsor Paper- no longer than 3 pages • Draft Approval Submission to Government either Ministerial submission or Cabinet Submission	• Draft Approval Submission to Government either Ministerial submission or Cabinet Submission
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



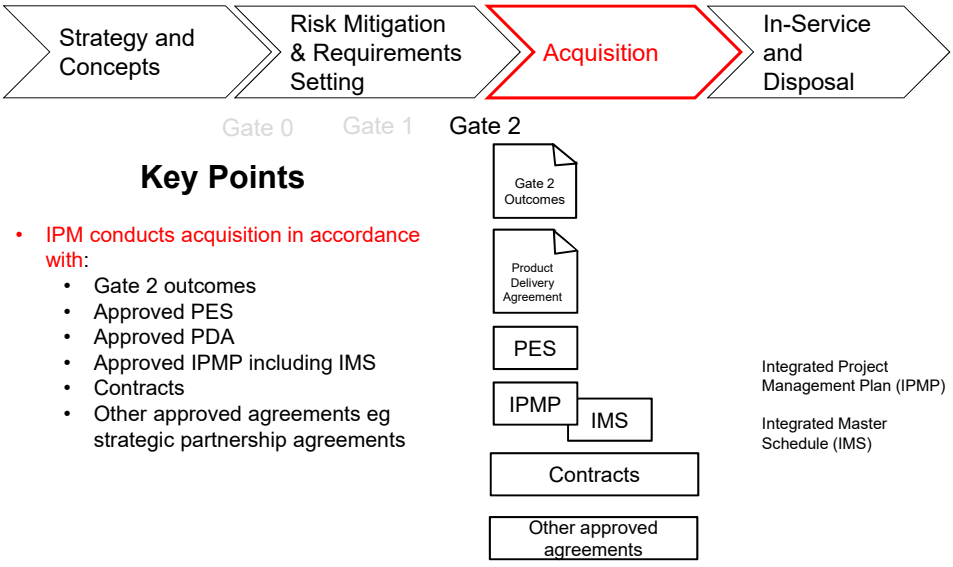
Gate 0 Gate 1 Gate 2

723

Acquisition

- Objective: acquire Capability
  - inclusive of FIC and
  - introduce it into service.
- Activity:
  - Delivery Group formally transitions systems to CM
- Primary task: IPM manages Project in accordance with:
  - Gate 2 approval; and
  - corresponding documents and agreements.

Acquisition key documents



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

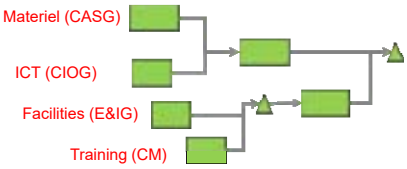
725

Acquisition: FIC

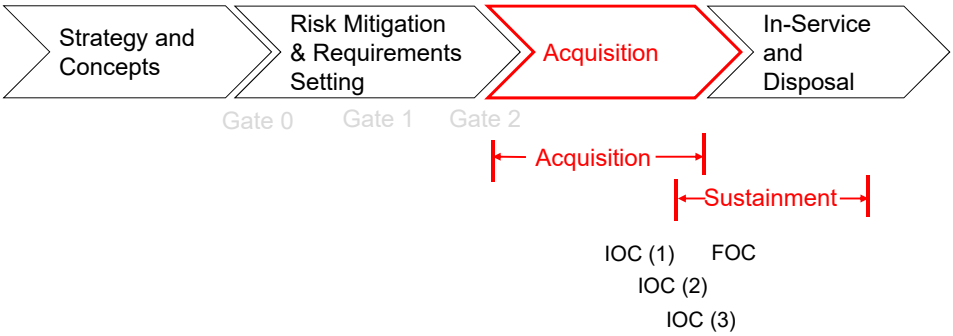
- IPM is responsible for delivery of FIC in two ways:
  - Delivers FIC for which lead Delivery Group is responsible.
  - Coordinates and integrates all FIC.
- Respective FIC delivery groups accountable for delivering their elements as agreed in plans/agreements (IPMP, PDA)

FIC

Integrated Project

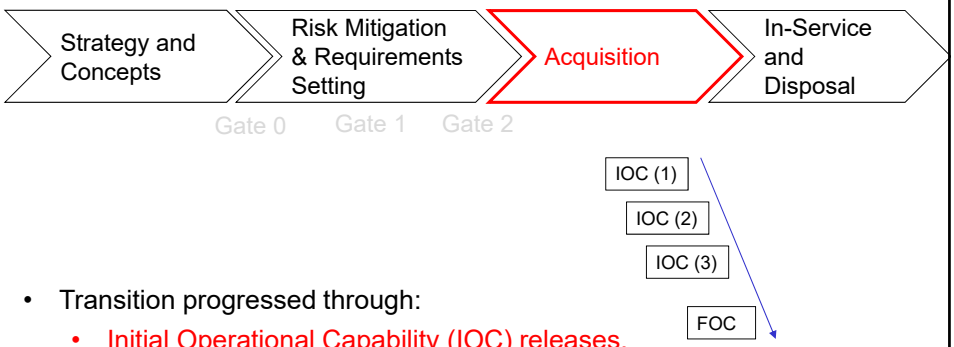


Acquisition: Transition



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

Acquisition – Transition to In-Service Phase



- Transition progressed through:
  - Initial Operational Capability (IOC) releases.
  - Final Operational Capability (FOC).

728

Initial Operational Capability (IOC)

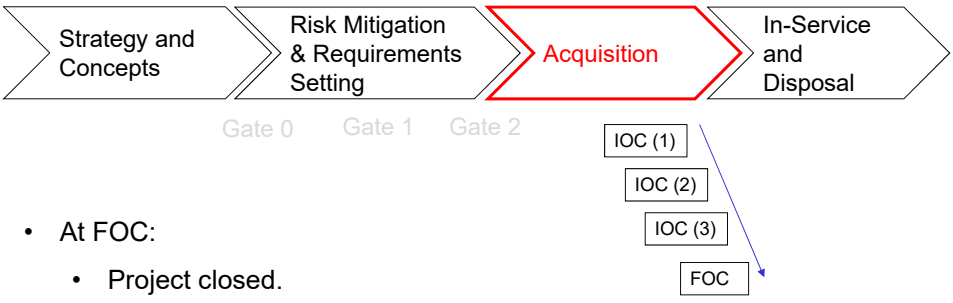
- IOC is the capability state relating to the in-service realisation of the first subset of a capability system that can be employed operationally.
- Declaration of IOC is made by the Capability Manager, supported by the results of OT&E and declaration by the Delivery Group that the FIC have been delivered.
- IOC can be declared when one or more subsets of the capability can be deployed on operations.
- IOC considers all FIC required to deliver the subset of capability required.

729

Final Operational Capability (FOC)

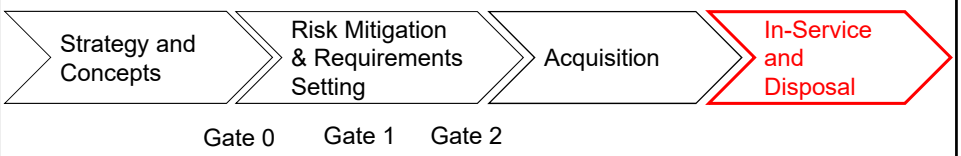
- FOC is the capability state relating to the in-service realisation of the final subset of a capability system that can be employed operationally.
- Declaration of FOC is made by the Capability Manager, supported by the results of OT&E and declaration by the Delivery Groups that the FIC have been delivered.
- FOC is declared when the entire capability can be deployed on operations.
- FOC considers all FIC required to deliver the full capability

Acquisition – Transition to In-Service Phase



- At FOC:
  - Project closed.
  - IPMT stood down.
  - Integrated Product Manager IPdM assumes responsibility.
  - IPMT transitioned to IPdMT and populated for sustainment effort.
- Sustainment conducted during Acquisition Phase from IOC.

IN-SERVICE AND DISPOSAL



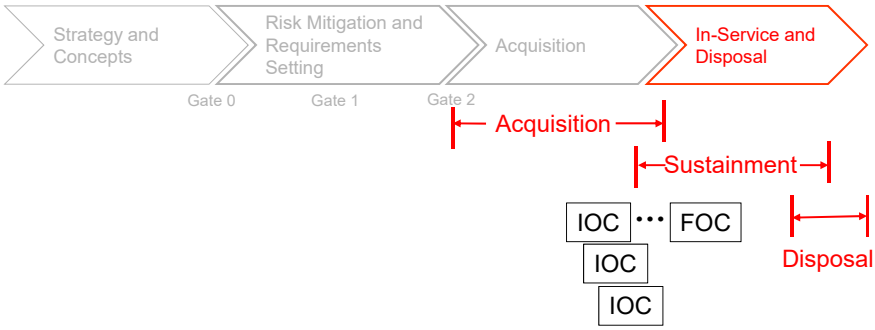
732

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 disposed of or sold.

733

In-Service and Disposal Phase



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

734

In-Service and Disposal Phase

Acceptance of capability by CM is key objective based on:

- compliance:
  - legislative requirements (eg environment and safety); and
  - regulatory requirements (eg seaworthiness),
- appropriate transition into in-service phase; and
- acceptable sustainment arrangements.

735

In-Service and Disposal: Key Documents

- Integrated Product Manager (IPdM) appointed.
- Integrated Product Management Team (IPdMT) established.

IPdM
IPdMT
Can be established earlier if appropriate

- Product Delivery Agreement / Materiel Support Agreement.
- Product Delivery Schedules.

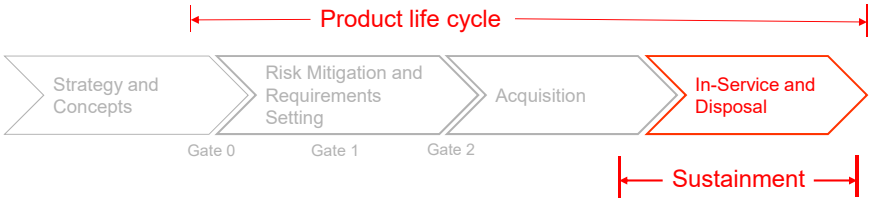
PDA
PdS
Must be established before IOC, FOC

- Integrated Product Management Plan.

IPdMP
Evolved from IPMP during the Acquisition Phase

736

In-Service and Disposal: Sustainment is Core



- sustainment: in-service support activities
- focus: meeting specified preparedness requirements at minimised life-cycle cost.
- successful sustainment outcomes rely on good Product Management from earliest stages of CLC.

Sustainment

737

- Defence defines sustainment as provision of:
  - personnel, logistics and other support required to maintain and prolong operations or combat; and
  - goods and services required to achieve preparedness (readiness & sustainability) goals for life of Defence element.

Sustainment

738

Sustainment activities include:

- routine sustainment work
  - Maintenance; and
  - provision of spares, supplies.
- managing changes to:
  - preparedness levels; and
  - operating concept.
- managing:
  - obsolescence,
  - incorporating planned technology refresh,
  - upgrades to maintain capability, and
  - OEM recalls.

739

Sustainment Business Cycle

- Meet specified preparedness requirements at minimised life-cycle cost.
- PDA/MSA:
  - reviewed, updated at least annually:
  - ensure resources match agreed performance levels,
  - basis for budget allocations, and
  - basis for sustainment performance management and reporting.

740

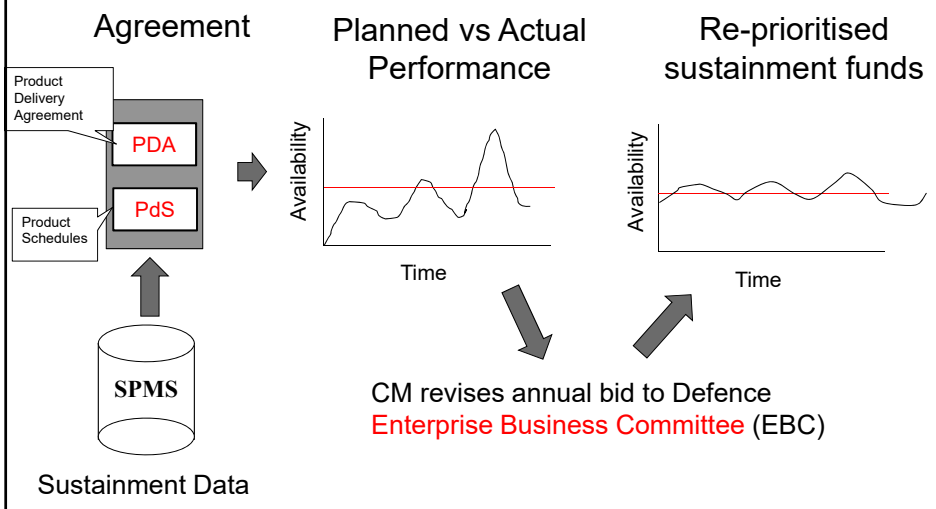
Defence Performance Reporting

- PGPA Act requires all Commonwealth entities to report results against plans in an annual performance statement.
- "Parliamentary committees over several years have stated an interest in Defence's reporting of its sustainment performance and, in particular, obtaining greater insight into that performance".

Ref Para 1.4 ANAO Report No.2 2017–18 Defence's Management of Materiel Sustainment

741

Sustainment Business Cycle: Annual Review



Sustainment Performance Measurement System (SPMS)

742

Sustainment Planning and Management

- IPdMs manage updates to PDAs/PdSs and budget estimates including:
  - Sustainment Plans and Schedules.
  - Cost Estimates.
  - Risks and emergent changes.
  - Communicating impacts.
  - Cost-capability trade-offs.

743

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.

744

Product Management/ Sustainment/ ILS

- Successful sustainment relies on Materiel Logistics/ Integrated Logistics Support practice early in CLC.
- Analyses such as:
  - Supportability Analysis.
  - Logistics Support Analysis (LSA).
  - Reliability Availability Maintainability (RAM).
  - Life Cycle Costing Analysis (LCCA).

745

ILS

- Ensures that availability, supportability, and lifecycle cost of capability is considered during design and development of mission and support system.
- ILS practitioners:
  - influence system requirements and design;
  - define support elements for capability lifecycle; and
  - contribute to planning and management of support system.

746

Disposal

- Process of removing systems from service:
  - unsuitable, or
  - surplus.
- Must be approved by appropriate CM.
- Materiel Logistics Disposal and Sales (MLDS) responsible for planning and implementation.
- Divided into minor and major disposals:
  - Sale
  - Scrap
  - Transfer
  - Gifting
  - Conversion/re-use
  - Destruction

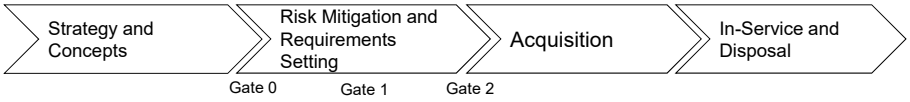
747

Recap

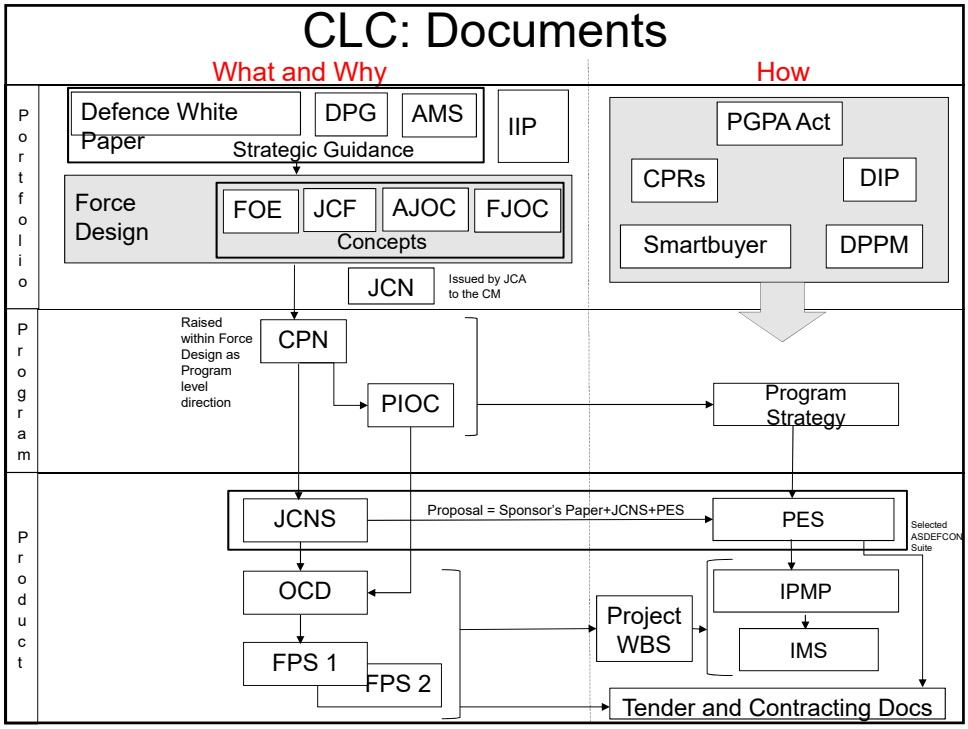
748

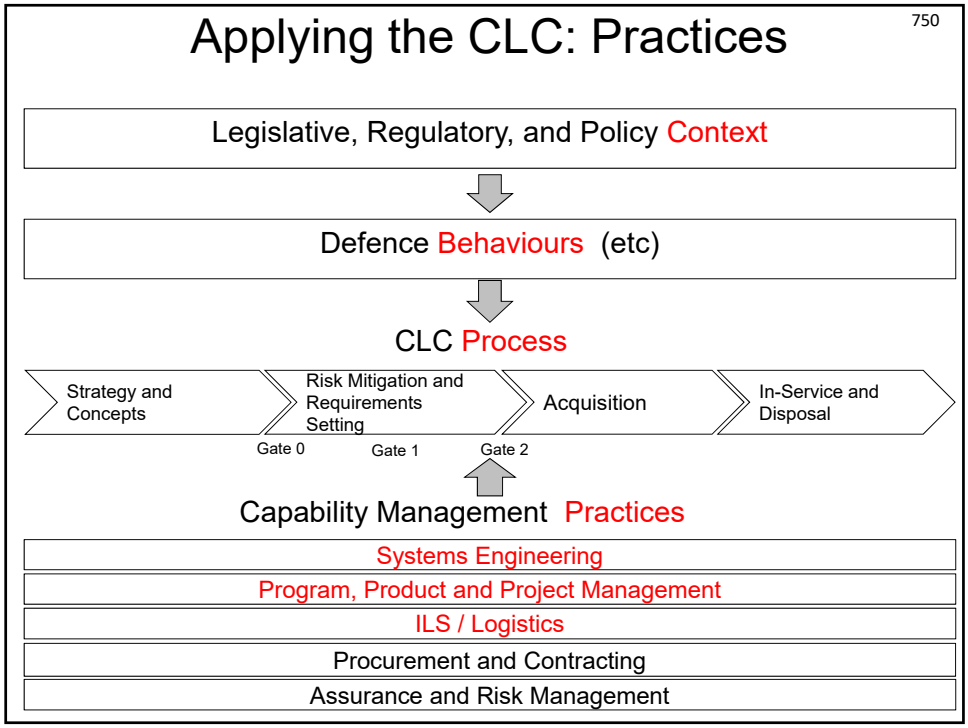
CLC Overview

- Life Cycle



- Frameworks
  - Force Design Framework
  - Smart Buyer Framework
  - Contestability Framework
  - CLC Management Layers
  - CLC Accountability Model
- Practices : SE, PM, ILS…


CLC: Documents
What and Why
How
Portfolio
Program
Product
Defence White Paper
DPG
AMS
Strategic Guidance
IIP
Force Design
FOE
JCF
AJOC
FJOC
Concepts
JCN
Issued by JCA to the CM
PGPA Act
CPRs
DIP
Smartbuyer
DPPM
Raised within Force Design as Program level direction
CPN
PIOC
Program Strategy
JCNS
Proposal = Sponsor's Paper+JCNS+PES
PES
Selected ASDEFCON Suite
OCD
FPS 1
FPS 2
Project WBS
IPMP
IMS
Tender and Contracting Docs


Applying the CLC: Practices
750
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
Program, Product and Project Management
ILS / Logistics
Procurement and Contracting
Assurance and Risk Management

Applying the CLC: Practices

751

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

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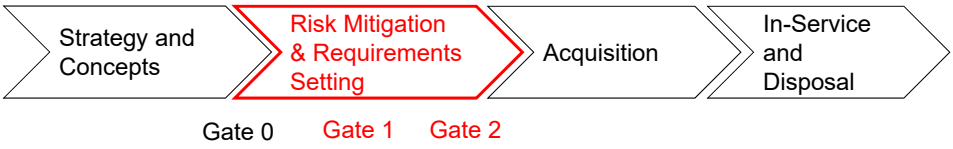
Procurement and Contracting

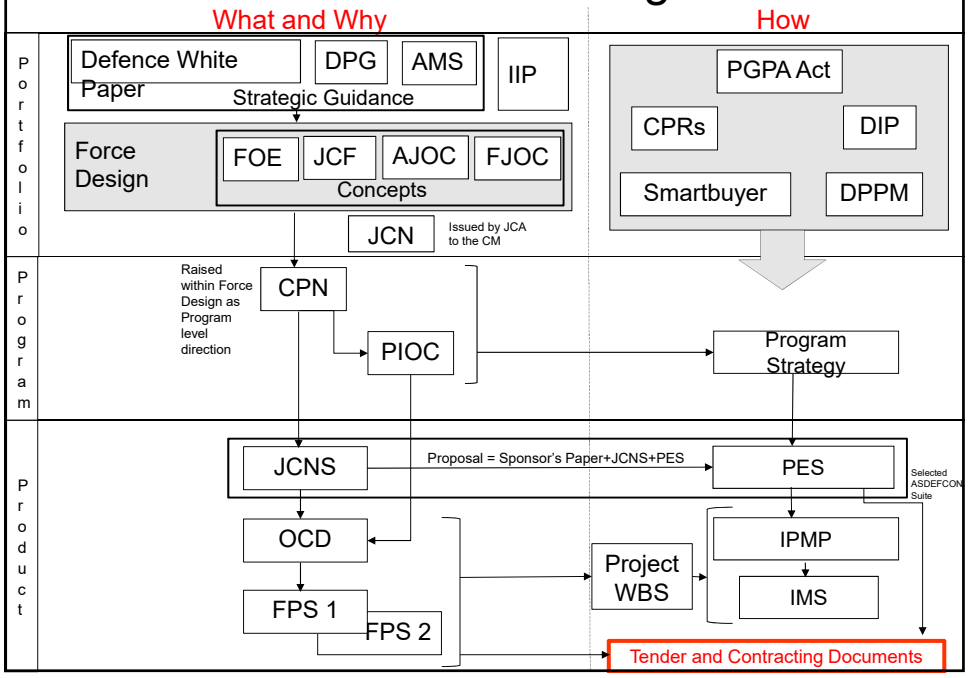
Dr Mike Ryan & Dr Shari Soutberg

CLC: Tender and Contracting

- Key outcomes of CLC: acquire and sustain capability assets.
- achieved through 'solicitation' ie tendering and contracting.
- Major focus of CLC acquisition solicitation between Gate 1 and Gate 2.
- Major contract mostly established just after Gate 2.
- Contract Management conducted in Acquisition and In-Service and Disposal Phases.



CLC: Tender and Contracting Documents



755

Procurement and Contracting

- Materiel acquisition and sustainment contracts worth approximately $12 billion.
- Securing defence capability and defendable spending of taxpayer monies relies on good procurement and contracting practices:
  - maximise 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.

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 Life Cycle	• Planning • Sourcing • Managing
Contracting Templates	• ASDEFCON Templates

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Legislative and Policy Context

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Resource Management Framework

- The Commonwealth Resource Management Framework governs:
  - how Defence uses and manage public resources;
  - consists of legislation and policy; and
  - cornerstone is PGPA Act.

Defence Proc & Contracting Policy Context

759

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

Source: DPPM April 2017

Defence Proc & Contracting Policy Context

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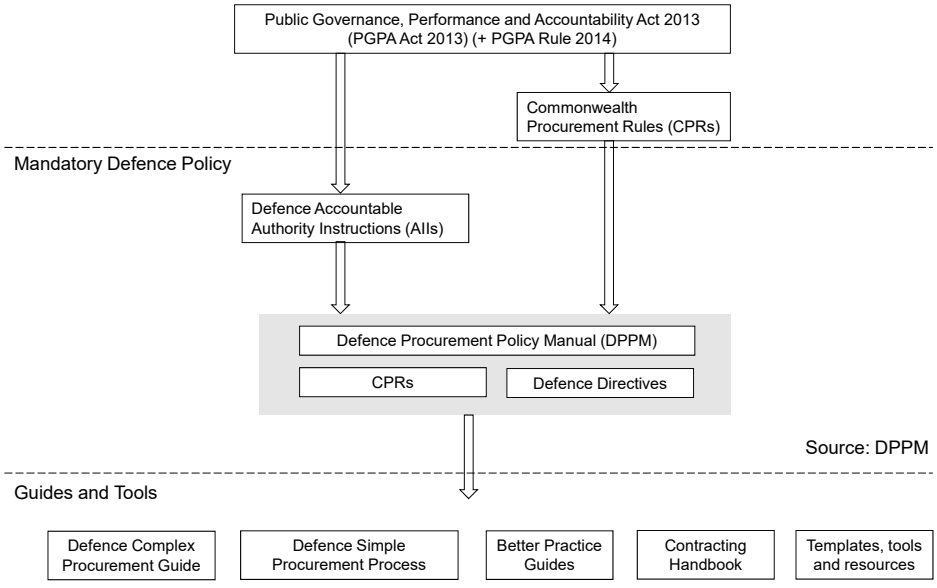
Legislation and policy can affect Defence procurement through contract, for example:

- Commonwealth legislation such as Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).
- State-based legislation:
  - Environment Protection Act 2017 (Vic).
  - Professional Engineers Act 2002 (Qld).

Source: DPPM April 2017

Hierarchy of Commonwealth Legislation & Policy

761



762

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

763

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

764

Commonwealth Procurement Rules

- Commonwealth Procurement Rules (CPRs):
  - have effect under the PGPA Act 2013;
  - set out rules that officials must comply with when they procure goods and services;
  - indicate good practice;
  - keystone of Government's procurement policy framework; and
  - achieving value for money is the core rule.

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Defence Procurement Policy Manual (DPPM)

- Defence Procurement Policy (DPPM):
  - promotes responsible and accountable spending by Defence officials;
  - assists 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;
  - supports proactive management of risks relating to procurement.

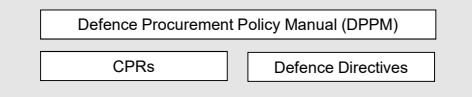
Source: DPPM April 2017

766

Defence Procurement Policy Manual

Incorporates:

- specific CPRs, and
- additional Defence Procurement Policy Directives.



Source: DPPM April 2017

767

DPPM applicability

- Applies to and must be complied with by all Defence officials.
- Contractors:
  - application may be extended to a Contractor through appropriate provisions in contracts, or
  - a Contractor may be prescribed to be a Defence official iaw Defence's Accountable Authority Instructions.
- Compliance—see paragraph 4.15 of CPR and related Note.
- Defence is always under an obligation to ensure that its procurement activities (whether outsourced or not) deliver value for money (VFM) to the Commonwealth.

Source: DPPM April 2017

768

Compliance with DPPM, CPRs, Directives

- Officials are not permitted to depart from mandatory requirements of:
  - PGPA Act,
  - CPR,
  - AAI, and
  - FINMAN 2.
- If a Defence official departs from the DPPM in a way that results in departure from CPR, then the official will have contravened the law.

769

Compliance with DPPM, CPRs, Directives

When considering a possible departure from the DPPM, Defence officials should:

- consider if reasonable and justified;
- consult their supervisor; and
- be responsible and accountable for the consequences.

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Procurement : Core Principles

771

CPR Core Principles

- CPRs have core principles that Defence officials need to consider when planning and undertaking procurement :
  - Value for Money.
  - Competition.
  - Non-discrimination.
  - Ethical Behaviour: balance between probity and industry engagement.
  - Risk Management.

772

Value for Money

- 'Value for Money' is 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

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Value for Money

- Does not mean lowest price goods or services.
- Must consider financial and non-financial costs and benefits:
  - quality of the goods and services;
  - fitness for purpose;
  - supplier's relevant experience and performance history;
  - flexibility of proposal (eg innovation, adaptability)
  - environmental sustainability; and
  - whole-of life perspective including costs.

Source: DPPM Chapter 2

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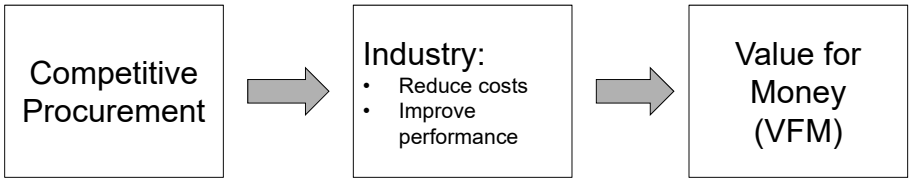
Competition

- Key element of 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.



Source: DPPM Chapter 2

775

Competition

- Competition does not necessarily mean open tender
- More than one supplier can be competitive.
- If open competition not feasible, can explore limited competition subject to relevant CPR.

Source: DPPM Chapter 2

776

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
  - origin of their goods and services.

Source: DPPM Chapter 2

777

Non-discrimination: Exemptions

- Exemptions can be sought:
  - through measures under para 2.6 of CPR (eg protection of essential security interests);
  - Australian Industry Capability (AIC) policy;
  - specific Government policy decisions; and
  - free-trade agreement exemptions.

Source: DPPM Chapter 2

778

Proper Use of Public Resources

- Section 6 of the CPRs sets out the requirement for Defence officials to properly use and manage public resources.
- 'Proper' means:
  - Efficient: maximum value for resources used.
  - Effective: achieving intended outcomes incl price, quality and quantity.
  - Economical: minimising cost, avoiding waste.
  - Ethical: honesty, integrity, probity, diligence, fairness and consistency.

Source: DPPM Chapters 2 and 4, Source: CPRs 6.1-6.5

779

Ethical Behaviour

Officials undertaking procurement must act ethically :

- recognise and deal with actual, potential and perceived conflicts of interest;
- deal with potential suppliers, tenderers and suppliers equitably:
  - seek internal or external advice when probity issues arise, and
  - not accepting inappropriate gifts or hospitality;
- carefully consider use of public resources; and
- comply with all directions incl Privacy Act 1988 and Crimes Act 1914.

*Source: CPR 6.6

780

Probity

- Probity is evidence of ethical behaviour:
  - Complete/confirmed integrity, uprightness and honesty in a process.
  - Dept of Finance website lists principles which underpin ethics and probity in Government procurement.
- 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,
  - ANAO,
  - Senate Estimates & other Parliamentary Committees, and
  - media.

*Source: DPPM para 66 and 67

781

Probity

- Legislative and policy obligations for Defence Officials related to probity incl:
  - PGPA Act (s25-29) due care, diligence, good faith, declaring interests etc;
  - Public Service Act 1999: APS Values & Code of Conduct
  - DI(G) PERS 25-4 - Post Separation Employment;
  - DI(G) PERS 25-6 – Conflicts/ declarations of interests; and
  - DI(G) - PERS 25-7 - Gifts, Hospitality and Sponsorship.

Source: DPPM Chapter 2

782

Commercial Acumen

- Understanding:
  - how industry is/can be used for Defence business;
  - commercial drivers of industry;
  - how to engage with industry and manage commercial relationships; and
  - dealing appropriately with potential suppliers, tenderers.
- Critical aspect of capability management.

783

Consistency with Government policies

PGPA Act s21 requires:

- Defence actions that are "not inconsistent with the policies of the Australian Government", for example:
  - Cabinet decisions, and
  - other Government approvals (decision or approval establishes a course or line of action).
- Defence officials exercising delegations (esp PGPA Act s23) should do so consistent with terms of any Australian Government decisions or approvals relevant to the procurement.

DPPM p6

784

Procurement-related Delegations

785

Purpose of Delegations

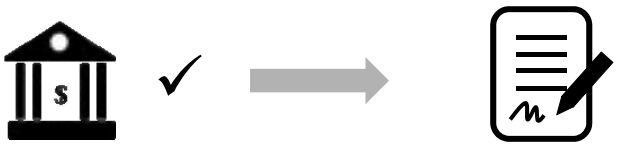
- Delegations provide authority to exercise a power to:
  - take an action, and/or
  - make certain decisions for procurement.
- System of procurement delegations:
  - is pragmatic necessity in an organization,
  - reflects:
    - risk,
    - amount being committed (spent), and
    - necessary controls.

DPPM p6

786

Purpose of Delegations

- Provide authority to exercise a power to:
  - take an action, and/or
  - make certain decisions for procurement:
- Procurement delegations address:
  1. committing Commonwealth funds (public monies) for the procurement for Goods and/or Services; and
  2. establishing an arrangement (eg contract) with a supplier by the physical act of, eg, signing a contract.

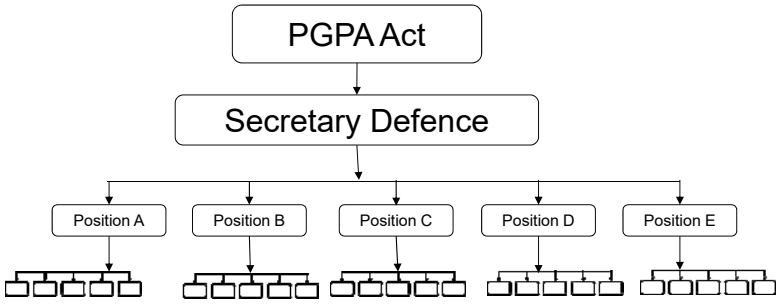


DPPM p6

787

Defence System of Delegations

- Defence system of procurement delegations:
  - Conferred on/delegated to Secretary under PGPA Act.
  - Defence implements a corresponding system of delegations which confers authority on others in Defence.



DPPM p6

788

Defence System of Delegations

- 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).

DPPM p6

789

Reasons for Delegations in Procurement

- For 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 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.

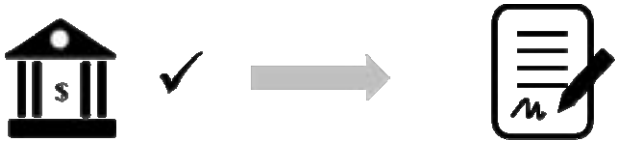
DPPM p6

790

Procurement and Contracting Delegations

Under PGPA Act, delegations applying to procurement are:

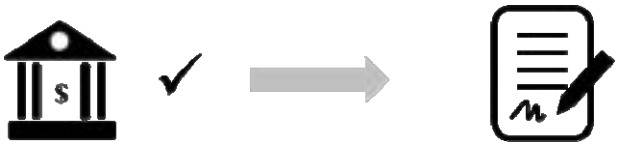
1. Commitment Approval
   - Being able to commit public funds to an activity.
   - PGPA Act section 23 (3).
2. Enter into an Arrangement
   - Enter into a 'contract' (paid contracts, standing offers, non-financial arrangements).
   - PGPA Act section 23 (1)



Section 23(3) Section 23(1)

791

Sequence for Exercising Delegations



Commitment Approval

Section 23(3)

Enter into an Arrangement

Section 23(1)

792

Procurement and Contracting Delegations

In addition….

- Defence officials are required to obtain an 'Endorsement to Proceed' (EtP) before undertaking certain procurements:
  - All 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.

DPPM p6

793

Applicability of Section 23 Delegations

Section 23 PGPA Act delegations apply to all kinds of *procurements*:

- Both delegations:
  - establishing a contract;
  - establishing a standing offer arrangement (deed);
  - each order placed under standing offer arrangement;
  - 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 if 'nil-cost' contract change required.

794

Planning the Procurement:

Method of Procurement, Approach to Market and Delivery Model

795

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.

796

1. Method of Procurement

- Under the CPRs, there are two main procurement methods:
  - Open tender: approach open market and invite submissions.
  - Limited tender: approach only one or more potential suppliers to make submissions.
- Under the CPR, the default position is open tender.
- Limited tender includes only one supplier (often called a 'sole source' procurement).

797

1. Method of Procurement

Selecting open or limited tender, dependent on:

- nature and structure of the market;
- extent of competition (number of competitive suppliers); and
- schedule, cost or other constraints (such as intellectual property, security, etc).

798

1. Method of Procurement

Very limited circumstances for limited tender (CPR 10.3):

- extreme urgency;
- unsolicited innovative proposals;
- no real alternative (eg no competition technical solution); and
- additional deliveries of goods and services.

799

1. Method of Procurement

- Must ensure:
  - method commensurate with the scope, scale, and risk of procurement;
  - consistent with VFM; and
  - all procurement method decisions are documented.
- EtP documents procurement method for non-materiel procurements at or above $200,000.
- Commitment Approval delegate (s23(3)) confirms procurement method decision.

800

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.
- Not determined by open or limited tender

801

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.
  - US Foreign Military Sales (FMS): Use FMS 'cases'.

802

3. Project Delivery Model

- Type of contracting arrangement:
  - Prime contract,
  - Managing Contractor,
  - Design and Construct contract, or
  - Alliance contract.

803

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

804

Design Each 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.

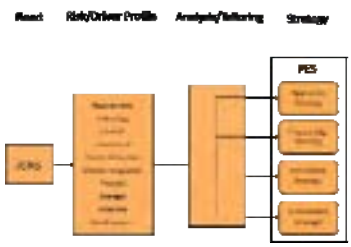
805

Smart Buyer

806

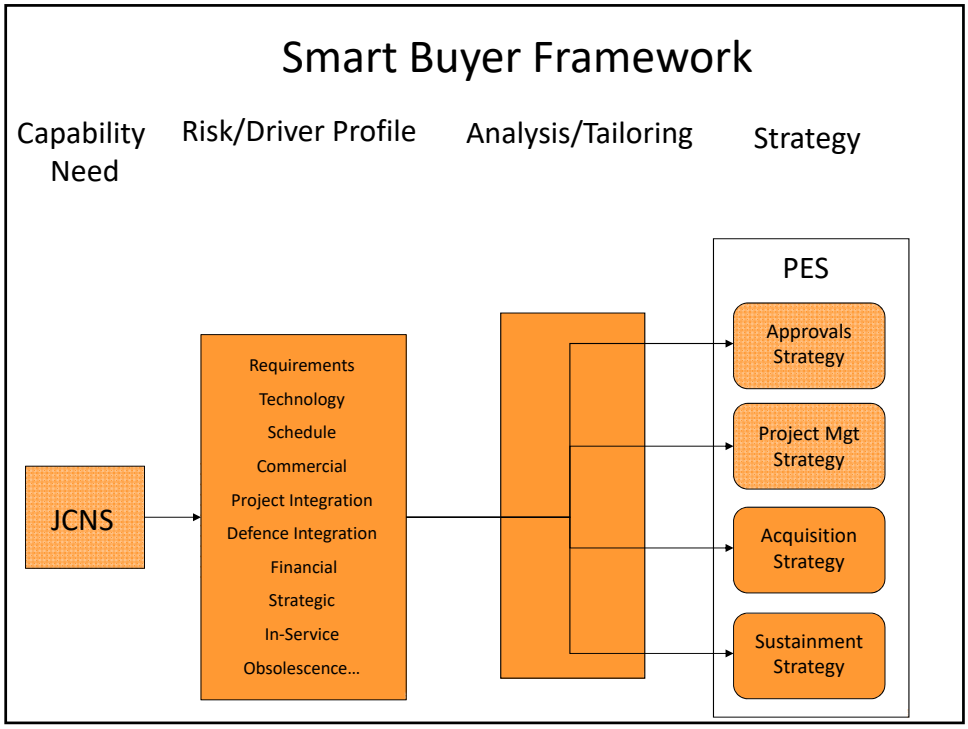
Smart Buyer

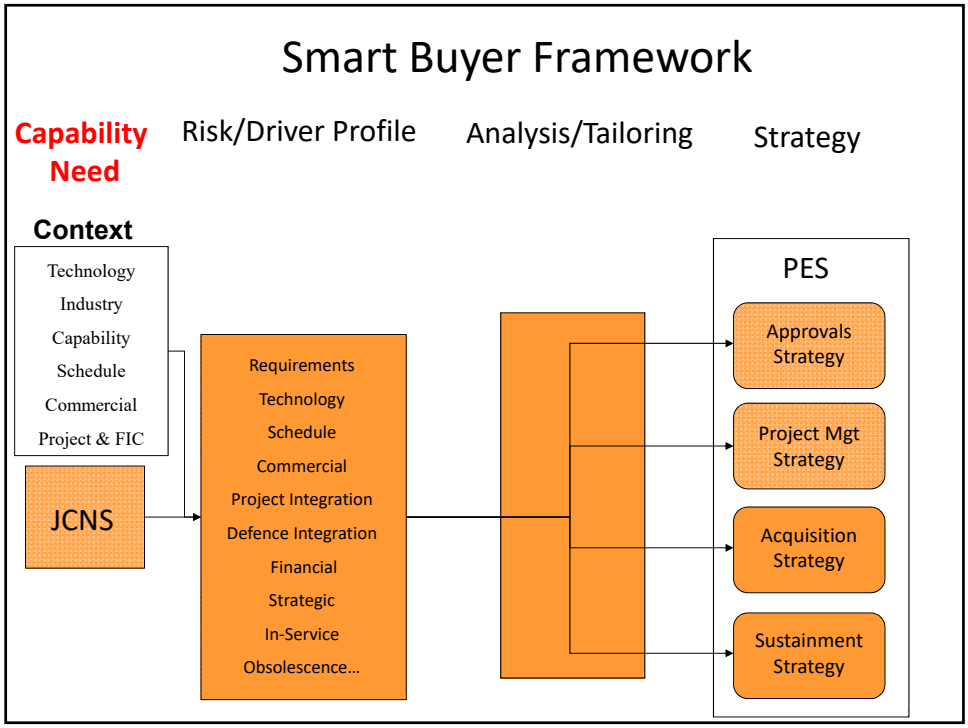
- Smart Buyer helps develop:
  - Business Case for a proposed investment in capability.
  - Project Execution Strategy (PES).



Source: Smart Buyer Kick-off Meeting Pack

Dr Mike Ryan & Dr Shari Soutberg





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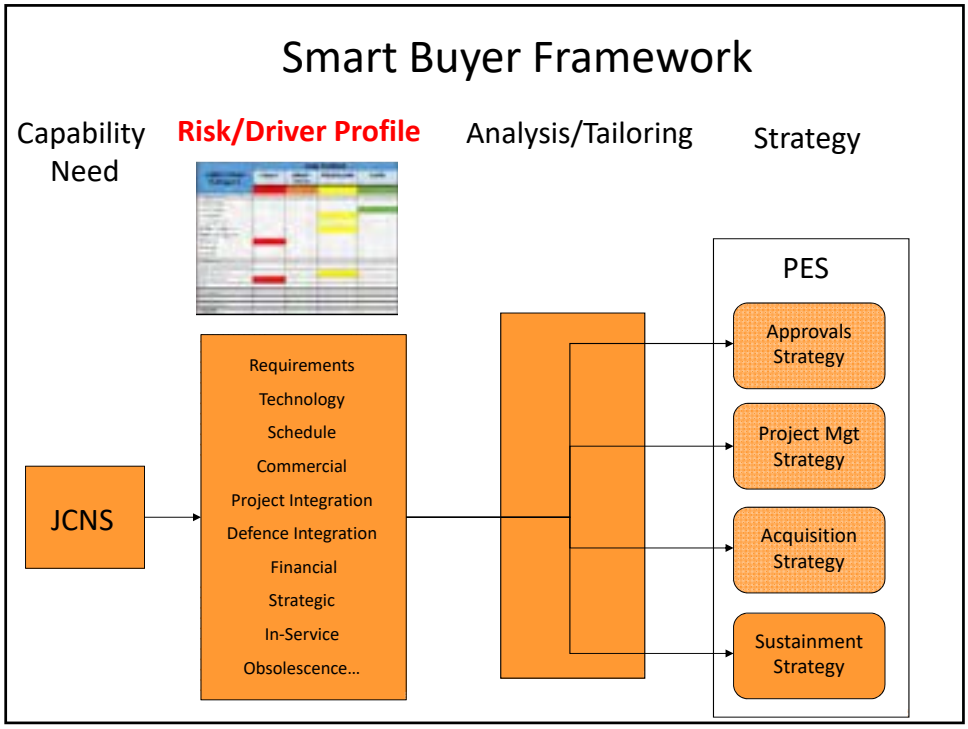
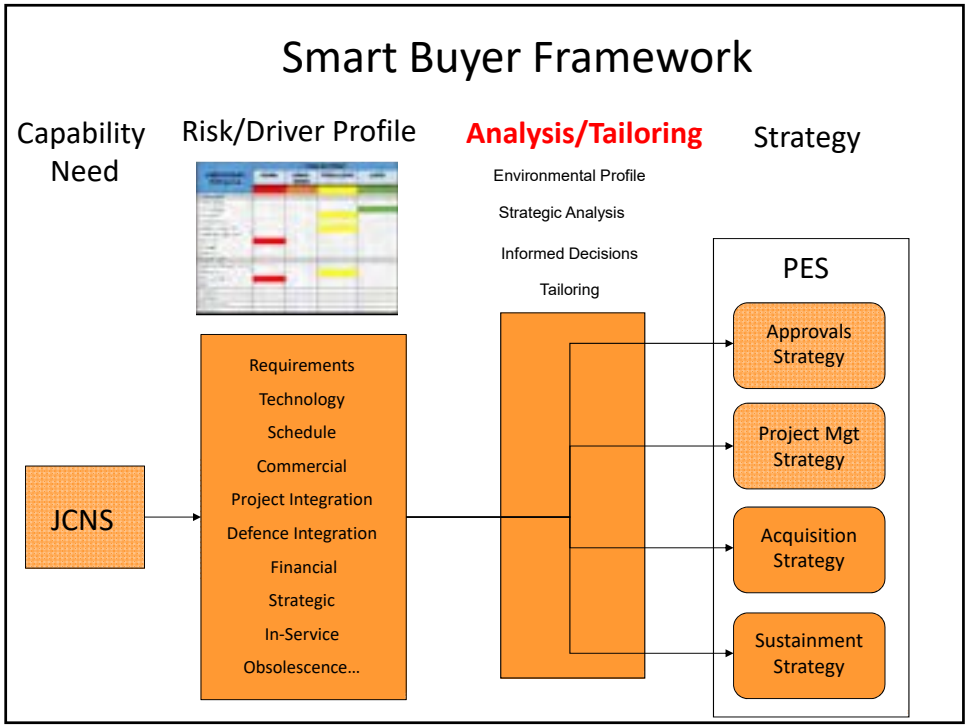
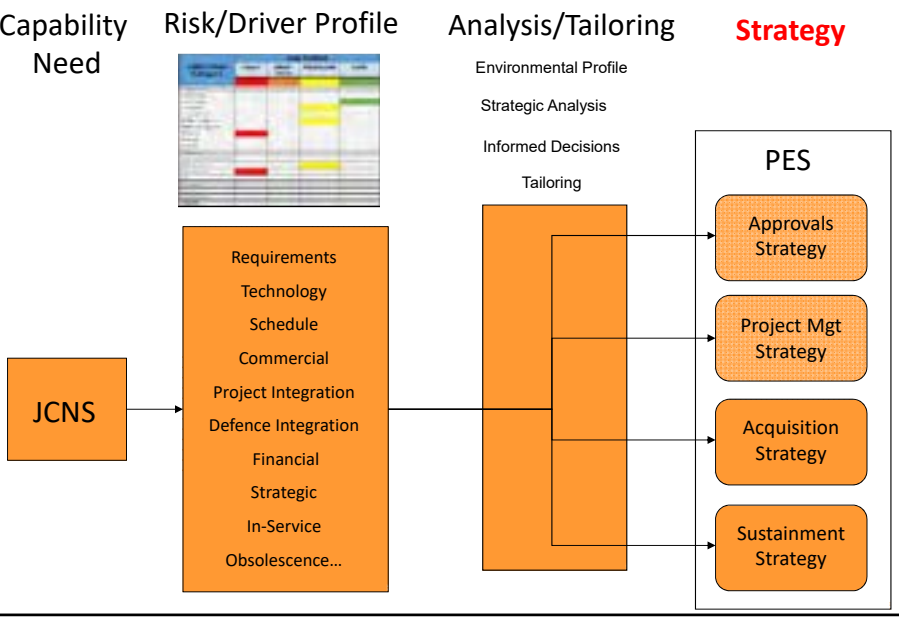




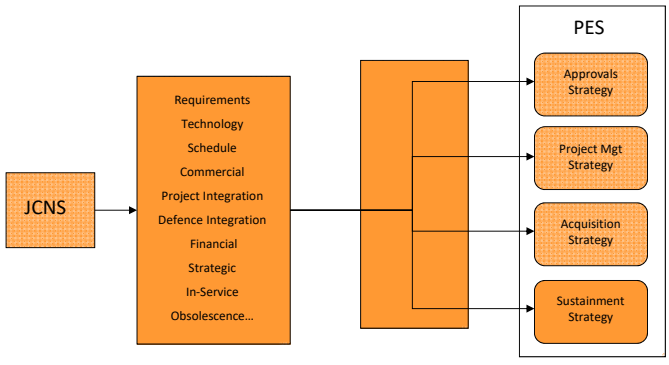
Smart Buyer Framework



812

Smart Buyer

- Key steps:
  - Understanding the context.
  - Identifying risk and drivers and their impact.
  - Developing a **tailored strategy** that matches risk and other relevant factors.



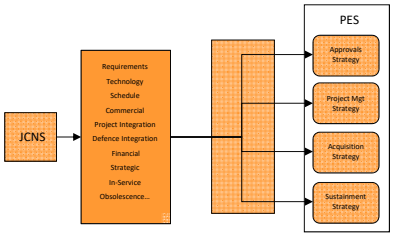
Source: Smart Buyer Kick-off Meeting Pack

813

Smart Buyer: Designing Each Procurement

Helps decide best procurement approach as captured in PES:

- Approvals: delegations for decision-making.
- Acquisition:
  - Method of Procurement.
  - Approach to Market.
  - Delivery Method.
- Sustainment:
  - Method of Procurement.
  - Approach to Market.
  - Delivery Method.
- Project Management: impacted by all.



814

PES: Tailored Strategy

- Approval Strategy:
  - Authorities: such as National Security Committee (NSC), One/Two Ministers.
  - Pathway:
    - fast track from Gate 0 to Gate 2, and
    - significant risk reduction studies Gate 0 to Gate 1.
- Acquisition Strategy:
  - stages to acquisition, contracting approach, and
  - approach to down-selecting options.
- Sustainment Strategy:
  - support concept and broad support arrangements
- Project Management Strategy:
  - role of Project eg Prime System Integrator (PSI).

815

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

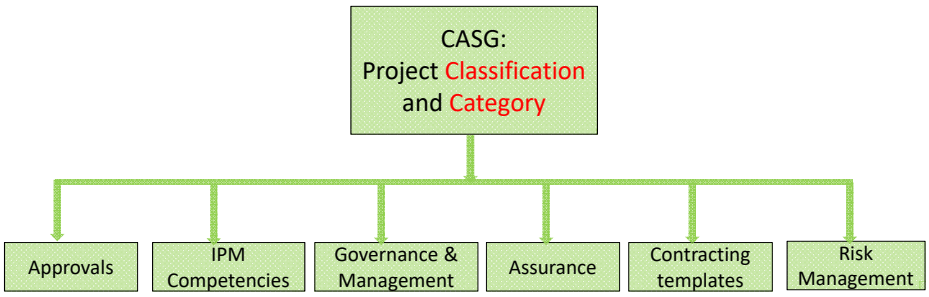
816

Categorisation and Classification

817

CASG Project Classification and Categorisation

- CASG classifies and categorises Acquisition projects to guide approval, reporting, assurance etc.
- Based on risk, complexity, and context, CASG determines the classification eg Major Project and category eg ACAT II.
- Smart Buyer used to inform, define and tailor the Project.



818

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.

819

Implementing Defence Procurement and Contracting

820

Generic Life Cycles

Generic lifecycles which can be scaled and applied to CLC dependent on circumstances.

System Life Cycle

Pre-Acquisition Phase	Acquisition Phase	Utilization Phase	Retirement Phase

Project Life Cycle

Conceive	Develop	Implement	Terminate

Procurement Life Cycle

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

Source: DPPM

821

Procurement Life Cycle

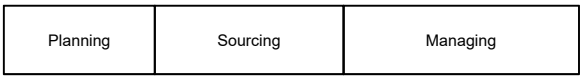
- The Procurement Life Cycle is also scalable and tailorable.
- Can be applied to ANY procurement.
- Following describes how it can be tailored when progressing an investment proposal and project through the CLC.

Source: DPPM

822

Procurement Life Cycle

- In its most general form the Procurement Life Cycle is divided into three phases and seven distinct but interrelated stages :

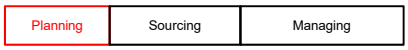


Source: DPPM

823

Procurement Lifecyle

- In its most general form the Procurement Life Cycle is divided into three phases and seven distinct but interrelated stages:
  - Planning



    1. Plan the procurement.
    2. Develop 'Request documentation' such as RFT.

824

Procurement Life Cycle

- In its most general form the Procurement Life Cycle is divided into three phases and seven distinct but interrelated stages :
  - Planning
    1. Plan the procurement.
    2. Develop 'Request documentation' such as RFT.
  - Sourcing

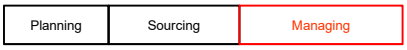
    3. Approach the market.
    4. Evaluation.
    5. Negotiation and contract signature.

Source: DPPM

825

Procurement Life Cycle

- In its most general form the Procurement Life Cycle is divided into three phases and seven distinct but interrelated stages:
  - 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.

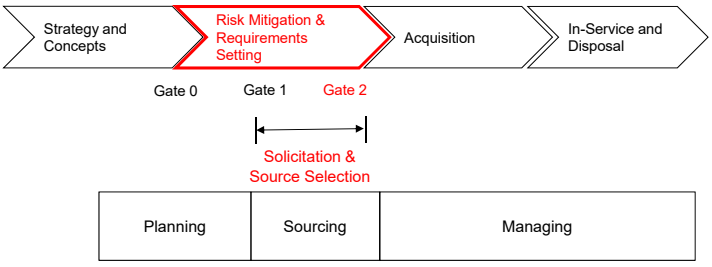


Source: DPPM

826

Relationship to CLC

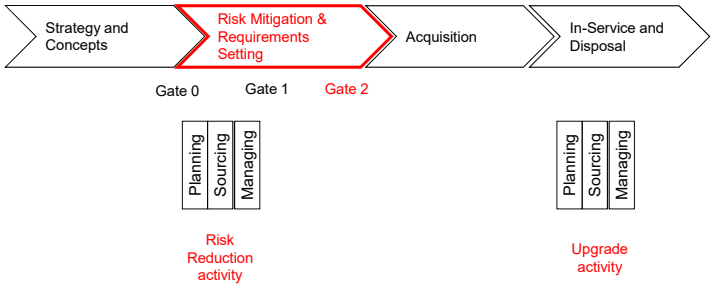
The Procurement Life Cycle is pivotal to deciding the strategy proposed in the PES for a major acquisition.



827

Relationship to CLC

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



828

1. Procurement Plan

- Level of detail in Procurement Plan reflects scope, scale and risk of procurement.
- For less complex procurements, the EtP document may be sufficient to serve as Procurement Plan.
- For procurements to be considered by IC the Procurement Plan will be informed by the Smart Buyer analysis.

Source: DPPM April 2017 Para 97

829

1. Procurement Plan

- The Procurement Plan will normally cover the following:
  - description of 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).

Planning	Sourcing	Managing

Source: DPPM April 2017 Paras 96

830

2. Request Documentation

- Sets out rules for the procurement describing to potential suppliers:
  - specifics of the procurement;
  - how 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.

Planning	Sourcing	Managing

DPPM: Paras 98 and 99

831

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.
  - Rules of the Process: rules for submission.
  - Draft Contract.

Planning	Sourcing	Managing

832

2. Request Documentation: SOW

SOW describes:

- scope and quantity of Goods and Services;
- requirements:
  - function and performance requirements;
  - certification;
  - training materials;
  - not specific designs or product descriptions;
  - 'essential requirements' (if not met excluded); and
- timeframes expected for delivery of goods and services.

Planning	Sourcing	Managing

833

2. Request Documentation: Conditions

Conditions for Participation:

- mandatory minimum requirements for supplier submissions.
- Defence rejects any submission that doesn't meet conditions for participation.
- assurance of legal, financial, technical or commercial capabilities of supplier to meet requirements of procurement.

Planning	Sourcing	Managing

DPPM: Paras 102

834

2. Request Documentation: Evaluation Criteria

- Sets up fair and equitable assessment of submissions.
- Criteria dependent on nature of procurement.
- Evaluation of tenderers should be based on:
  - balance of all the criteria, or
  - if weighting methodology used, on relative importance of each criterion.
- Defence officials should consider setting out criteria and weighting in request documentation so potential suppliers can appropriately focus their responses.

Planning	Sourcing	Managing

DPPM: Paras 105, 106

835

2. Request Documentation: Rules of the Process

- Request documentation sets out rules eg:
  - lodgement of submissions (eg AusTender) incl closing time for submissions; and
  - answering questions and distributing responses during tender open.

Planning	Sourcing	Managing

DPPM: Paras 107, 108

836

2. Request Documentation: Draft Contract

- Contains 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 risk with the tenderers' non-compliances with draft contract
- Enables tenderers to be evaluated against a common baseline.

Planning	Sourcing	Managing

DPPM: Paras 109

837

3. Planning: Approach the Market

- Procurement 'design' such as RFT, RFP
- appropriate type of tendering documents eg ASDEFCON
- Suite of Request Documentation developed:
  - Statement of Work (SOW).
  - Conditions for Participation.
  - Evaluation Criteria.
  - Rules.
  - Draft Contract.

Planning	Sourcing	Managing

DPPM: Paras 109

838

Sourcing: 4. Evaluation

- Evaluation Plan:
  - Internal Defence document.
  - Sets out method for evaluating submissions.
  - Must be finalised before approach is made to the market.

Planning	Sourcing	Managing

DPPM: Para 111

839

Sourcing: 4. Evaluation

- May use different evaluation 'structures':
  - Steering Committee.
  - Evaluation Board or Team.
  - Subordinate evaluation Working Groups.
- Can use internal or external advisers or experts to assist evaluation, for example:
  - technical requirements, or
  - financial viability or price.

Planning	Sourcing	Managing

DPPM: Para 111

840

4. Evaluation: Evaluation Report

- CPRs require Defence officials to maintain appropriate documentation of the decision making process for each procurement.

Planning	Sourcing	Managing

DPPM: Paras 115-117

841

4. Evaluation: Evaluation Report

Evaluation Report will normally contain:

- summary of the evaluation process;
- summary of the assessment of each submission;
- reasons for exclusion of submissions from further consideration;
- recommendations of preferred tenderer(s) (based on value for money); and
- any issues which need resolution during contract negotiations.

Planning	Sourcing	Managing

DPPM: Paras 115-117

842

4. Evaluation: Notifying Tenderers

- CPRs require tenderers to be:
  - notified promptly of evaluation outcomes; and
  - if requested, a debrief (both successful and unsuccessful tenderers).

Planning	Sourcing	Managing

DPPM: Paras 119-120

843

4. Evaluation: Notifying Tenderers

- 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 negotiated, the name of successful supplier and total contract price.
- Defence officials should keep a written record of debriefing.

Planning	Sourcing	Managing

DPPM: Paras 119-120

844

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 seek to resolve issues identified during the evaluation.

Planning	Sourcing	Managing

DPPM: Paras 121-123

845

5. Negotiation and Award of Contract

- At any time during the procurement process, Defence can:
  - determine that awarding a contract is not in the public interest
  - serious step with potential legal and management risks.
- Public interest grounds generally arise in response to new information or unforeseen events.

Planning	Sourcing	Managing

DPPM: Paras 121-123

846

Managing

6. Contract management:
   - Significant Project effort.
   - Negotiated contracted arrangements.
   - Contract amendments.
   - Acquisition contracts based on milestones.
   - Sustainment contracts based on performance.
7. Disposal:
   - Completion of contract.
   - Project closure.

Planning	Sourcing	Managing

DPPM: Paras 121-123

847

Tendering and Contracting Templates

848

Contracting Templates

- Contracting templates developed by Commonwealth entities to meet:
  - different procurement needs and profiles; and
  - size, complexity and nature of the procurement activity.

849

Contracting Templates

- Templates include:
  - Commonwealth Contracting Suite.
  - The Australian Standard for Defence Contracting (ASDEFCON).
  - Defence Suite of Facilities Contracts.
- ASDEFCON used in Capability Management.

850

Contracting Templates

Defence contracting templates are:

- drafted and regularly updated; and
- reflect applicable:
  - Commonwealth legislation;
  - Commonwealth policy (including the CPR); and
  - Defence policy.

DPPM: p35, 36

851

Contracting Templates

Commonwealth, State and Territory legislation and policy affects procurement and has to be addressed including:

- Contracting and Legal.
- Finance.
- Environment.
- Work Health and Safety.
- Security.

DPPM: p35, 36

852

ASDEFCON Templates

- Defence procurement supported by ASDEFCON suite which is made up of 20 different templates for tendering and contracting.
- Associated handbooks and related training are available for some templates.

Source: Department of Defence Website: Doing Business with Defence

853

ASDEFCON Templates

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ASDEFCON (Strategic Materiel)
ASDEFCON (Complex Materiel) Volume 2
ASDEFCON (Complex Materiel) Volume 1
ASDEFCON (Support)
ASDEFCON (Support Short)
ASDEFCON Linkages Modules
ASDEFCON (Services)
ASDEFCON (Standing Offer for Services)
ASDEFCON (Standing Offer for Goods)
ASDEFCON (Standing Offer for Goods & Maintenance Services)
ASDEFCON (Shortform Goods)
ASDEFCON (Shortform Services)
Request for Quotation and Purchase Order and Contract (Form SP020)
ASDEFCON (Request for Information)
Template Letter for Release of Draft Documents to Industry
ASDEFCON (Invitation to Register)
ASDEFCON (Request for Proposal)
ASDEFCON Defence Asset Templates
Government Furnished Facilities Licence
ASDEFCON Toolbar, Style Set and User Guide

Source: Department of Defence Website: Doing Business with Defence

854

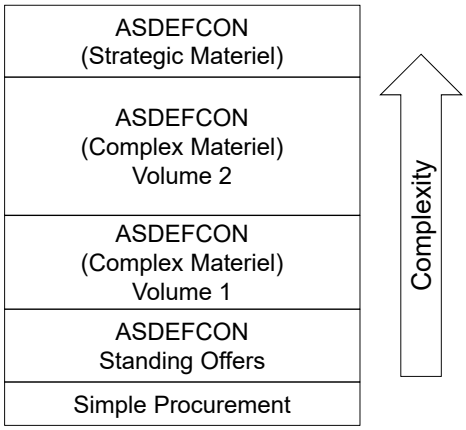
ASDEFCON Templates: Materiel

- Simple Procurement (of Goods and Services related to materiel).
- Materiel Acquisition.
- Materiel Support.
- Linked and Combined Materiel Acquisition and Support Contracts.

Source: Department of Defence Website: Doing Business with Defence

Materiel Acquisition Contracting Spectrum

855



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

Why have ASDEFCON Templates?

856

- Common templates supports efficiencies.
- Standardise and benchmark Defence's business
- Support Commonwealth and Defence policies;
  - reflect 'best practice'; and
  - support VFM and accountability.
- Improve relationships with industry by improving templates.
- Professionalism of Defence staff.
- Lead contracting reform in Defence.

Source: Department of Defence Website: Doing Business with Defence

857

Selection and Tailoring of Templates

- ASDEFCON templates expected to be tailored to suit circumstances.
- Users select and tailor the template(s).
- Selecting the right contract template is integral.

Source: Department of Defence Website: Doing Business with Defence
Source: Contract Template Selection and Tailoring Guide Version 2.1 April 2016

858

Selection and Tailoring of Templates

- ASDEFCON template selection and tailoring:
  - enables best VFM;
  - ensures sound governance and accountability; and
  - achieves a balance across risks:
    - technical,
    - contractual, and
    - managerial.

Source: Department of Defence Website: Doing Business with Defence
Source: Contract Template Selection and Tailoring Guide Version 2.1 April 2016

859

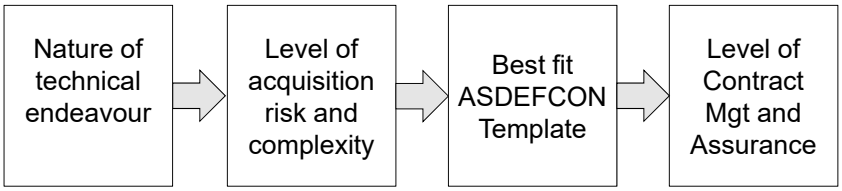
ASDEFCON Template Selection

- Level of contract management and assurance is commensurate with risk and complexity.
- Pivotal is understand nature of technical requirement especially technical complexity.
- Failure to relate tendering contacting 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

860

ASDEFCON Template Selection



Extent of system design and development

Risk of system development success

Sets up tendering and contract management which corresponds to risk

If risk is high then significant contractual management:
- provision of documentation eg plans
- reporting reqs
- assurance activities

861

ASDEFCON Templates

- 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).

Source: Department of Defence Website: Doing Business with Defence

862

ASDEFCON Template Selection: SOW

- SOW captures the scope and nature of work including technical requirements.
- 'Technical requirements' are significant drivers of the complexity and risks of the procurement.

SOW drives template selection.

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

863

Template Selection & Tailoring Guidance

- Defence Contract Template Selection and Tailoring Guide helps select the most appropriate template based on 'best fit' with SOW for procurement.

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

864

Pivotal Role of SOW

- SOW details work to be done during contract:
  - Supplier, such as produce documents; and
  - Customer, such as review documents.
- SOW needs to be accurate:
  - Unnecessary work requirements increases cost without commensurate increase in value.
  - Insufficient work requirements (esp technical) can jeopardise outcomes.

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

865

Pivotal Role of SOW

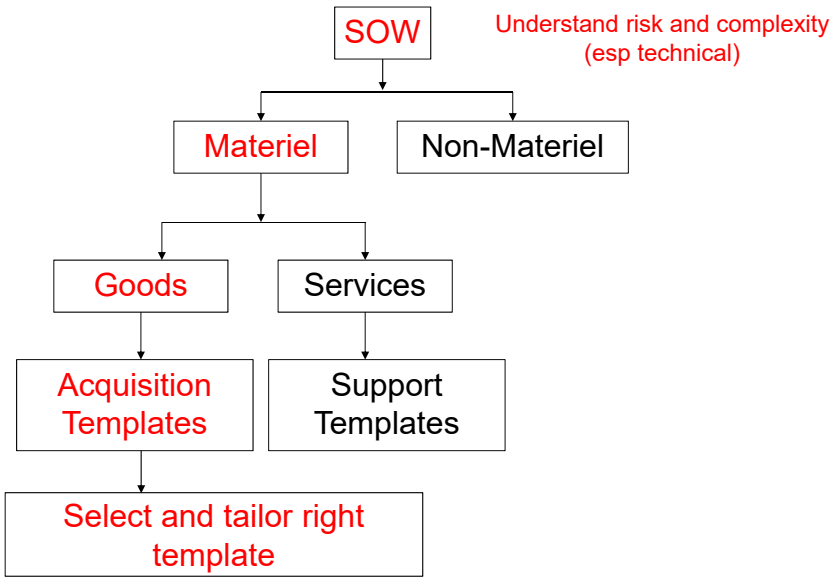
Before selecting a contracting template it is essential to:

- understand the technical nature of the activity;
- be clear about goods and/or services to be acquired;
- develop a sound SOW:
  - work to be done, and
  - who does the work.

SOW drives VFM.

866

Choosing the Right ASDEFCON Template



867

Steps in Template Selection & Tailoring

- Step 1: is it a procurement or disposal/transfer of asset; is it a materiel or non-materiel procurement.
- Step 2: identifies template for a materiel procurement.
- Step 3: describes steps for tailoring ASDEFCON templates.
- Step 4: options for non-materiel procurements using ASDEFCON, other Defence and Commonwealth templates, and standing offers / panels.
- Step 5: templates for the disposal or temporary transfer of Defence Assets.

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

868

Materiel Procurement

- Materiel procurements include goods and services for 'military purposes' ie materiel.
- 'Goods' : major platforms, eg ships, vehicles and aircraft through to consumables, eg fuels and oils.
- 'Services' related to materiel include:
  - services applied directly ('physically') to materiel eg maintenance activities ('Materiel Support Services'), and
  - services 'related' to materiel, eg inventory requirements determination ('Indirect Materiel Services').

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

869

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

870

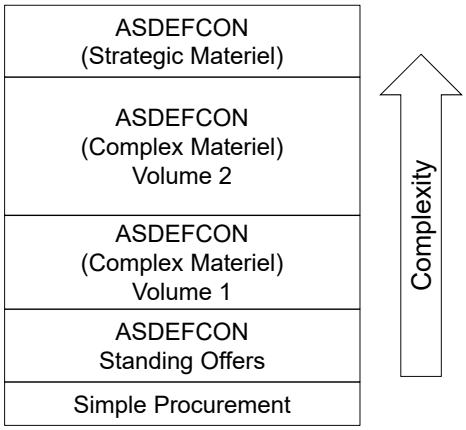
Range of ASDEFCON Templates

- 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

871

Materiel Acquisition Contracting Spectrum



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

872

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:
  - Follow-on support arranged in a single procurement.
  - ASDEFCON Linkages Modules 'link' draft ASDEFCON contracts for acquisition and support under a single RFT.

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

873

Contents of ASDEFCON Templates

- The templates are available on the Defence intranet and http://www.defence.gov.au/casg/DoingBusiness/Procurement Defence.

874

Contents of ASDEFCON Strategic Materiel

Preliminary Pages

Part 1 - Conditions of Tender

Part 1 - Annexes to the Conditions of Tender

Part 2 - Draft Conditions of Contract

Part 2 - Attachments to Draft Conditions of Contract

Part 3 - Draft Statement of Work

Part 3 - Annexes to the Draft Statement of Work

Part 3 - Data Item Descriptions

Part 3 - MSR Checklists

875

Part 3 - Statement of Work

Purpose:

- communicate Commonwealth requirements and standards for work to be carried out under the Contract and
- allocate work responsibilities between the Commonwealth and the Contractor.

876

Part 3 - Statement of Work

Brings together all 'technical' aspects (requirements and Practices) relevant to the CLC into a contract including:

- Project Management.
- Systems Engineering.
- Integrated Logistics Support.
- Configuration Management.
- Verification and Validation.
- Health, Safety and
- Environment.

877

Part 3 - Statement of Work

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

878

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.
- DIDs detailed as Annex to SOW.

Source: ASDEFCON (Strategic Materiel)

879

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.
- DIDs detailed in Annex to SOW

Tender Life Cycle Cost Model (TLCCM)

Source: ASDEFCON (Strategic Materiel)

880

Part 3 - Data Item Descriptions (DID)

- 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, for example:

"*the Tender Life Cycle Cost Model shall provide sufficient detail to enable the Commonwealth to understand the LCC model developed by the tenderer*"

Source: ASDEFCON (Strategic Materiel)

Dr Mike Ryan & Dr Shari Soutberg

881

Part 3 - Data Item Descriptions (DID)

- DIDs are selected from 'superset':
  - Tender Document Requirements List (TDRL); or
  - Contract Data Requirements List (CDRL).
- Tender or Contract Data requirements are determined to be core or optional.
- Annex C to the Draft Statement of Work (V3.1) provides the comprehensive list of possible Data Items.

882

Part 3 - Data Item Descriptions (DID)

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)

883

Part 3 - Data Item Descriptions (DID)

Bringing this together:

- 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.

Source: ASDEFCON (Strategic Materiel)

884

Part 3 - Data Item Descriptions (DID)

Bringing this together:

- 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.
- 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)

885

Part 3: Mandated System Review Checklists

- System reviews are an important form of assurance
- MSR defines Commonwealth's requirements and minimum expectations for reviews during Contract.
- includes 'exit criteria' for assessing successful completion of review.
- extent of assurance through system reviews (number, depth, type) depends on the nature of the work (SOW: risk, complexity).
- Examples of MSR during system development:
  - Integrated Baseline Review (IBR).
  - System Requirements Review (SRR).
  - System Definition Review (SDR).

Source: ASDEFCON (Strategic Materiel)

886

Part 3: Mandated System Review Checklists

Important reviews concerning the built system:

- Functional Configuration Audit (FCA): demonstrates Configuration Item's actual performance complies with specification (applies to Mission System & Support System).
- Physical Configuration Audit (PCA): 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): 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).
- …

Source: ASDEFCON (Strategic Materiel)

887

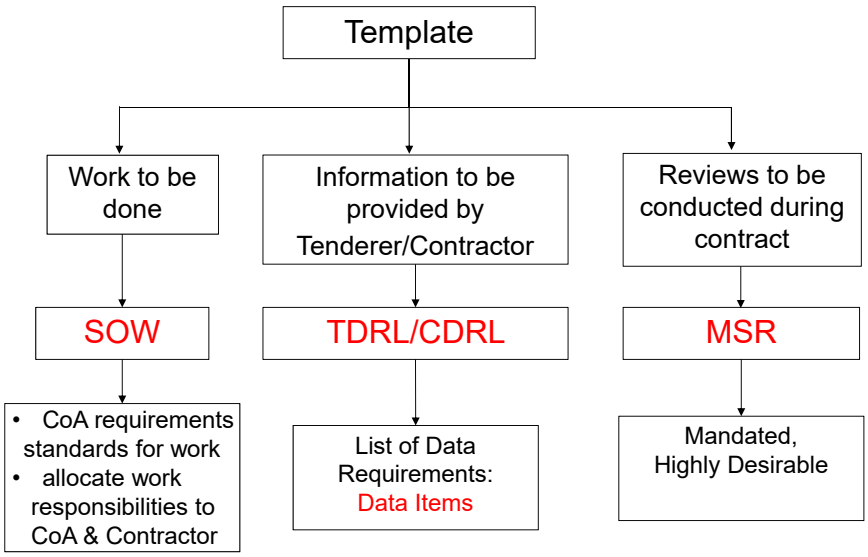
Part 3:Mandated System Review Checklists

Important reviews concerning the built system:

- …
- 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



Dr Mike Ryan & Dr Shari Soutberg

RISK MANAGEMENT AND ASSURANCE

890

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

891

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).

892

Interrelated Concepts

Essential to good governance are robust regimes for:

- Risk Management.
- Assurance.

Risk Management

894

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.

Source: PGPA Section 16

895

Duties with Respect to Risk Management

So…

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

896

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."

30/2015 CDF/OUT/2015/682
The Joint Directive by CDF and Secretary of Department of Defence on the management of risk in Defence

897

Defence Risk Management: evidence

The Joint Directive emphasises that a key principle applying to all decisions is to accept and treat individual risks based on evidence.

898

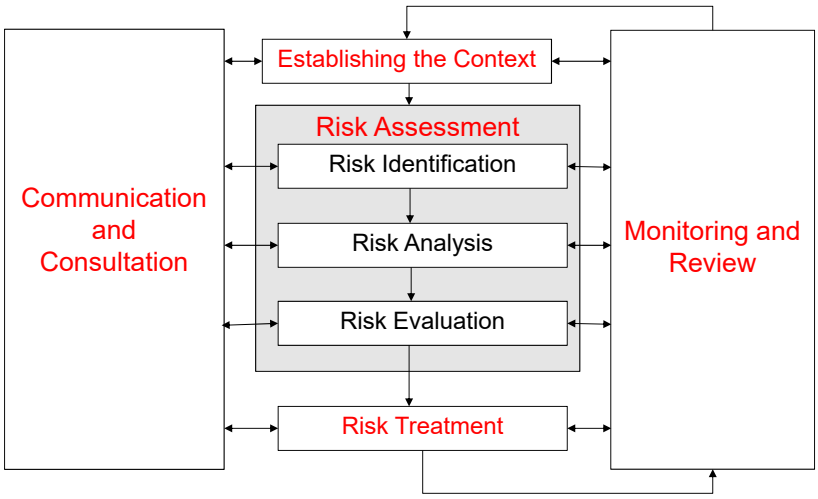
Definitions

- 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

AS/NZS ISO 31000 Risk Management pp 1-2

899

Risk Management Process



Reference: AS/NZS ISO 31000:2018

900

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 not be risk averse in decision-making.

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 and ranking between risk events.
5. Plan what to do to control, reduce, eliminate the risk events.
6. Implement risk mitigation, reduction.

902

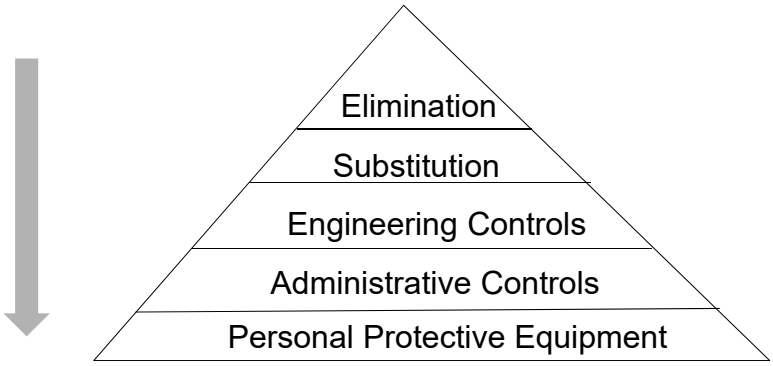
Risk Management and the CLC

Multiple risk frameworks in Defence relevant to CLC include but are not limited to:

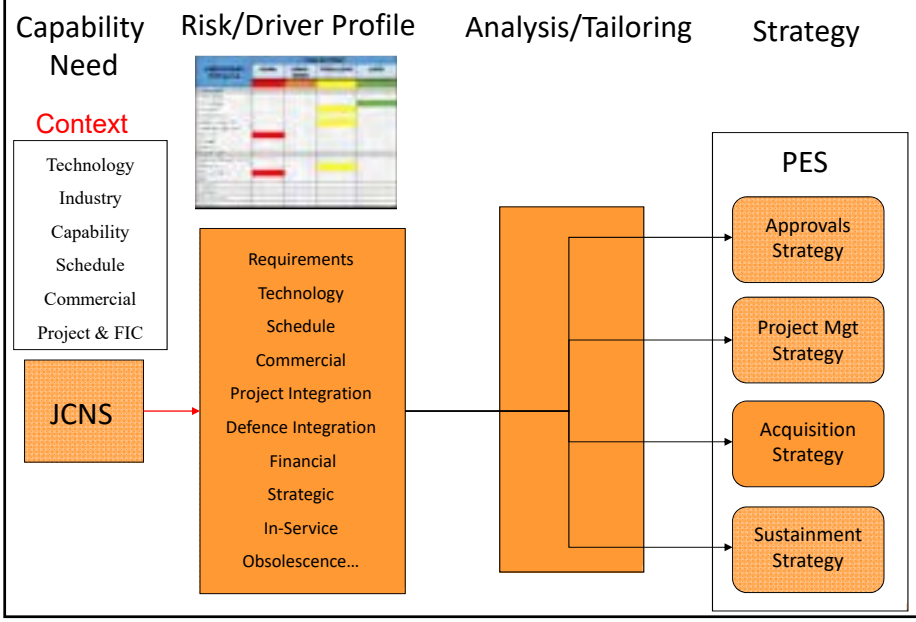
- CLC Risk Mitigation Phase emphasising risk treatment.
- Smart Buyer Risk Framework.
- Technical Risk Assessment (TRA),
- Technical Implementation Risk Assessments (TIRA),
- Schedule Compliance Risk Assessment (SCRAM).
- Technical Risk Management.

Technical Risk Management

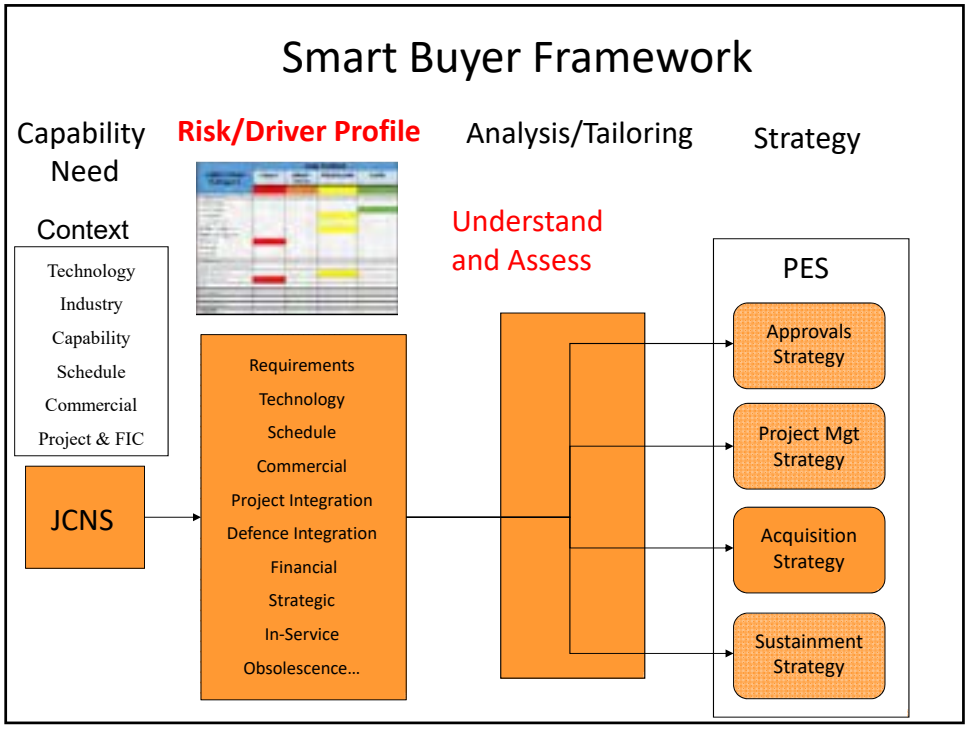
- Technical Hierarchy of Controls for a system.
- Use different ways to control the risk depending on what is possible, cost and the impact.

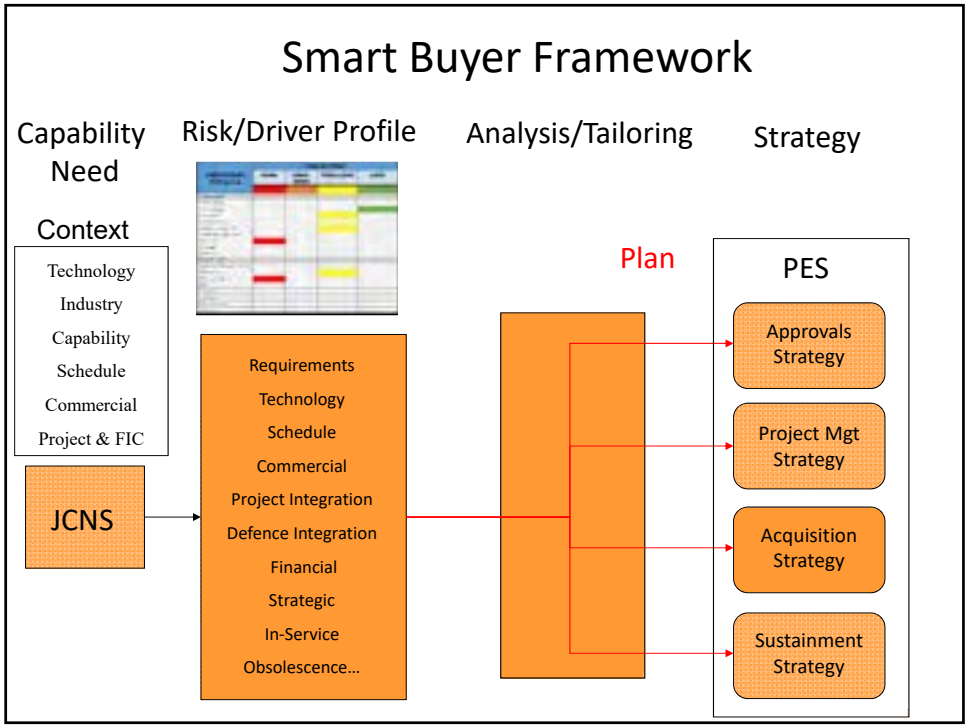


Smart Buyer Framework



Dr Mike Ryan & Dr Shari Soutberg





907

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

908

CLC Risk Management: Acquisition Categories

Risk Category	Risk Event	Treatment/ Mitigation
Requirements	Requirements incomplete Not verifiable Ambiguous	Additional requirements development Technical trial to determine constraints Peer review
Technology	Not mature Unproven	Develop technology further, trial Field in increments
Schedule	Schedule not achievable	Redevelop WBS and schedule
Commercial	Limited competition in market	Contract with appropriate performance incentives
Project Integration	Related Projects misaligned	Establish Prime System Integrator to manage interdependencies
Defence Integration	FIC delivery misaligned	Establish Steering and review group
Financial	Schedule slippage affects milestone achievement	Establish Program level so that flexibility to accommodate changes
Strategic	Changing threat situation	Ensure growth in system requirements and capabilities
Industry	Industry not investing in field	Funding to establish industry capability

909

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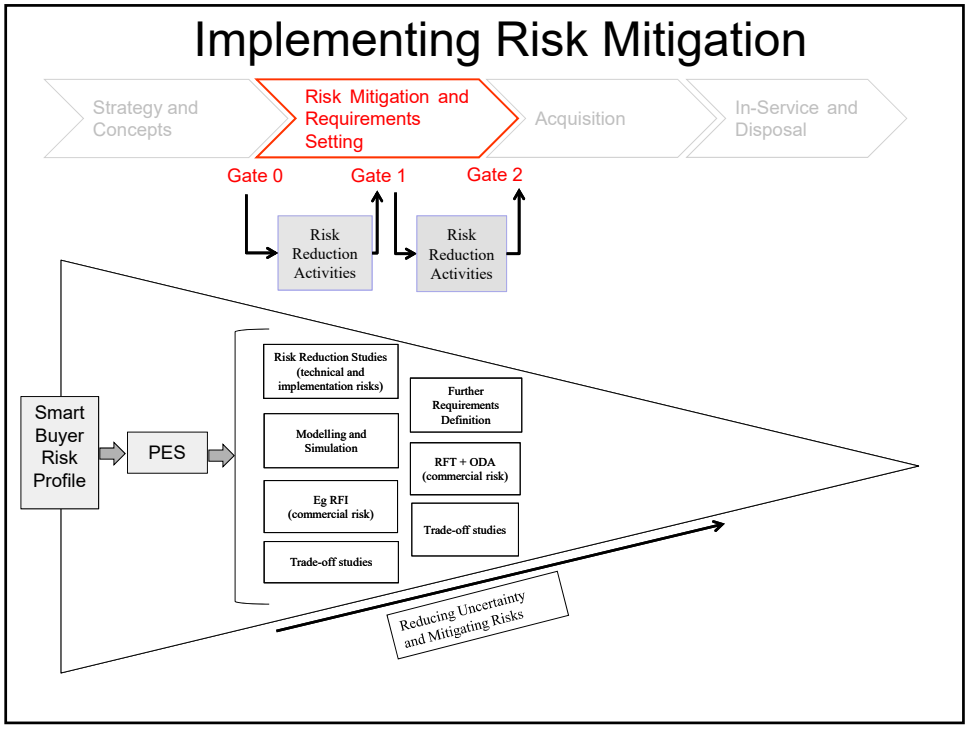
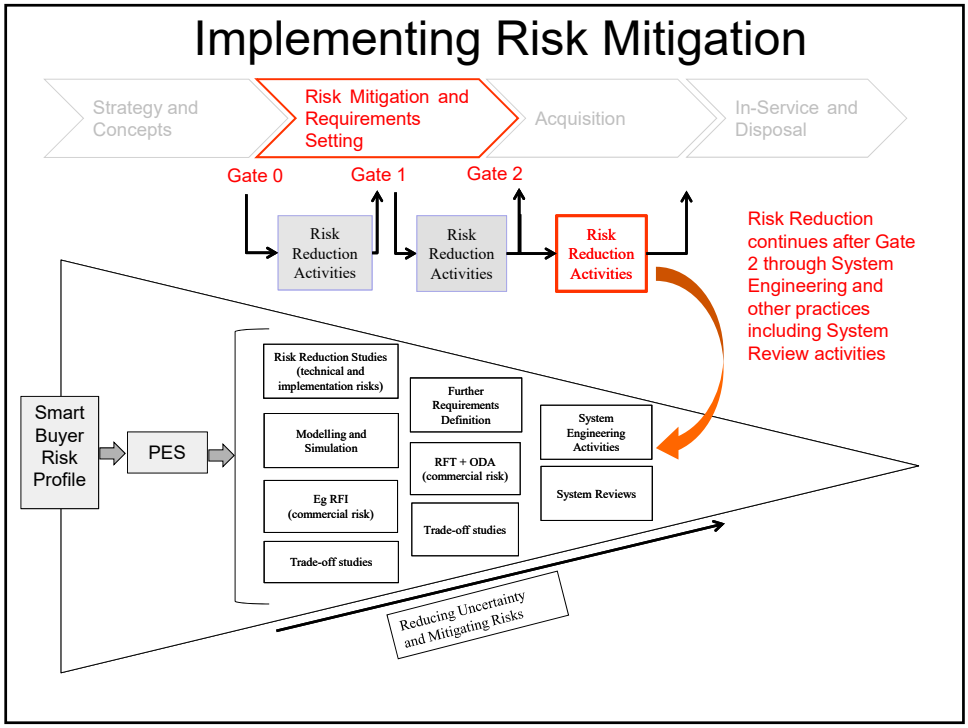

Implementing Risk Mitigation
Strategy and Concepts
Risk Mitigation and Requirements Setting
Acquisition
In-Service and Disposal
Gate 0
Gate 1
Gate 2
Risk Reduction Activities
Risk Reduction Activities
Smart Buyer Risk Profile
PES
Risk Reduction Studies (technical and implementation risks)
Modelling and Simulation
Eg RFI (commercial risk)
Trade-off studies
Further Requirements Definition
RFT + ODA (commercial risk)
Trade-off studies
Reducing Uncertainty and Mitigating Risks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Acquisition
In-Service and Disposal
Gate 0
Gate 1
Gate 2
Risk Reduction Activities
Risk Reduction Activities
Risk Reduction Activities
Risk Reduction continues after Gate 2 through System Engineering and other practices including System Review activities
Smart Buyer Risk Profile
PES
Risk Reduction Studies (technical and implementation risks)
Modelling and Simulation
Eg RFI (commercial risk)
Trade-off studies
Further Requirements Definition
RFT + ODA (commercial risk)
Trade-off studies
System Engineering Activities
System Reviews
Reducing Uncertainty and Mitigating Risks

913

Expectations of Risk Approach to CLC

- A structured and deliberate approach to risk management processes supports PGPA duties through:
  - reducing and controlling risk; and
  - clear consideration of risks in decision-making.
- Conscious risk reduction mindset:
  - throughout the CLC (not just to Gate 2); and
  - targeted risk control actions focused on identified risks.

Assurance

915

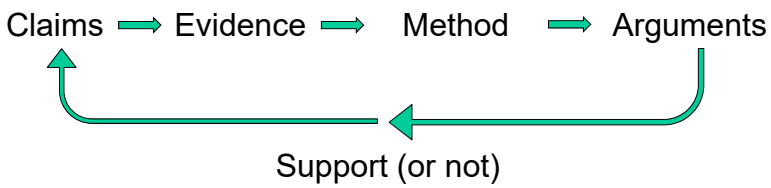
Meaning of Assurance

- 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

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

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); and
- justification of the choice of top-level claim and the method of reasoning.

Source ISO/IEC 15026-1:2013

Assurance in Capability Management

918

- 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.

919

Assurance in Capability Management

- CLC assurance activities are conducted:
  - across the whole CLC;
  - across various dimensions of capability management (eg technical, safety, financial, seaworthiness);
  - to provide confidence to decision-makers and managers; and
  - to assure compliance with legislative and regulatory obligations.

920

Program of Assurance Activities

- Many different assurance activities across the CLC.
- Program, Product and Project Sponsors need to:
  - plan assurance 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 circumstances.
- Should establish a clear view of Assurance Program and capture this in the IPMP and appropriate subordinate plans.

921

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.

922

Contestability Framework

- Key assurance activity during Investment Approval Pathway.
- Reviews force design outputs and all Gate submissions.
- Ensures:
  - alignment with strategic and resource guidance;
  - an acceptable basis for decision-making; and
  - plans can be executed.
- Reviews risk assessments and treatment strategies.
- Reviews cost and schedule estimates.
- Independent assurance reviews and ‘deep dives’.

923

Review Panels

- Independent assurance that augments reporting.
- Reviews health of Program, Product or Project:
  - Gate Reviews.
    - Capability Manager or Program Sponsor and/or the Delivery Group initiates.
    - Independently chaired panel before all Gates and critical milestones.
  - In-Depth Reviews.
    - Program Sponsor, VCDF or DepSec Strategic Policy and Intelligence or Delivery Group Head initiates.
    - Independently chaired.
    - As a result of a significant trigger or particular concern.

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Program-level Health Checks

- Responsibility of Program Sponsor.
- Conducted on regular basis: typically tri-annual basis
- Supports progress reporting to Capability Manager, members of Program Steering Group and other key stakeholders.
- Standardised across IIP.
- Reduces need for additional performance reporting.

Interim CLC Manual 2017

925

Independent Assurance Reviews (IAR)

- CASG's assurance framework.
- Provides reliable advice on:
  - continuing viability of capability investment decisions; and
  - health and outlook of Programs, Projects, Products.
- Chartered Board with skills and experience.
- Lead up to key Project milestones or annually.
- Sustainment reviews in lead up to major events in Product Life Cycle:
  - such as mid-life upgrades; or
  - periodically, one to three years.

CASG Business Framework 2017
Interim CLC Manual 2017

926

Deep Dive Reviews

- Led by Force Design Division:
  - supported by Program Sponsor and Contestability Division (as appropriate);
  - scheduled in Force Design Forward Work Plan; and
  - focuses on a Program, cross-Program or Capability Stream.

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SCRAM

- The Schedule Compliance Risk Methodology (SCRAM):
  - structured approach to identifying Project risks and issues with technical or engineering origin;
  - understand impact on Project schedule outcomes; and
  - evidence and recommendations for treatment of risks and issues.

928

SCRAM

- Technical and engineering aspects include:
  - requirements definition,
  - system design, development, production,
  - system integration and test, and
  - software development.

929

When Can SCRAM be Applied?

- Projections of schedule outcomes at any point in the CLC:
  - evidence for Smart Buyer especially technical implementation risk-profiling especially up to Gate 2.
  - assess Project health from Gate 0 to Acceptance.
- 'Due diligence' assessments during management handovers.
- Identify sources of technical implementation risk.
- Determine practical risk mitigation actions.
- Focus on:
  - system development,
  - software development, and
  - system integration.

930

Technical Regulation

- Technical Regulation:
  - Confidence to Capability Managers.
  - Safety and technical integrity of systems and equipment.
  - Fitness for service, safety and environmental compliance.

931

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.
- Land Technical Regulation (Landworthiness):
  - Technical Regulation of ADF Materiel Manual – Land.
- Explosive Ordnance Regulation:
  - DI (G) LOG 4-1-006 - Safety of Explosive Ordnance.

932

Audit

- Cornerstone of good public sector governance.
- Objective assessments of whether public resources are managed responsibly and effectively to achieve intended results.
- Audit helps:
  - public sector organizations achieve accountability and integrity,
  - improve operations, and
  - instill confidence among citizens and stakeholders.

933

Range of Audits

- Three main categories of audits: dependent on relationship between auditor and the person being audited:
  - first-party,
  - second-party, and
  - third-party audits.

https://advisera.com

934

Range of Audits

- Third-Party Audits:
  - Organisation engages an independent party to perform an audit.
  - Organisation wants to create a quality management system (QMS) that conforms to a standard set of requirements (eg ISO 9001).
- …

935

Range of Audits

- …
- Second-party audit:
  - Audit of a supplier to ensure that they are meeting requirements in contract or other agreement.
  - All or part of the contract or agreement can be audited.
  - On-site reviewing of processes or off-site review of documents.
  - Not relevant to certification.

936

Range of Audits

- …
- First-Party Audits:
  - Often called internal audits.
  - Organisation audits processes in the quality management system.
  - Audit assesses if processes as conducted:
    - meet standard, and
    - rules the organisation has set itself.

937

ANAO

- Relevant activities of ANAO:
  - Performance audits of Australian Government programs and entities; and
  - Assurance reviews of Australian Government entities.
    - Source: https://www.anao.gov.au/about/legislation-and-standards

938

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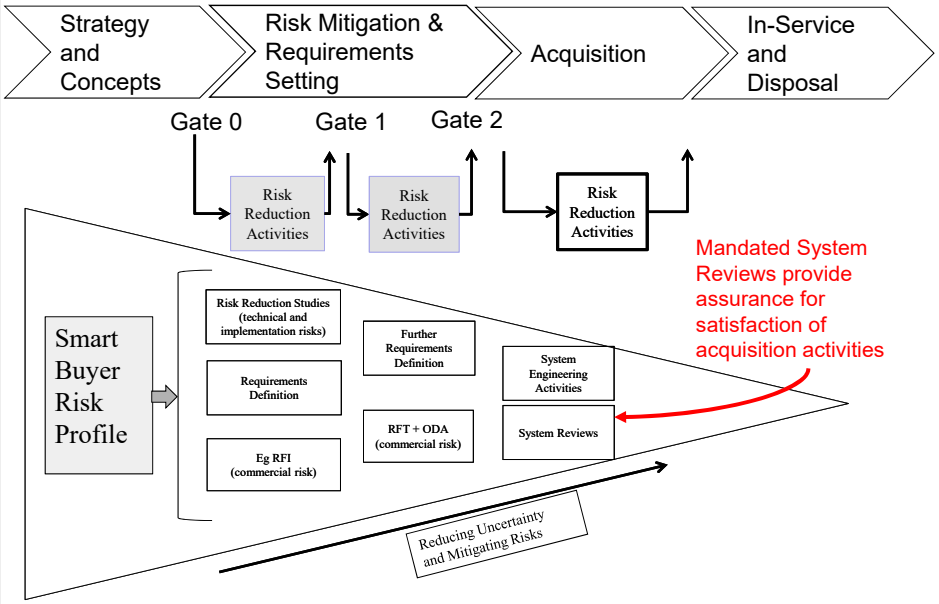
    - Source: https://www.anao.gov.au/about/legislation-and-standards

- ANAO Auditors use:
  - financial audits,
  - performance audits,
  - investigations, and
  - advisory services.

Implementing Risk Mitigation



940

Mandated System Reviews

- Based on System Engineering
- Provides assurance on achievement of progress for contracted work.
- Form of Assurance Case for each step in system development, production and delivery.

Source: ASDEFCON (Strategic Materiel)

941

Mandated System Reviews

- Pivotal System Reviews (most materiel acquisitions) include:
  - Integrated Baseline Review (IBR).
  - System Requirements Review (SRR).
  - System Definition Review (SDR).
  - Preliminary Design Review (PDR).
  - Detailed Design Review (DDR).
  - Support System Detailed Design Review (SSDDR).

Source: ASDEFCON (Strategic Materiel)

942

T&E Categories

- Developmental Test and Evaluation (DT&E)
  - Largely undertaken in the Acquisition Phase.
  - Support design and development effort.
  - Generally undertaken by contractors.

943

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  - Between the Acquisition and Utilisation Phases.

944

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  - 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.

945

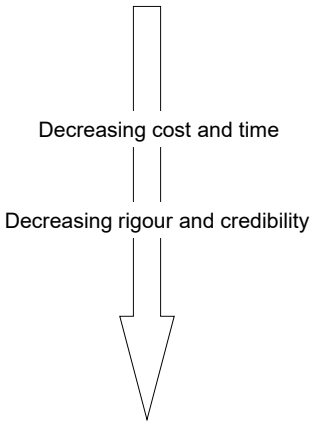
Verification and Validation (V&V)

- Systems engineering process aims for 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
  - built the right system (validation).
- T&E supports V&V.

946

Methods of V&V

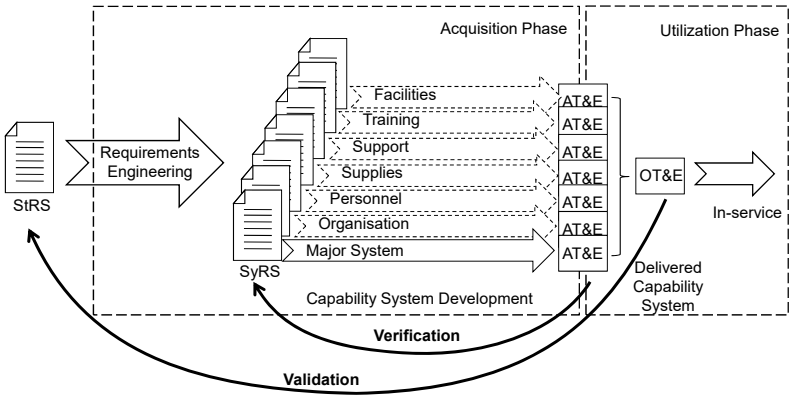
- T&E
- Demonstration
- Experiment
- Analysis
- Modelling
- Simulation
- Inspection/examination
- Similarity
- Certification
- Implication



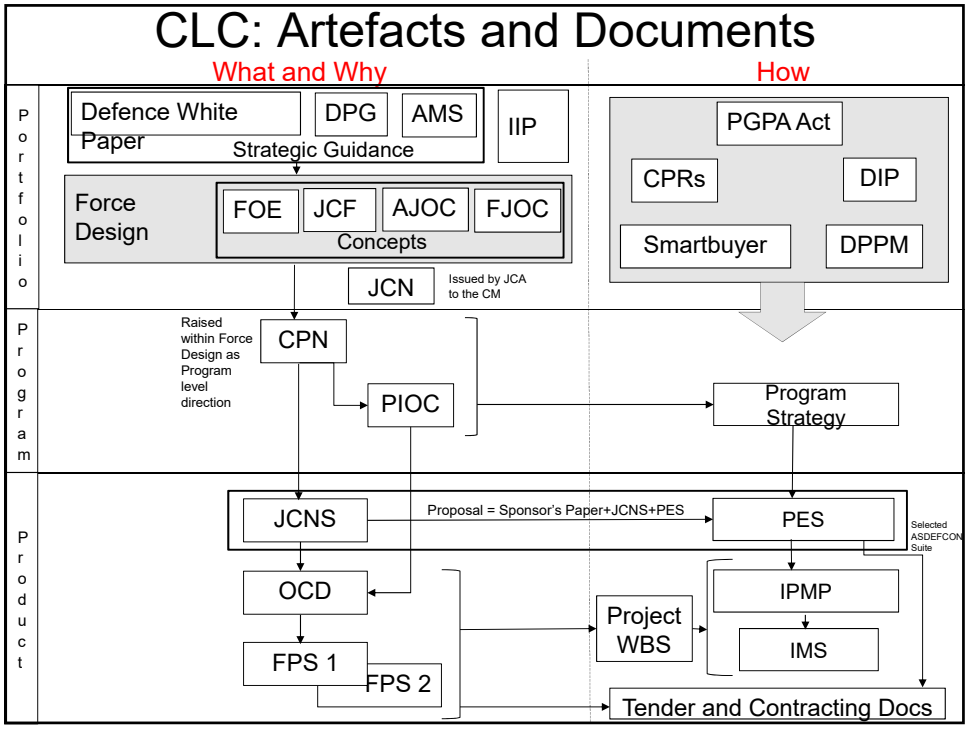
Don Greenlee, "T&E As An Element of SE and Vice Versa: It's Only Fair Play", Systems Engineering/Test & Evaluation Conference, 8 Nov 2004.

Dr Mike Ryan & Dr Shari Soutberg

V&V



CLC ARTEFACTS AND DOCUMENTS



950

Implementing the 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 aspects of the CLC.

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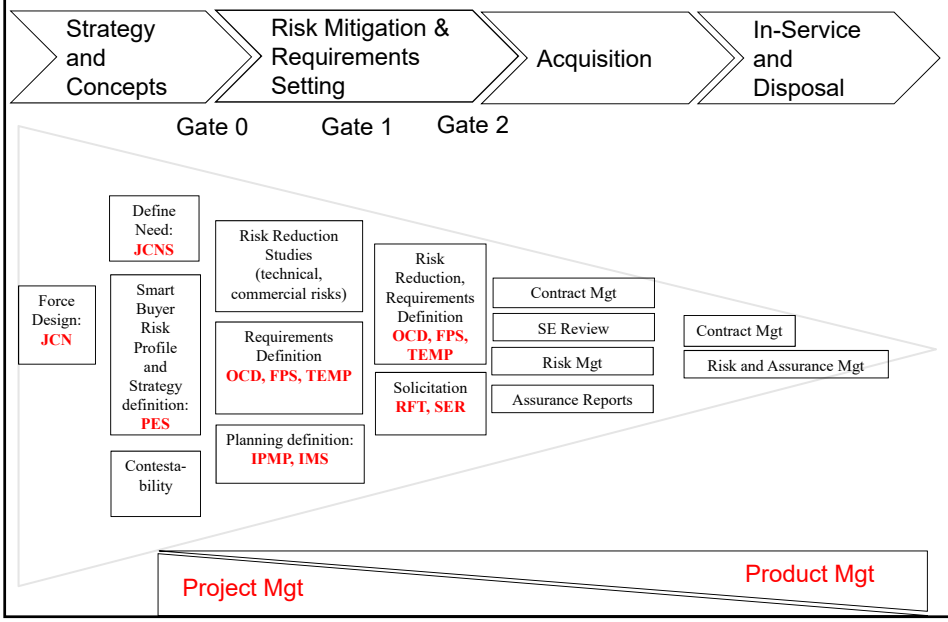
Implementing the CLC

- Next section will use the examples introduced on Day 1:
  - IAMD
  - Electronic Support (ESM).
- Examples will step us through the key CLC artefacts and documents leading up to Gate 2.
- Following slides are provided for reference reflecting latest known guidance with focus on new documents (to Gate 2).

Implementing the CLC (Example)



953

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

954

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 software development:
  - requirements,
  - models,
  - design documents,
  - project plans, and
  - risk assessments.

955

Meaning of Artefact

- We will use artefact as any means of communicating information associated with the CLC including documents, models, plans, architectures, and proposals.

956

Scope of Artefacts Being Covered

- Many artefacts are created through the CLC from early Capability Narratives through to Project closure and disposal documentation.
- This course focuses on CLC artefacts:
  - identified as core to the CLC; and
  - 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.

957

Scope of Artefacts Being Covered

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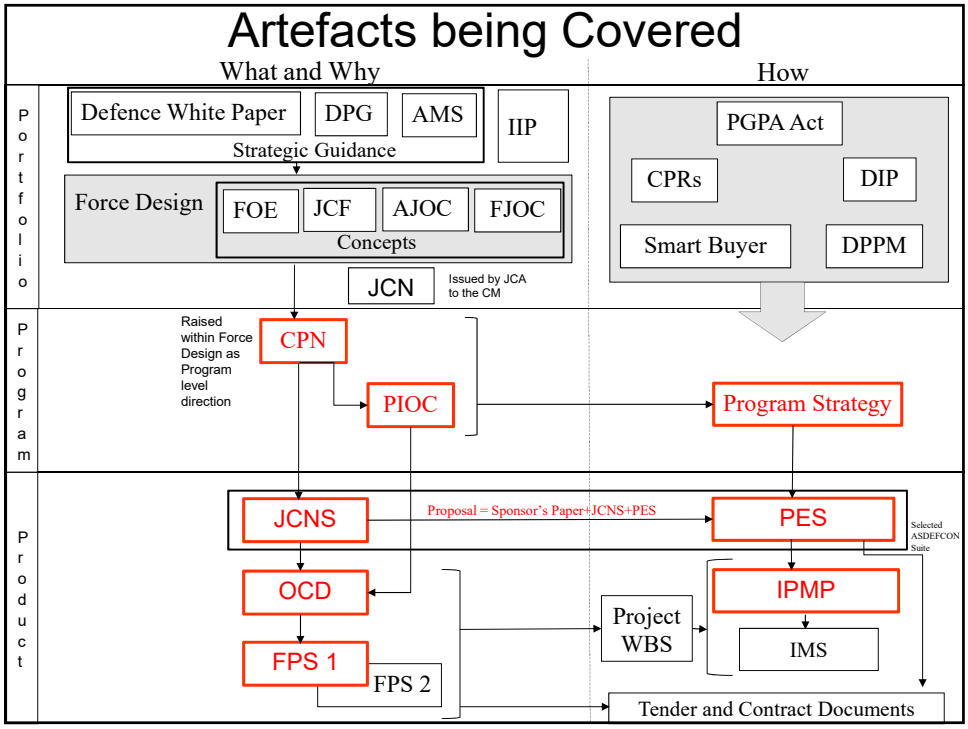
Artefacts being Covered



Key CLC Artefacts

959

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

Key CLC Artefacts

960

- …
- Proposal Artefacts at Program, 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).

PROGRAM ARTEFACTS

PROGRAM EXAMPLE:

Integrated Air and Missile Defence (IAMD)

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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); and
  - missiles eg ballistic and cruise missiles (missile defence).

964

Program Example: IAMD

- Integrated:
  - Operational and technical collaboration between systems.
  - Military advantage.

Source: http://www.anzidlsoc.com.au/1600_AIR6500_Brief_to_TDL_Interoperability_Summit_2017.pdf

965

Program Example: IAMD

- Largely based on data or information exchange.
- Focus on Command Control Communication Computer Intelligence Surveillance and Reconnaissance (C4ISR) elements.
- C4ISR are *"systems, procedures, and techniques used to collect and disseminate information".*

966

IAMD Key Components

- Key components of IAMD system:
  - Sensors: detect threats.
  - Command and Control: Battle Management System (BMS):
    - information collection, processing, dissemination.
  - Effectors/weapons: respond in some way to the threat.
- IAMD also uses 'layers' of defence for the different types of threats so:
  - Short-range.
  - Medium-range.
  - Long-range.

Dr Mike Ryan & Dr Shari Soutberg

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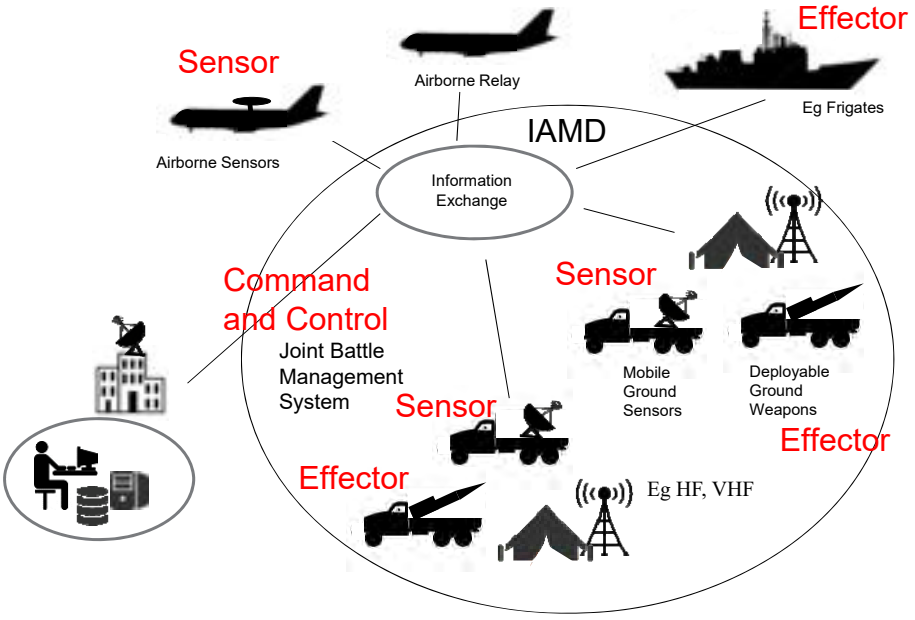
IAMD: In Summary

- Air Defence: conventional air threats eg aircraft, unmanned aerial vehicles, helicopters
- Missile Defence: ballistic and cruise missiles, hypersonic
- Unified Operations: *information exchange/ interoperability*
- Layered Defence

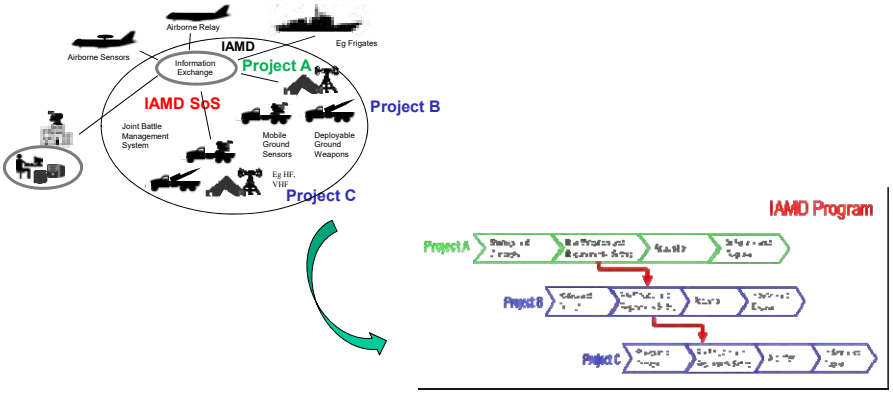
Possible Components of IAMD



969

IAMD: SoS and Program

- IAMD is an example of a *System of Systems (SoS)* which corresponds to a CLC Program.
- Constituent *systems* correspond to constituent Projects and Products.



970

Australian Defence Force IAMD

- ADF IAMD Program announced in 2016 Defence White Paper.
- *"A modern and integrated ground-based air defence 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
- Good reference: The Sir Richard Williams Foundation.

971

Three Elements of ADF IAMD

1. Upgrade of ADF's existing air-defence system:
   - Includes C4I systems and sensors.
   - Long range-air-defence.
   - Vigilare (*250 separate interfaces*).

https://www.airforce.gov.au/technology/aircraft/intelligence-surveillance-and-reconnaissance/e-7a-wedgetail

972

Three Elements of ADF IAMD

2. Joint Battle Management System (BMS):
   - Coordinate and synchronise ADF operations.
   - Interconnect platforms, systems, sensors.
   - Across air, land, sea, space, cyber.
   - Provides shared situational awareness.

Source: http://www.defence.gov.au/dmo/EquippingDefence/LAND-75-ph3.4-BMS

973

Three Elements of ADF IAMD

3. Ground-based air-defence capability (GBAD):
   - Surface to air system (short-range).
   - Improves protection for deployed personnel (incl man-portable systems).

http://www.australiandefence.com.au/news/2-billion-for-nasams-gbad-system

974

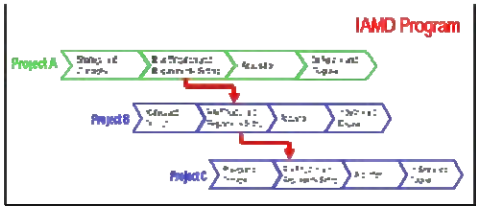
Elements of IAMD

- 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.

AIR 6500 Phase 1

AIR 6500 Phase 2

Land19 Phase 7B



Indicative only

975

RECAP OF PROGRAM LAYER

976

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

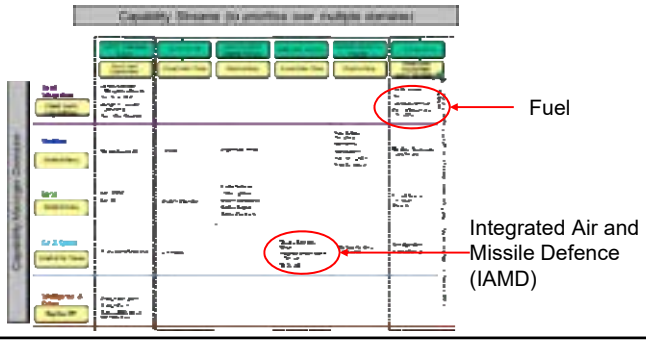
A Program, in the context of managing Defence capability, is defined as a group of related Projects, Products, and activities that are managed in a coordinated way to optimise capability outcomes within allocated resources.

Source: Interim Capability Life Cycle Manual

977

Objectives of Programs

- Programs in the Defence context generally of two types:
  - *Operational outcomes* eg joint capability.
  - *Resource commonality* eg common systems or resources (eg fuels) which provide efficiencies.



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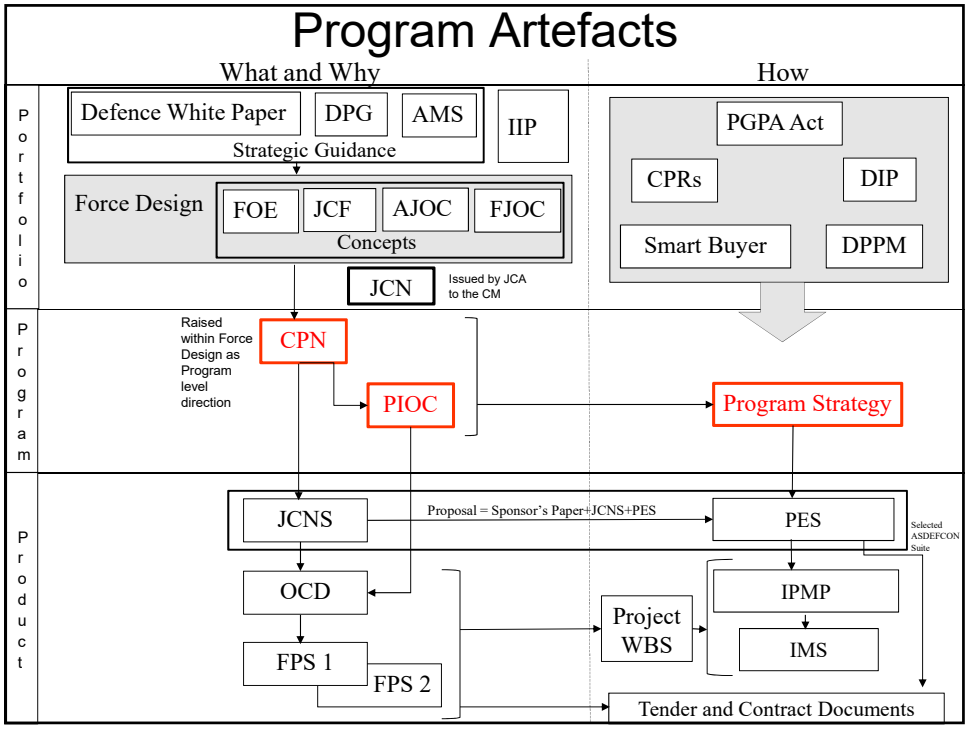
Program Approach—Benefits

- Can better prioritise across Defence Portfolio.
- Improves the strategic view for government direction.
- Efficiencies across similar Products and Projects.
- Facilitates Joint Force by Design.



980

Program Artefacts as a Common Reference

- Program-level artefacts provide an overarching reference for constituent Projects and Products.
  - Program: Parent artefact
  - Project and Product: Subordinate artefacts
- Aligned: Related Projects and Products reference common Program information to enable aligned and, where appropriate, joint force outcomes.
- Efficient: Each subordinate artefact leverages the parent artefact so that only the essential 'delta' is developed.

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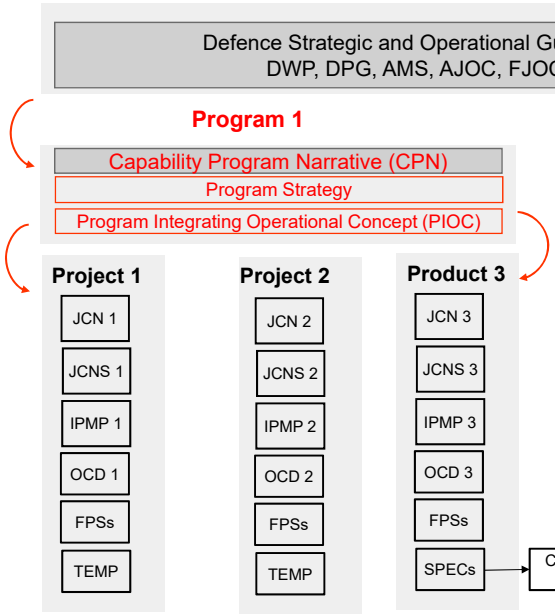
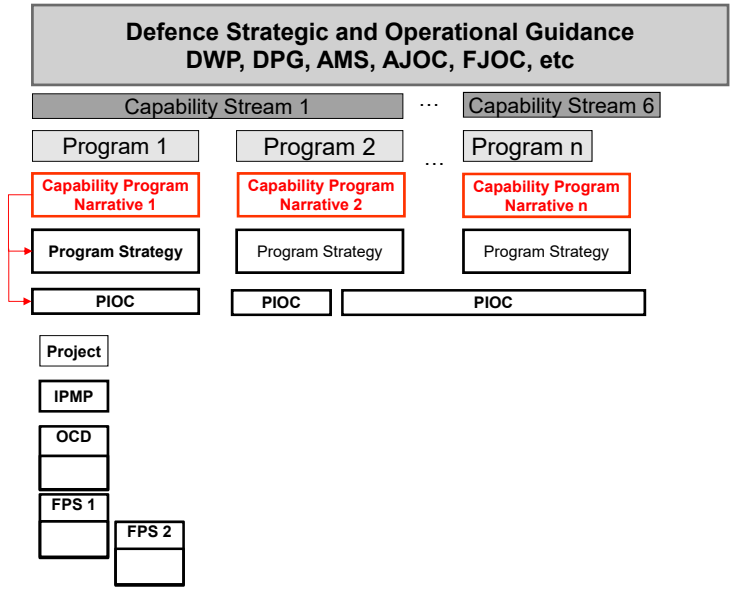
Program Refs: Aligning Project/Products

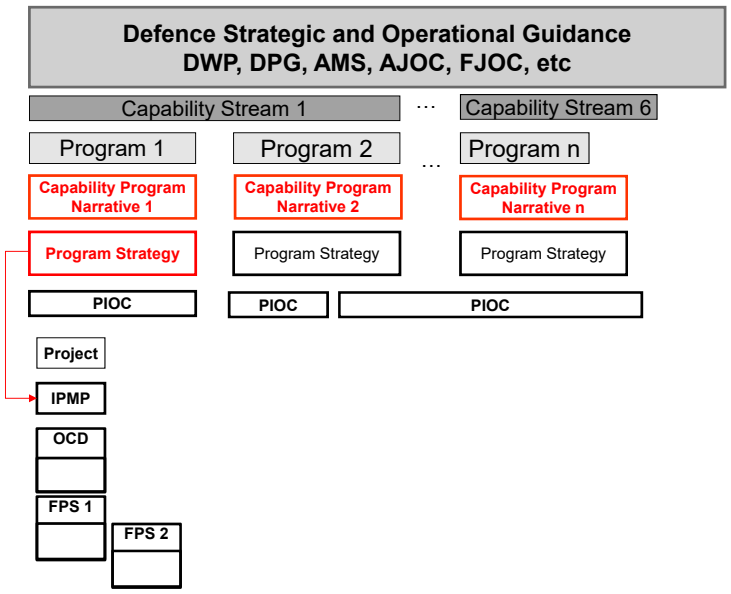


- Common 'umbrella' reference
- Aligning Project and Product requirements
- Supports integration and interoperability
- 'Town Plan'

Program References: Reducing Project/Product Documents



Program References & Project/Product Documents



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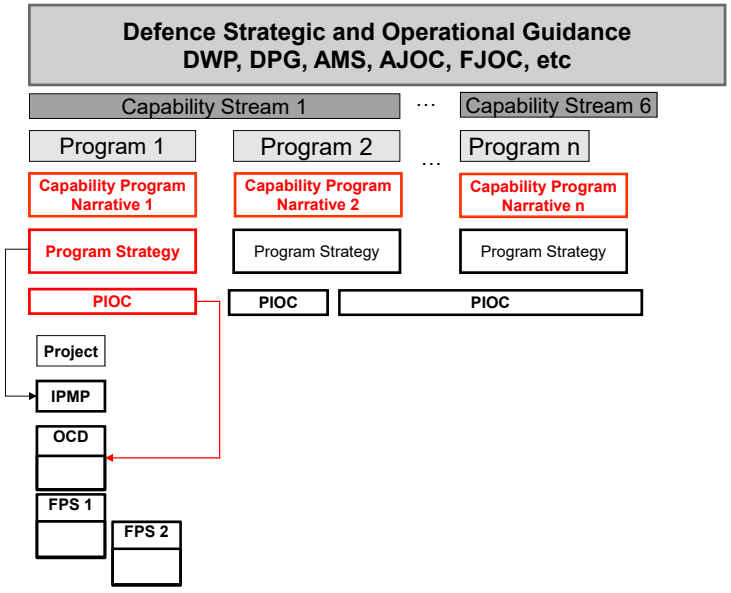

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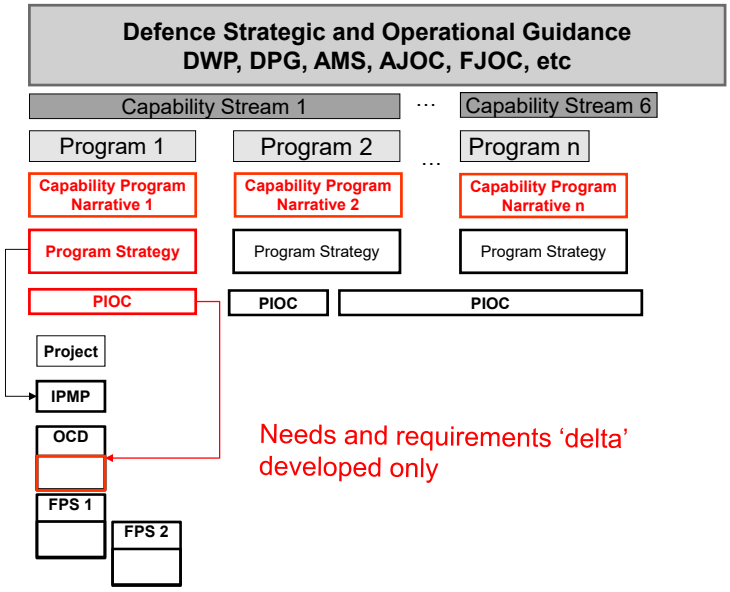

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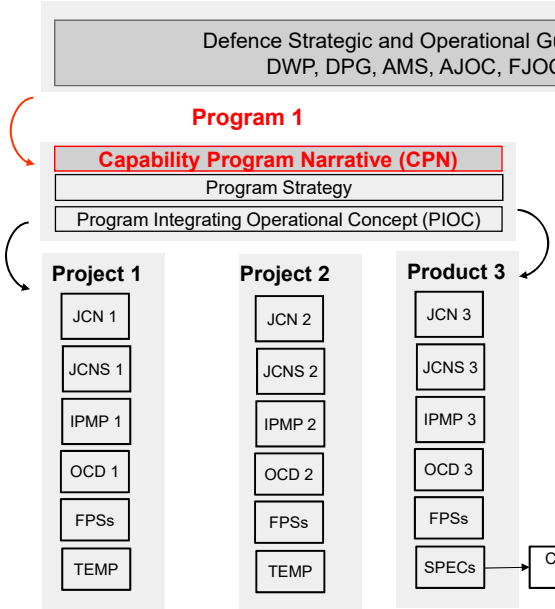
PROGRAM-REFERENCE ARTEFACTS

987

Capability Program Narrative (CPN)

Program Refs: Aligning Project/Products



- Common 'umbrella' reference
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- 'Town Plan'

989

Capability Program Narrative (CPN)

- Raised by Force Design Division
- Enduring Program-level direction including concepts and requirements.
- 'What' and 'Why'.

990

Capability Program Narrative (CPN)

- Provides the Capability Manager 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.

991

Possible IAMD CPN – Key Components

- Vision of what IAMD is and how it will operate to address the threat.
- 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.

992

Possible IAMD CPN—Why

eg: *Increasingly sophisticated air and missile threat to deployed forces:*

- *globally and within our region; and*
- *likelihood that it will increase in years ahead.*

Why: Threat

993

Possible IAMD CPN—What

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.*

What: Operational Effects

994

Possible IAMD CPN—What

eg: *Flexibility for further enhancement to handle more complex threats and to integrate new technologies as they emerge.*

What: Required Features

995

Possible IAMD CPN—What (I2)

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: better connect the communications, sensor and targeting systems of various platforms so that they can more effectively combine their capabilities, generating greater potency and lethality".

Eg: ensuring that the delivered system is able to fuse and share information to enhance the accuracy and speed of ADF's systems response to air and missile threats".

What: Integration and Interoperability

Sources:
- https://gateway.icn.org.au/project/4022/air-6500-joint-battle-management-and-integrated-air-and-missile-defence-system
- Integrated Air and Missile Defence Study: The Challenge of Integrated Force Design Air Vice-Marshal John Blackburn April 2017

996

Possible IAMD CPN—What

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).*

What: Specific Inclusions and constraints

997

Possible IAMD CPN—What

eg:

- 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
  - medium-range surface-to-air missile system

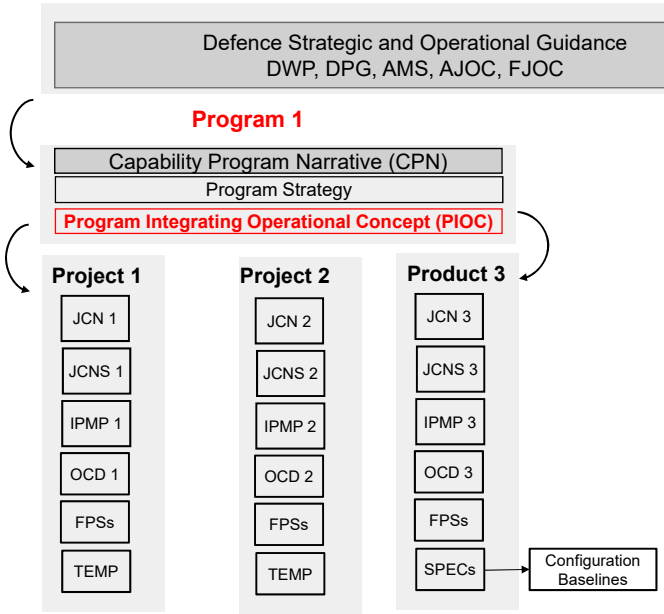
What: Actionable Deliverable Terms

998

Program Integrating Operational Concept (PIOC)

Dr Mike Ryan & Dr Shari Soutberg

Program Ref: Integration & Interoperability



1000

PIOC: Overview

- Who develops it?
  - Program Sponsor; and
  - requires endorsement from Joint Force Authority (VCDF)
- When is it developed?
  - when a Program is established and then maintained.
- Support provided by VCDF Group:
  - Joint Force Authority (JFA)
  - Force Integration Division (FID):
    - Joint Integration and Capability Assurance (JICA) and
    - C4ISR Design Authority

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PIOC: Intent

1001

- Top-down design documents on Integration & Interoperability.
- Achieve a Joint Force by Design.
- Limit 'after market' integration.
- Uniform, consistent overarching design direction to constituent systems (related Programs, Projects, & Products).
- Reduce detail in subordinate documentation.
- Identify I2 risks and define risk reduction actions.

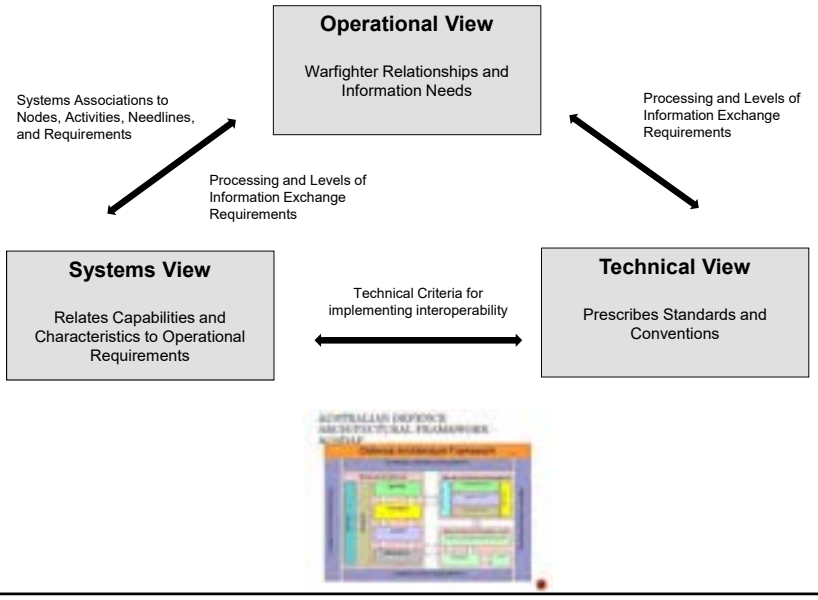
PIOC: Architecture Information

1002

http://www.defence.gov.au/casg/EquippingDefence/JCG02-JointCapabilitiesGroup

1003

PIOC: Architecture Information



1004

PIOC Possible Content: Operational

Operational view:

- mission; scenarios; policies & doctrine; needs & constraints
- Program boundary and content
- IAMD operations (scenarios): Concept of Operations (CONOPS)
- Operational roles and responsibilities
- Collaboration requirements in coalition/sovereign operations
- Operational dependencies including definition of Information Exchange Requirements (IERs)

1005

PIOC Possible Content: Traceability

- Traceability to relevant higher level guidance, for example:
  - Joint Supporting Concept.
  - Integration Operational Concept (IOC) Integrating Objectives.
  - directed I2 requirements eg Mode 5 IFF or Link 16.

1006

PIOC: Captures Detail on I2 Requirements

- General features:
  - Fully networked sensors and shooters
  - Resilient, ubiquitous, interoperable network
  - Joint priorities & formats
- Specific Requirements
  - Use of Tactical Data networks (TDL)
  - Information Integration: receiving, processing, fusing mass information from AUS & Coalition networks:
    - Satellite and UAV imagery
    - electronic and signals intelligence
    - space-based infrared systems
    - voice and data intelligence inputs

1007

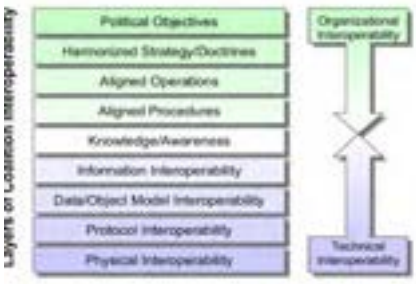
PIOC: Identifies Applicable Systems for I2

- Integration aspects:
  - extant/planned communications systems,
  - extant/planned command and control,
  - extant/planned geospatial and intelligence products
- Interoperability aspects:
  - E-7 Wedgetail,
  - Air Warfare Destroyer (Aegis),
  - SEA 5000 Future Frigate,
  - P8,
  - Triton,
  - F-35A,
  - F/A-18 Super Hornet and Growler
  - Key Allies

1008

PIOC: Specify Technical Requirements

Coalition Interoperability "Tolk" Model



Introducing a Reference Model for Measures of Merit for Coalition Interoperability, Andreas Tolk, June 2003

Open Systems Interconnection (OSI) model

Source: http://fi-ghent.fi-week.eu/fia-session-i-linked-open-data/

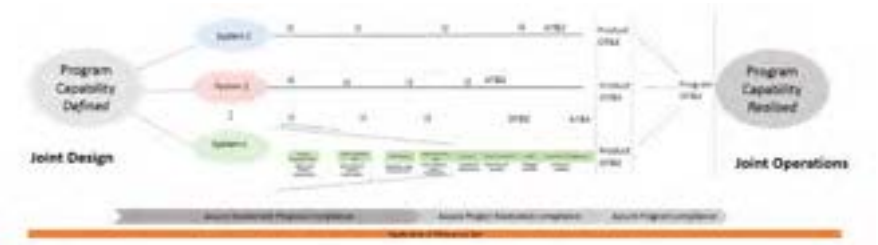
1009

PIOC: 'Umbrella' Design Document

- Provides design guidance in form of:
  - Program needs;
  - Program-level architectures:
    - derived from joint war fighting architectures; and
    - supported by C4ISR Design Authority.
  - Program-wide process and technical standards—such as Technical Data Links Interoperability (Link 11,16, 22); and
  - Joint Force requirements including US Interoperability.
- Can use Defence Architecture Frameworks.
- IAMD would consult with C4ISR Design Authority.

PIOC: Sets up Program Assurance

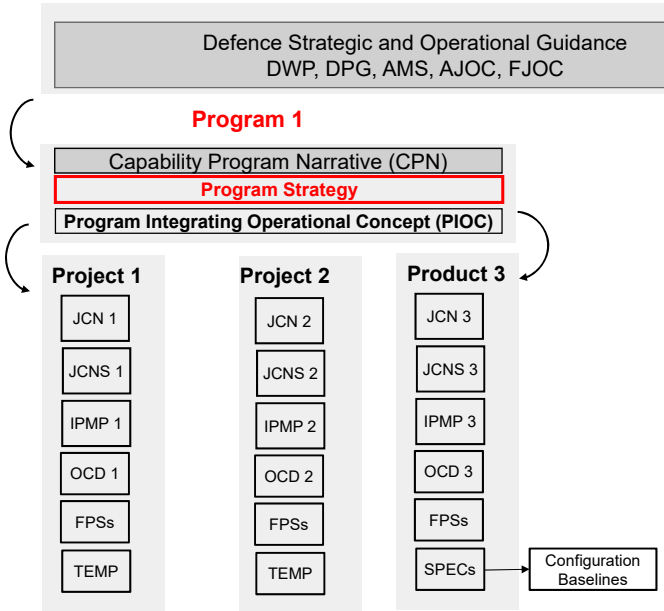
- Program T&E is achieved through coordination of T&E activities for constituent Projects and Products.



1011

Program Strategy

Program Ref: Integration & Interoperability

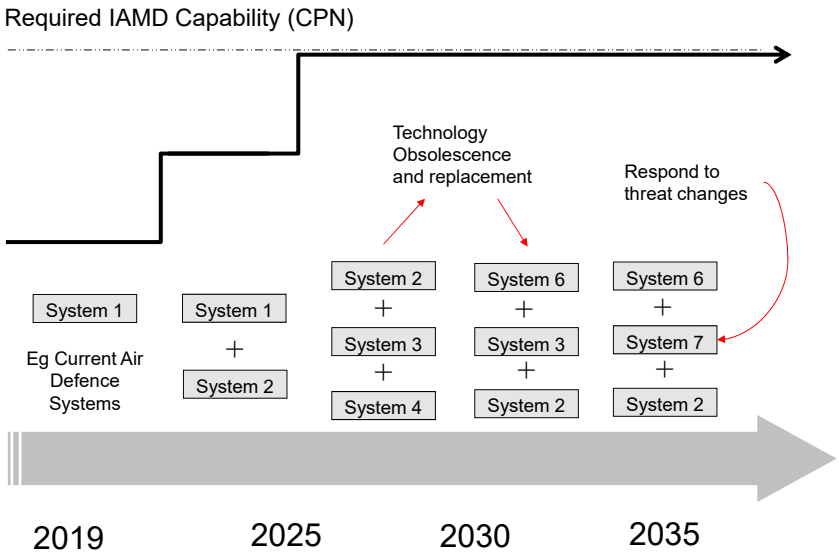


1013

Program Strategy

- Who develops it?
  - 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?
  - Ensures Program-level capability (CPN) over time.
  - Maintains pipeline of proposals/ activities to meet CPN.
  - Gaps and opportunities managed/ prioritized.

Program Strategy: Delivering CPN over Time



1015

Program Strategy

- Why is it produced?
  - defines how CPN will be achieved.
  - primary document for leading, managing and developing capabilities to satisfy Program outcomes.
  - helps Program Sponsor coordinate activities of:
    - Capability Manager,
    - Delivery Groups, and
    - Enabling Groups.
  - assists industry guidance and planning.

1016

Program Strategy

What is in the Program Strategy?

- How Program is aligned to CPN, Capability Stream requirements and Defence strategic direction.
- Integrated planning view of Projects Products incl FIC.
- How 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.

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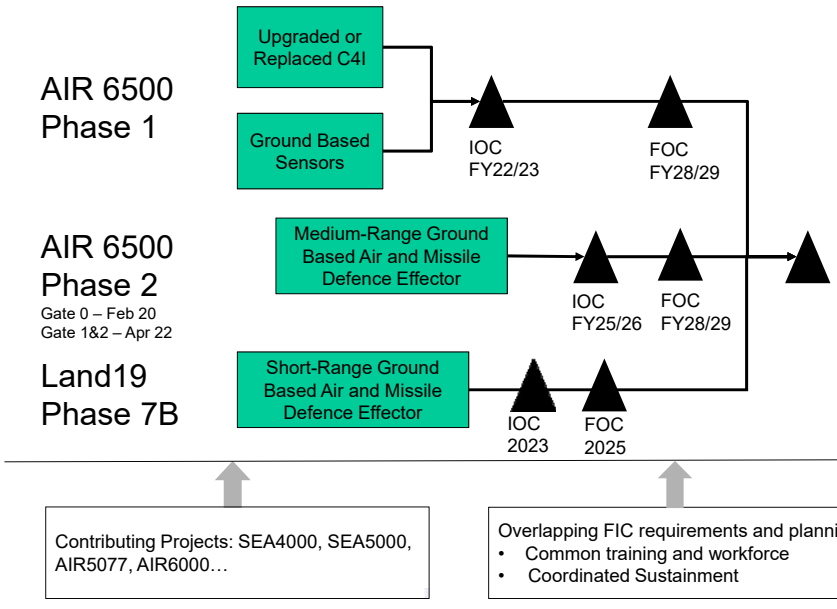
IAMD Program: Project Elements



1018

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 IAMD Program Roadmap, that is a Directive and not only a recommendation."

Reference: Williams Foundation Integrated Air and Missile Defence Study 2017

1019

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 mgt 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.
- …

Source: Defence Program Strategy Guide

1020

Program Strategy Content

- …
- 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

1021

Program Strategy Reviews

Reviews of Program Strategy:

- Program Sponsor responsible for periodic reviews of Program Strategy to identify, mitigate risk in Program.
- IC may direct that Contestability conducts a review.

1022

Program CLC Artefacts

Artefact	Description	Developed by	Authority
CPN:	Narrative which inform required capability of the subject group of capability systems	Force Design Division	Force Design Division
PIOC:	Operational and other features of the capability grouping both within the Program and relationships with other Programs	Program Sponsor	Program Sponsor Endorsed by Joint Capability Authority
Program Strategy:	Activities, management arrangements, including integrated schedule across related Projects and Products within the Program	Program Sponsor	Program Sponsor
Program Architectures:	Program features using Defence Architecture Framework (DAF) conventions	Program Sponsor/C4ISR Design Authority	Program Sponsor/C4ISR Design Authority

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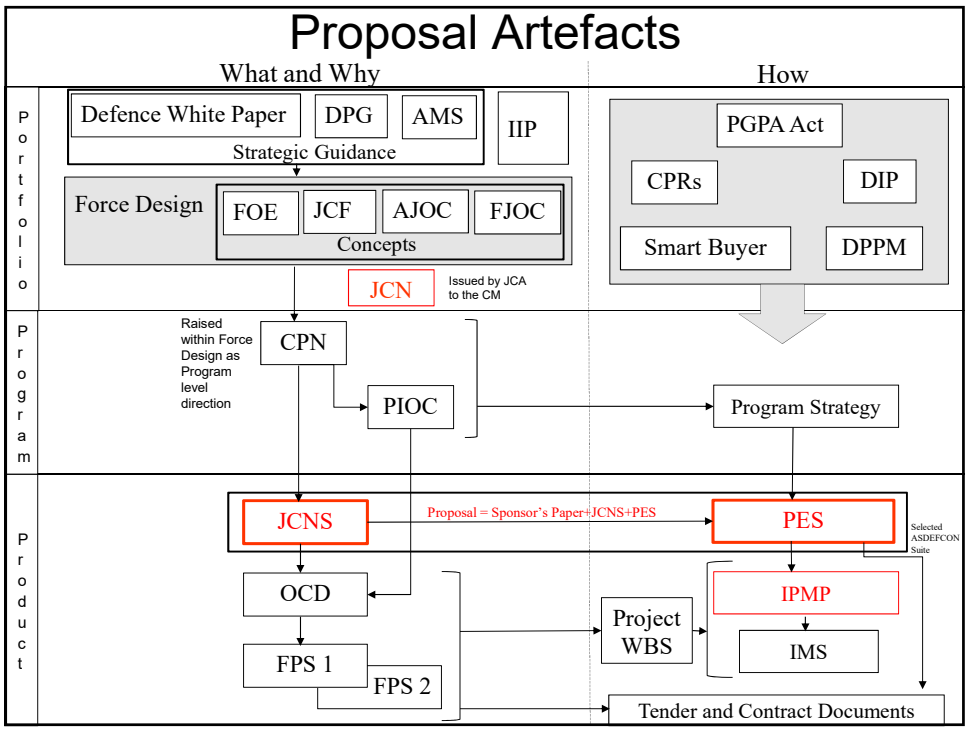
1023

PROPOSAL-LEVEL ARTEFACTS



CLC Case Study

1026

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.

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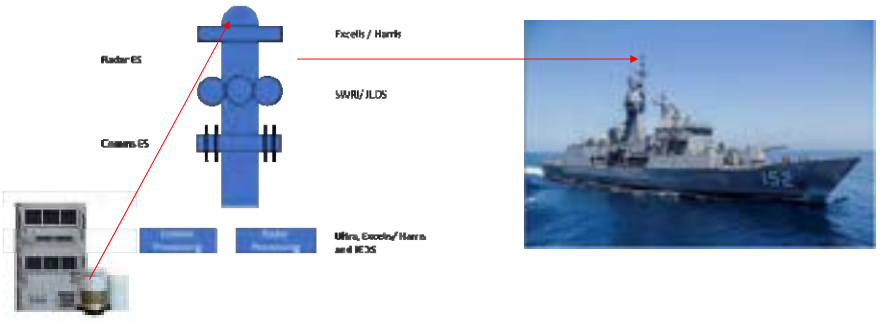
1027

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 application.
- Comprises antenna and processing equipment.
- Integrates and displays on the Combat System.

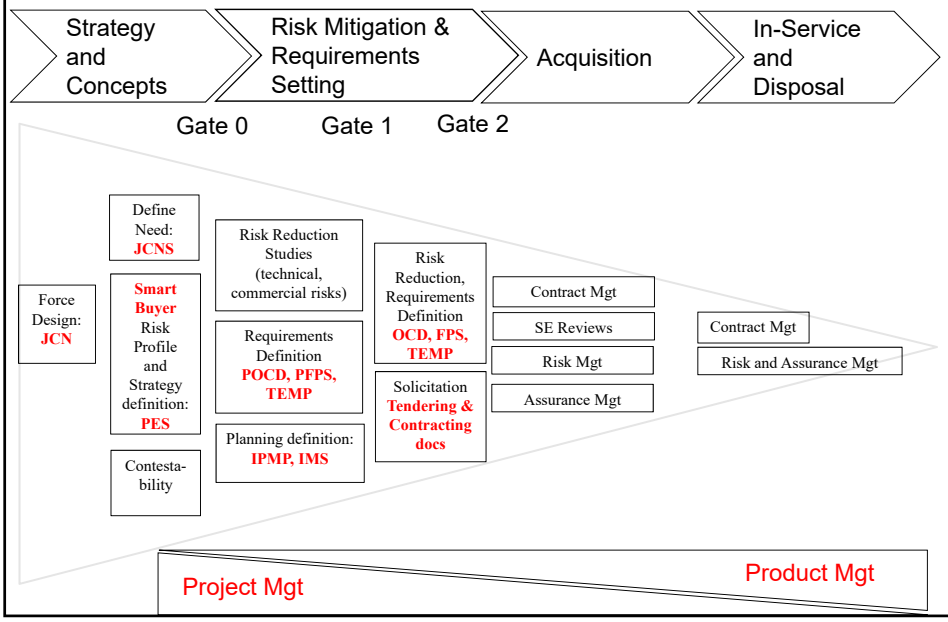


1028

SEA 1448 Ph4A Project: Key Factors

- To be installed on multiple platforms across 3 ship classes.
- Installation must be synchronised with availability of ships.
- Different installation requirements dependent on class:
  - physical installation differences; and
  - differences in Radio Frequency (RF) 'noise' situation.
- Multiple system vendors to create the system.
- Multiple installation contractors to install systems on ships.
- Time pressure to enable deployment of vessels with this capability.

Implementing the CLC—Example



1030

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.
  - Risk Management and Assurance.
- Then we will look at it in terms of artefacts and documents to be developed

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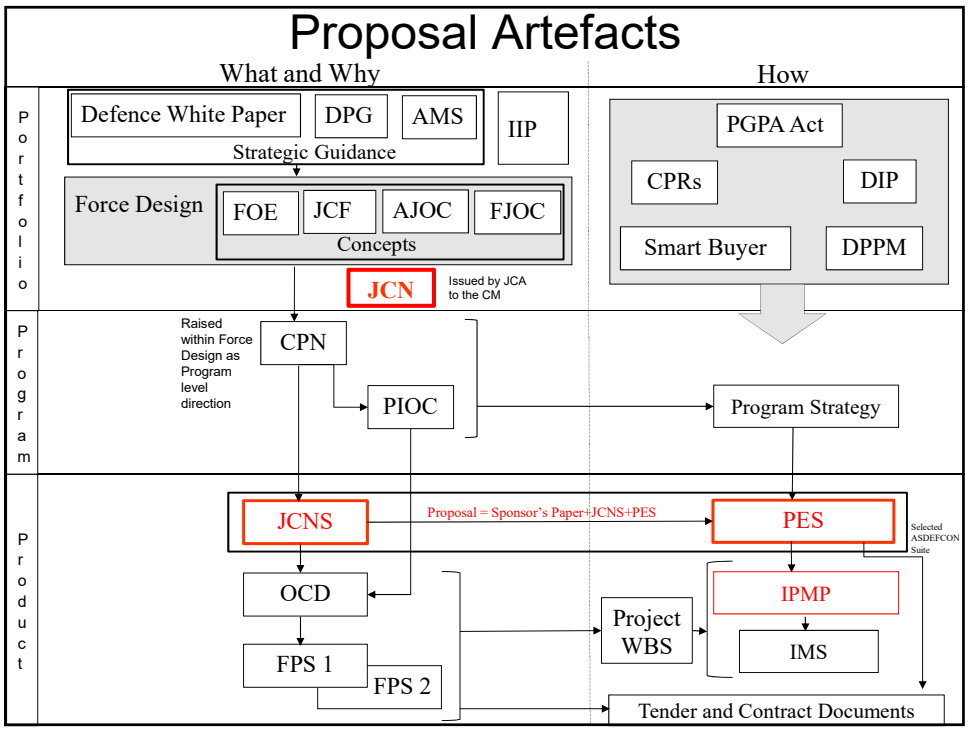
1031

Joint Capability Narrative (JCN)



1033

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.
  - Prepared as the rationale for an investment proposal.

1034

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.

1035

Identifying a Capability Gap

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

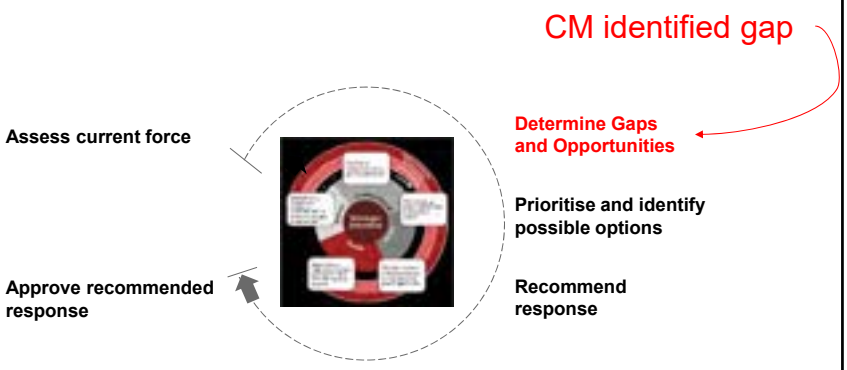
Force Design Framework (DCAP)

Gate 0 Gate 1 Gate 2

- Defence Capability Assessment Program (DCAP) produces recommended and prioritised capability investment.
- If conducted under CLC:
  - CM can indicate a capability gap; and
  - Capability Gap can have it considered as part of DCAP.

1036

ESM Example: Capability Gap



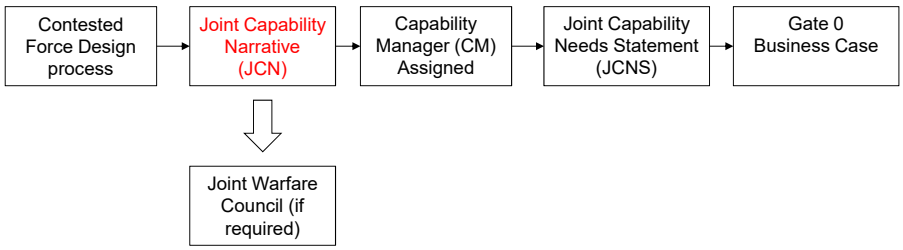
In the case of the ESM…

Navy recognised a vulnerability for their platforms.

1037

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.

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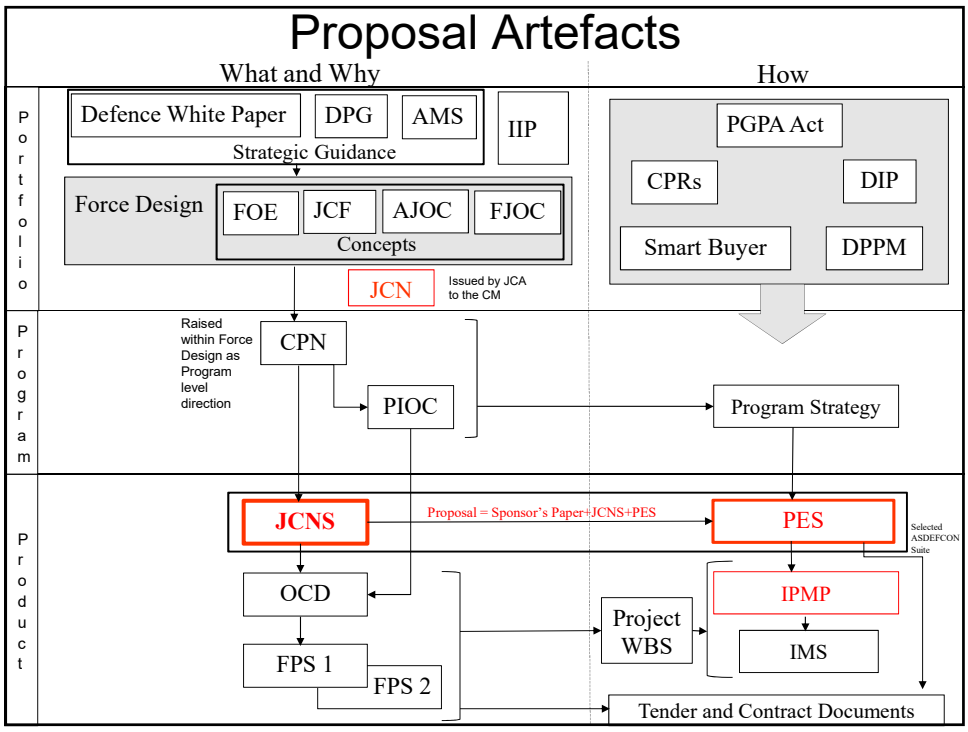
1039

Joint Capability Needs Statement (JCNS)



1041

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.
  - A key output of the Strategy and Concepts Phase.
- 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

1042

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.

- **Strategic Guidance**: RAN ships need be able carry out their mission safely and defend themselves

1043

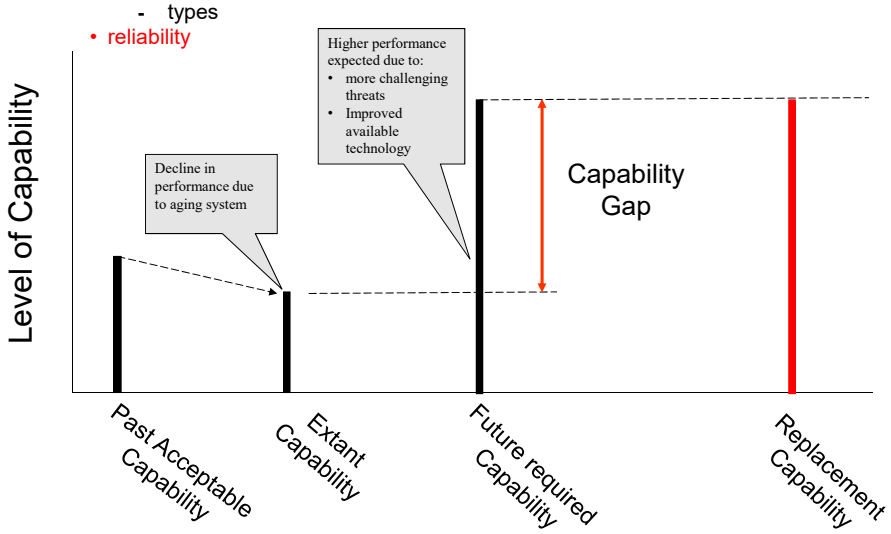
JCNS

- 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

    Source: Update Interim CLC Manual
  - …

ESM Capability Gap

Capability performance gauged on the basis of:
- ability to detect and classify radars/threats:
  - range
  - types
- reliability



1045

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

    Source: Update Interim CLC Manual
  - …

- **Capability gap/need**: system that can detect and classify contemporary radars and operate with required reliability
- **Action**: Replace existing ESM system
- **Options**:
  - augment current system with extra functionality
  - existing whole system product with lower performance
  - integrated solution created for RAN
- **Solution**: Integrated solution that fully meets capability need

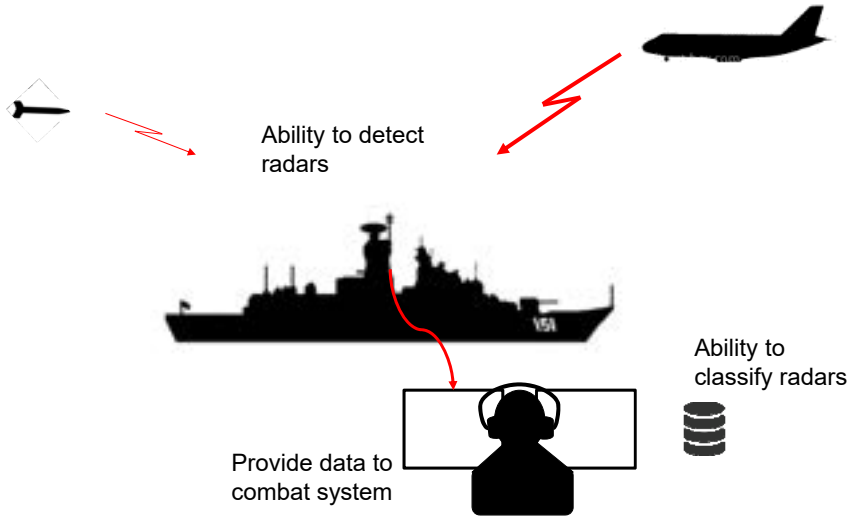
1046

JCNS: Hierarchy of objectives

- What is in it?
  - …
  - system need described as a hierarchical structure of objectives including FIC to address the gaps and opportunities posed in the JCN;

1047

JCNS: Hierarchy of Objectives



1048

JCNS: Hierarchy of objectives

- What is in it?
  - …
  - system need described as a hierarchical structure of objectives including FIC to address the gaps and opportunities posed in the JCN;

Hierarchy (priority) of capability objectives:

- ability to detect and classify radars;
- ability to record the technical and operational data of those radars,
- ability to provide data to the combat system for tactical purposes, and
- design and support arrangements to provide very high reliability

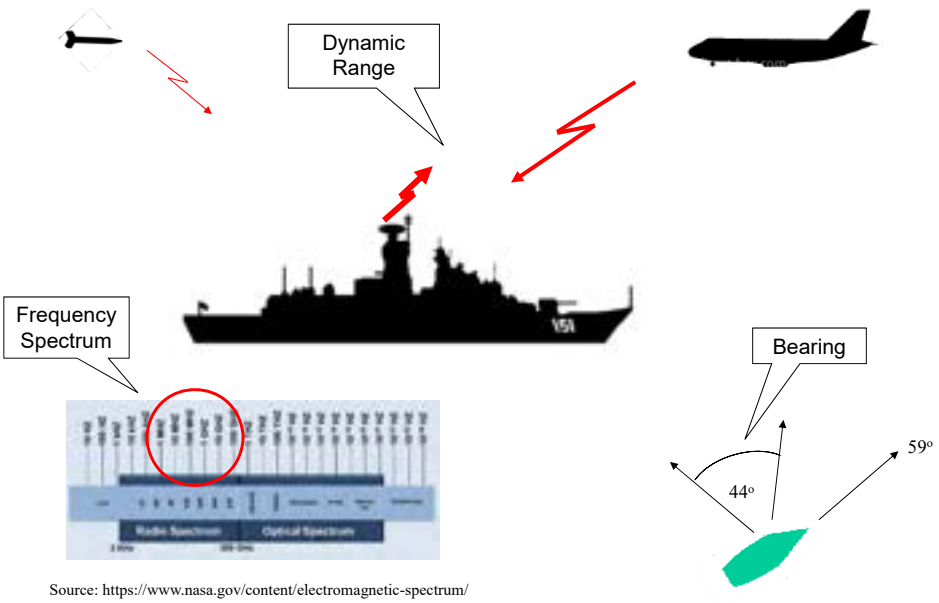
1049

JCNS: System Characteristics

- What is in it?
  - …
  - System characteristics;

1050

JCNS: System Characteristics



Source: https://www.nasa.gov/content/electromagnetic-spectrum/

1051

JCNS: System Characteristics

- What is in it?
  - …
  - system characteristics;

System characteristics:
- frequency spectrum of interest
- dynamic range (low to high power)
- ability to discriminate signal of interest from other EM radiation
- precision of angle of arrival for bearings to locate the transmitter
- number of receivers needed for surveillance of the necessary spectrum

1052

JCNS: Joint Capability & FIC Integration

- What is in it?
  - …
  - contribution to joint capability with FIC integration issues highlighted and interdependencies defined;

Source: Update Interim CLC Manual

Joint Capability & FIC integration :
- use a common system on multiple classes: ANZAC, AWD, LHD
- interface commonality especially with combat management systems
- efficiencies in training, maintenance and spares etc.

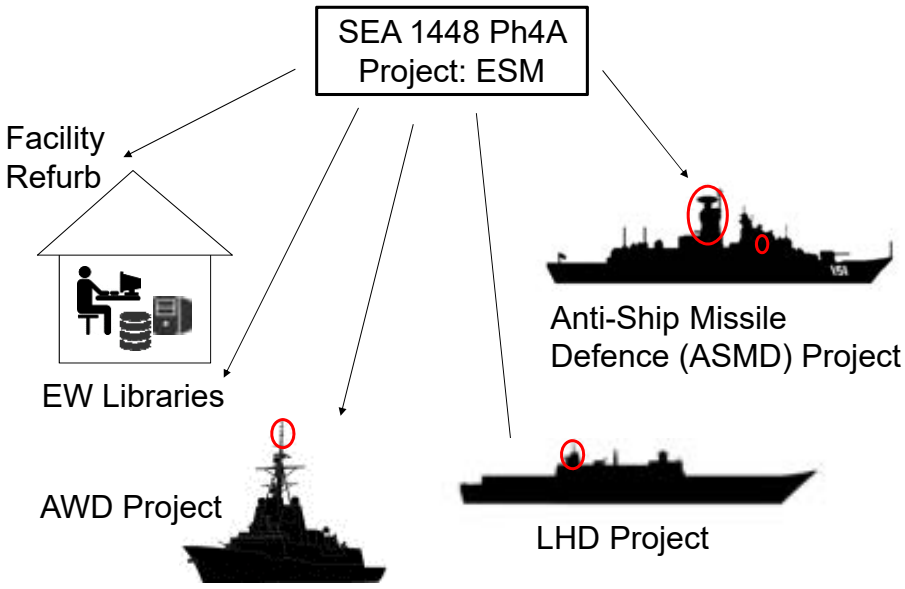
1053

JCNS: Relationship with other Programs

- What is in it?
  - …
  - Relationship with other Programs;

1054

JCNS: Relationship with other Programs



1055

JCNS: Relationship with other Programs

- What is in it?
  - …
  - Relationship with other Programs ;

Relationship with other Programs :

- facility development (eg JP 500 EW – EW Operations Support Facility)
- development of EW libraries
- major ship programs eg ASMD

Source: Update Interim CLC Manual

1056

JCNS: Relationship with other Programs

- What is in it?
  - …
  - describes CM's plan to meet the problem posed by the JCN;

Capability Manager's Plan:

- Establish Stand-alone Project for common-use system
- Leverage and align with related efforts
- Align with docking cycle for ASMD upgrade
- Achieve commonality across ship classes

Source: Update Interim CLC Manual

1057

JCNS: Review

- Who reviews and/or approves the JCNS?
  - Contestability Division reviews JCNS to test if:
    - aligns with Strategic Guidance
    - aligns with resourcing provisions; and
    - can be delivered within resourcing direction.
  - Presented at Gate 0 for approval by IC.
  - Defence Committee (DC) reviews JCNS only for:
    - most complex, politically sensitive, novel, high risk
    - where diverges from established policy
    - needs to endorse further development of selected options.

Source: Update Interim CLC Manual

1058

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.

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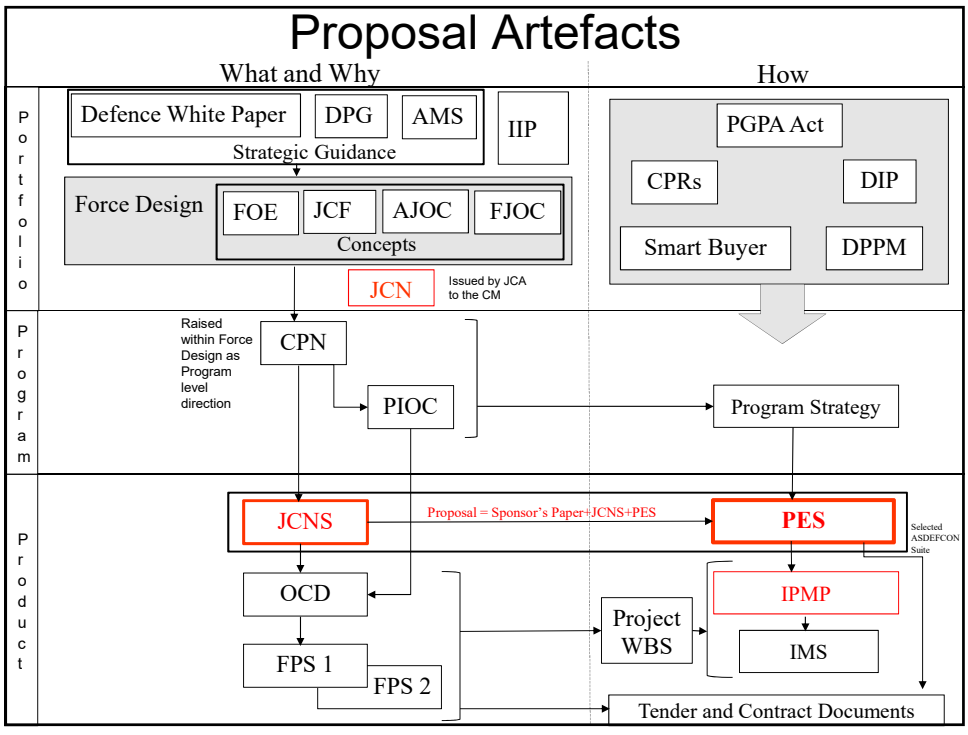
1059

Project Execution Strategy (PES)



1061

Strategy and Concepts Phase: Contestability

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

Gate 0 Gate 1 Gate 2

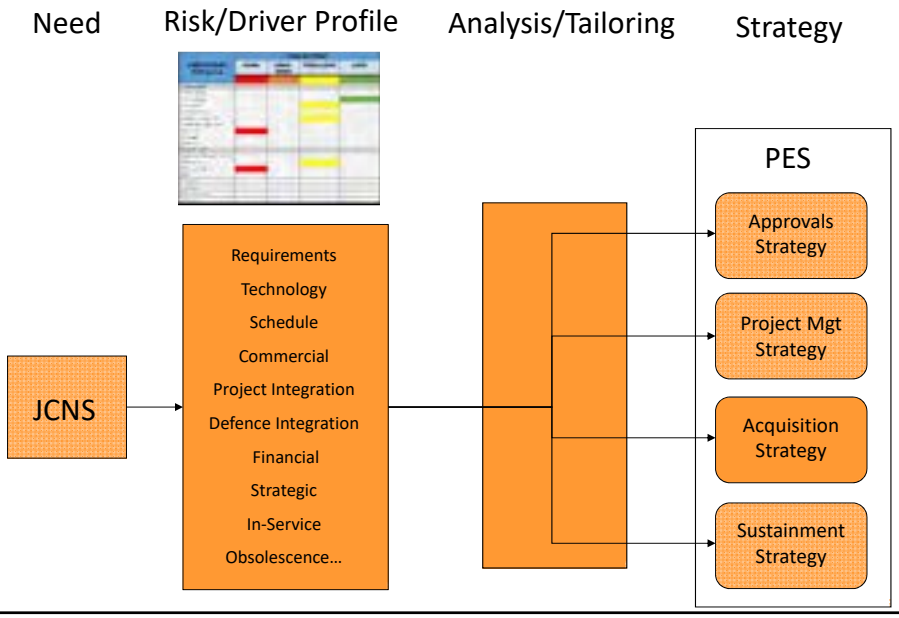
Force Design Framework (DCAP)

- 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

Smart Buyer Framework



1063

PES Overview

- High level, risk-based tailored strategy
- Four strategies developed using Smart Buyer Decision Making Framework:
  - Approval Strategy.
  - Project Management Strategy.
  - Acquisition Strategy.
  - Sustainment Strategy.

1064

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,
  - remains relevant until project closure,
  - may be updated as Project progresses, and
  - presented in conjunction with Business Case/Proposal and JCNS.

1065

PES – Key Points

- What is it's purpose?
  - high-level, tailored statement of strategy alternatives and recommended implementation strategy approach for realising capability need;
  - supports IC decision making at Gates 0, 1 and 2;
  - sets broad direction for the entire asset lifecycle:
    - whole Project and Product;
    - Total Costs of Ownership (TCO); and
    - all FIC.
  - …

1066

PES Development

- What is it's purpose?
  - …
  - document key Project factors, Risks and Drivers,
  - proposes 'information gathering' activities (risk reduction and requirements setting activities),
  - common reference for FIC providers and FIC integration.
  - identifies necessary resources and schedule, and
  - shapes subordinate plans including Integrated Project Management Plan (IPMP).

1067

PES: 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.

1068

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.

1069

PES: Considerations

- To develop the PES you need to address ALL factors that affect implementation including:
  - Operational Need.
  - Technical requirements, constraints.
  - Commercial factors including industry structure, required competition (for VFM), company capabilities.
  - Financial arrangements.
  - Project Management possibilities and constraints:
    - types of PM approaches,
    - scheduling and resourcing needs, and
    - resourcing.
  - Transition into Service.
  - Support/Sustainment factors.

1070

PES: Considerations

- There is no template for your Project.
- You need to be able to propose and argue the best BALANCE across these considerations to realise the capability need.
- PES document structure will change but the elements of a business argument essentially remain the same.
- The technical complexity of Defence projects requires that IPM, Project Sponsor must understand the technical factors.

1071

PES: Understand the Solution Context

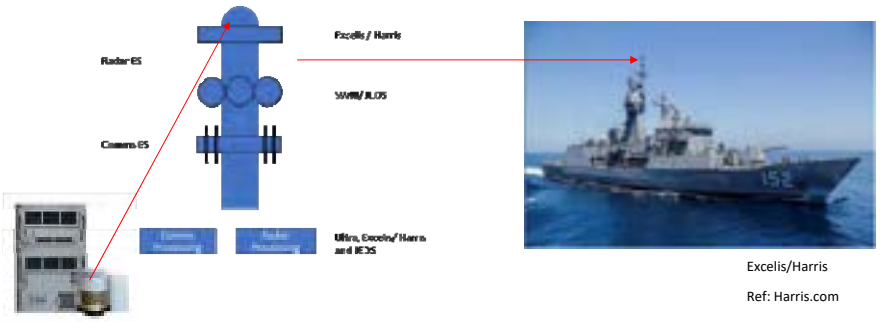
For the ESM case study need to understand:

- Operational factors, for example:
  - Operational imperative to deliver capability.
  - Availability of platforms.
- Technical factors, for example:
  - Solution will be based on a number of subsystems.
  - Technical risks.
- Support factors, for example :
  - Sovereign support capability.
  - Opportunities for efficiencies.
- Commercial and Project Management factors, for example :
  - Ability to leverage off other acquisition activities.

1072

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.



Excelis/Harris

Ref: Harris.com

1073

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).

1074

Case Study: ESM Risks and Drivers

- 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.

1075

Case Study: ESM Risks and Drivers

- Commercial:
  - Multiple interdependent vendors (Saab, Excelis, BAE, CEA).
  - Need for continuity of vendor workforce through the different phases of the Defence approval lifecycle.
  - Price and Schedule unclear.
- T&E:
  - Opportunity: ANZAC (HMAS Perth) at Pacific Missile Range Facility (PMRF) for missile firings.

1076

Case Study: Risk Reduction Activities

Targeted and funded risk reduction activities:

Excelis/Harris

Ref: Harris.com

- Technical:
  - Measurement of RF Environment:
    - measurements:
      - signal levels/ field density of the top-side of the vessel (top of ANZAC mast)
      - 'live' trials (PMRF) feasibility eg wrt other emitters
    - understand the ship's RF environment
      - secure key data for design and placement of ES
      - define filtering, blanking, shielding (Mexican hat)
  - …

1077

Case Study: Risk Reduction Activities

Targeted and funded risk reduction activities:

- Technical:
  - …
  - Ship Survey:
    - Practical installation eg measuring cable runs.
    - Installation of system elements below deck eg will the equipment racks fit in the spaces provided.
    - Use of pre-existing 'services' eg power.
    - Will it fit in space and weight provisions (budget).

Excelis/Harris

Ref: Harris.com

1078

Case Study: Risk Reduction Activities

Targeted and funded risk reduction activities:

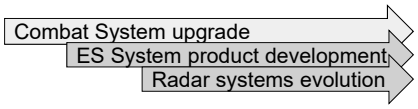
- Technical:
  - …
  - Requirements validation workshops:
    - Confirming feasibility of FPS requirements.
    - Each vendor reviewed FPS.
    - Discussed and resolved issues eg interfaces and integration of systems.

1079

Case Study: Risk Reduction Activities

Targeted and funded risk reduction activities:

- Technical:
  - …
  - Product Maturity / System development timeline.
    - Product vendors continually upgrade their product lines:
      - Saab upgrading 9LV combat system.
      - Excelis upgrading ES system product.
    - Vendors contracted to work together to understand implications of each development.
    - System software and hardware upgrades analysed to ensure synchronized outcomes at the right time.

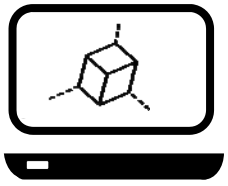


1080

Case Study: Risk Reduction Activities

Targeted and funded risk reduction activities:

- Technical:
  - Combat System Integration workshops.
    - Key vendors (Saab, Excelis, CEA) exchanged hardware and software models of their systems to develop an integrated solution.



1081

Case Study: Risk Reduction Activities

Targeted and funded risk reduction activities:

- Implementation:

Docking for ASMD upgrade

Delivery of ES Systems

1082

Case Study: Risk Reduction Activities

Targeted and funded risk reduction activities:

- Implementation:
  - Factors:
    - 10 systems: 8 platforms and two ashore.
    - ES systems delivered one at a time.
    - Installation on platform took a matter of weeks.
  - Opportunities:
    - Remove and install equipment.
    - Fitted For But Not With (FFBNW).
    - System Integration Lab.
    - Continuity of Workforce.

1083

Case Study: Risk Reduction Activities

Targeted and funded risk reduction activities:

- Implementation:

Docking for ASMD upgrade

eg 1QTR 2010 3QTR 2010 2QTR 2012 … 3QTR 2017

- FFBNW:
  - Remove equipment
  - Run cables
  - Prepare installation spaces

Delivery of ES Systems

2011 2017

1084

Case Study: Risk Reduction Activities

Targeted and funded risk reduction activities:

- Implementation:

Docking for ASMD upgrade

eg 1QTR 2010 3QTR 2010 2QTR 2012 … 3QTR 2017

Establish System Integration Lab (SIL)

Delivery of ES Systems

2011 2017

1085

Case Study: Risk Reduction Activities

Targeted and funded risk reduction activities:

- Implementation:

Docking for ASMD upgrade

Establish System Integration Lab (SIL)

- system integration and interface 'proving' prior to installation
- system software development (test new releases of hardware and software)
- operator and command team training

Delivery of ES Systems

1086

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 subordinate plans eg Integrated Project Management Plan (IPMP) and Integrated Master Schedule (IMS).

1087

1. Project Summary

- Relationships with other Programs, Projects and Products.
- Life of Type: How long capability is expected to be in service
- High-level resourcing and years of expenditure.
- Key schedule dates:
  - Eg approval schedule re Gates
  - Introduction into service timeline (IOC and FOC).
- Governance

1088

2. Project Factors

- Project Risk and Drivers profile determined using Smart Buyer Decision Making Framework and categories.
- PES includes potential actions in response to key risk or drivers.

1089

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).
  - Budget limitations: risk reduction, acquisition, support.
  - Industry structure and competitive environment.
  - Workforce: Defence and Industry.
  - Time constraints: eg Planned Withdrawal Date (PWD) of current assets.
  - Costs of tendering for industry and Commonwealth.
  - Extant source selection outcomes for similar systems.
  - Sovereign capability requirements.

1090

3. Acquisition Strategy

- PES includes assessment of 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.

1091

Case Study: ESM Acquisition Strategy

- Procurement method:
  - Options: open or limited tender.
  - Method adopted:
    - AWD Project – Open Tender (5 tender responses) .
    - SEA 1448: Limited tender:
      - leveraging AWD competition outcomes; and
      - differences in requirements eg interfaces, combat system, racks.

1092

Case Study: ESM Acquisition Strategy

- Approach to Market:
  - Options: RFT, RFP, RFQ, competitive evaluation, other iterative engagement process.
  - Approach adopted:
    - AWD used RFT.
    - SEA 1448 limited RFT:
      - previously used ITR, RFQ; and
      - had to adjust based on related procurement.

1093

Case Study: ESM Acquisition Strategy

- Project Delivery Model:
  - Prime System Integrator (PSI): Commonwealth (MEW SPO):
    - Commonwealth acquires systems.
    - Systems provided as GFE to ship installer.
    - Test in System Integration Lab before installation.
  - System and Installation Contractors: CoA contracted:
    - Prime contract with Excelis who in turn subcontracted, JEDS, SWRI, Ultra Electronics.
    - SAAB & BAE for system design & installation.
    - CSC for simulators for the LBTS.
    - CEA for radar blanking interfaces.

1094

Case Study: ESM Acquisition Strategy

- Contracting Template:
  - ASDEFCON Complex:
    - plus some elements (including DIDs) from Strategic Materiel.
  - No FMS needed in this case – commercial buy OK.

1095

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.

1096

ESM example: Sustainment Strategy

- Prime support 'agent': 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—that is, 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.

1097

5. Approvals Strategy

- Risk-Based Approach to Defence Investment Approvals Framework considers four categories of risk:
  - Finance.
  - Requirements.
  - Technical and Integration.
  - Industrial and Strategic.
- 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.

1098

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.

1099

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.

1100

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:
  - several system vendors;
  - several installation-related vendors; and
  - several FIC providers and enablers.
- IPMT composition eg structural, RF, SW integration expertise.
- Significant Risk Reduction activities.

Dr Mike Ryan & Dr Shari Soutberg

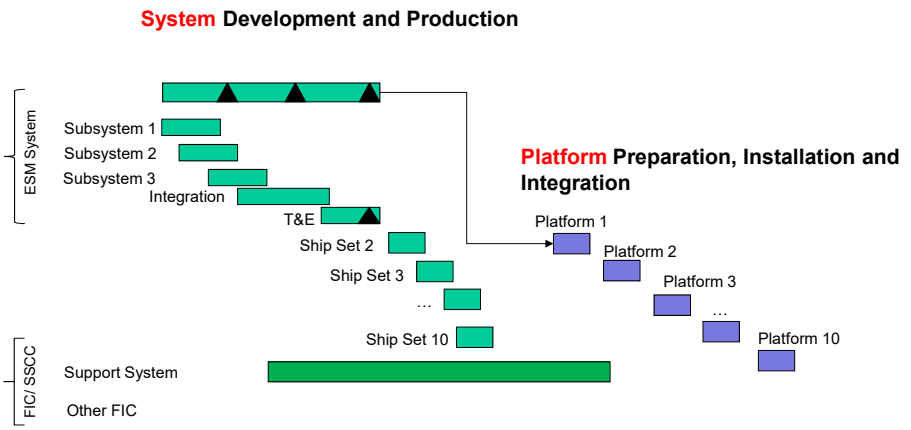
1101

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.

1102

Case Study: PM for SEA 1448 Ph4A



1103

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.

1104

Case Study: Engineering Planning

- Systems Engineering Plan:
  - Requirements: different requirements across different classes needed to be defined and reconciled.
  - Analysis planning: technical issues across different engineering disciplines eg physical mounting of antenna on mast, radio frequency (RF) interference with other emitters.
  - Integration planning:
    - ES system integration.
    - Shipboard integration (eg power, combat system).
    - Staged to fit platform availability .

1105

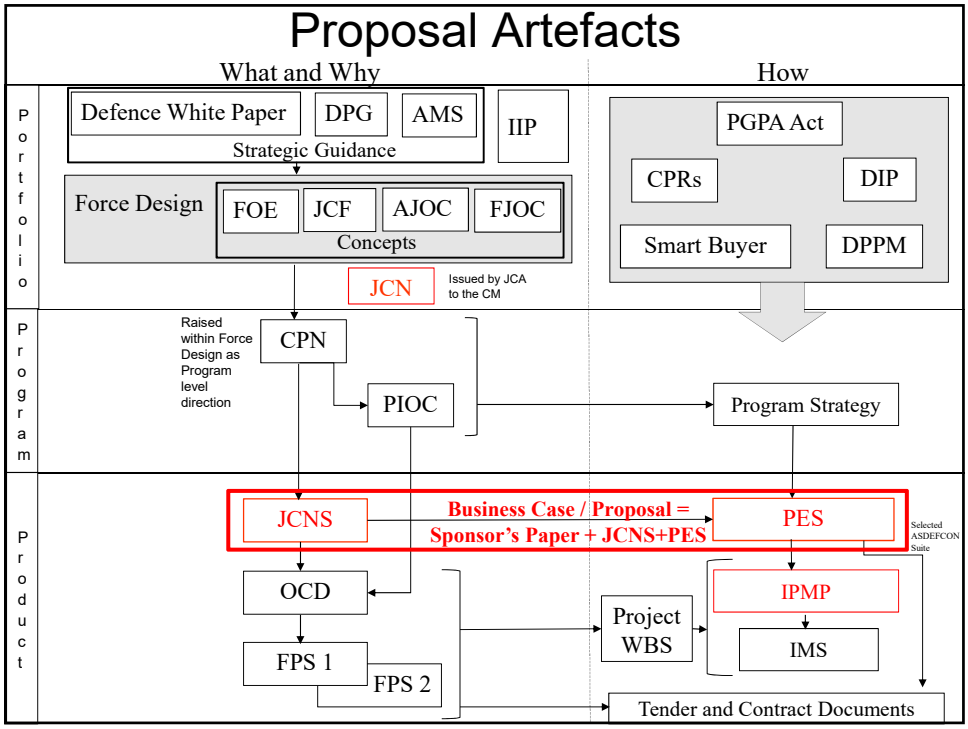
Case Study: Engineering Planning

V&V and T&E critical to delivering a fully operational system:

- Accurate, common and agreed documentation essential: multiple system development activities, integration and multiple stakeholders.
- Adhere to documented needs and requirements is essential:
  - *verified* against the documentation produced; and
  - *validated* against the original needs, goals and objectives.
- T&E effort supporting V&V:
  - needs to be carefully planned and implemented;
  - incremental approach building up 'objective quality evidence'; and
  - leverage/re-use OQE wherever possible.

1106

Gate Business Case/ Proposal



1108

CLC Business Case/ Proposal

- *"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

- Key features:
  - How capability options fit within both the Program and the Capability Stream.
  - Strategic logic of options and risks if capability not developed.
  - Ensures future requirements do not extend beyond strategic need.

1109

Better Business Case (BBC)

- Building Better Business Case:
  - NZ Treasury website (http://www.treasury.govt.nz).
- Systematic method to develop business cases for any program or project.
- Key aspects of a robust investment proposal are explicitly and systematically addressed through five distinc
- Does not matter if Defence document guidance varies: the five cases remain valid.

Source: http://www.treasury.govt.nz/statesector/investmentmanagement/plan/bbc/framework

1110

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.

1111

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.

1112

Case Study: Business Cases

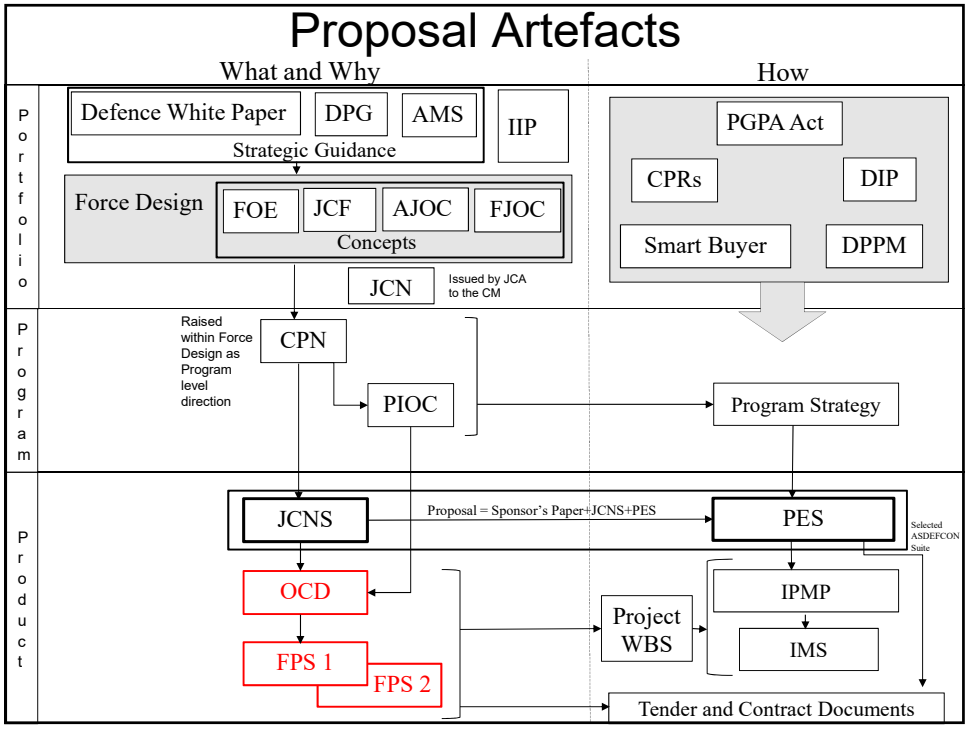
- Financial Case:
  - Resourcing provisions are addressed including:
  - costings defined:
    - estimates for risk reduction;
    - outcomes of risk reduction effort enabled better quotes (uncertainty increases costs);
    - estimates for acquisition and support; and
    - phasings and currencies defined.
  - workforce requirements and timings defined;
  - savings achieved by reducing support costs eg training, maintenance.

1113

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



1115

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.

1116

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.

1117

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.

1118

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.

1119

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.

1120

Better Business Case Framework

1121

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

1122

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

1123

Strategic Case: Aligned to Strategy

- Strategic Case:
  - argument that proposal aligns with strategic (capability and business) intent and is consistent with priorities.
  - includes description of strategic risks, issues, and constraints relevant to the proposal.
  - Satisfied by the JCNS.

Source: Defence VCDF website

1124

Economic Case: Value Proposition

- Economic Case:
  - argument on the method, considerations, and rationale used to select the options.
  - value proposition for proposed investment is sound eg
    - spend $10m to protect $1bn
    - need to be able to use the asset in necessary environments ie can't be constrained
    - standardised ES system across fleet economies of scale for:
      - acquisitions,
      - training, and
      - support.
- Supported by JCNS and PES.

Source: Defence VCDF website

1125

Financial Case: Resourcing

- 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; and
  - supported by PES.

Source: Defence VCDF website

1126

Commercial Case: Value for Money

- Commercial:
  - argue that base system is sufficiently similar to AWD ES system so that can leverage off other competitions (RFTs) and contracts to reduce cost of tendering
  - installation through ANZAC Alliance using existing contracts with BAE (installation) and SAAB (combat system integration)
  - Captured in PES

Source: Defence VCDF website

1127

Management Case: Efficient and Effective

- Management Cases are:
  - Addressed through management arrangements:
    - 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'.
  - Captured in the PES.

Source: Defence VCDF website

1128

Integrated Project Management Plan (IPMP)

1129

Integrated Project Management Plan

- Activities, roles and responsibilities, resources needed to deliver strategy.
- Demonstrates that:
  - strategy can be implemented within budget, schedule, quality and risk; and
  - risks are manageable and acceptable.
- Includes the Integrated Master Schedule (IMS):
  - major management control/decision points (i.e. stages);
  - major products and outcomes for each stage;
  - activities and resources required; and
  - sequencing and dependencies.

Source: Interim Capability Life Cycle Manual

1130

IPMP – Key Points

- Provides basis for subordinate plans eg Systems Engineering Management Plan (SEMP).
- All FIC activities, deliverables and dependencies.
- Basis for each FIC provider to report progress.
- Common reference (enabling shared understanding and coordinated realisation) by:
  - Sponsor.
  - FIC Providers.
  - CASG Line Management.
  - Project Office staff.

Source: IPMP Guide

1131

IPMP: Example Roles and Responsibilities

- Navy:
  - Provide x platforms on an agreed timeline.
  - Provide y crews for training.
  - Other sea assets for test program eg other vessels to test ES system performance.
- DSTG:
  - Provide advice on technology by a certain date.
  - Help develop the test program and analyse the results
- Airforce to provide test assets for sea trials.
- Joint Organisations (JEWOSU): provide test libraries and operational libraries.
- Regulators including seaworthiness, training.

Source: IPMP Guide

1132

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

…

Source: IPMP Template

1133

IPMP Structure

- …
- Annex A Project Management Planning Guidance
- Annex B Engineering Planning Guidance
- Annex C Sustainment Planning Guidance
- Annex D Commercial Planning Guidance
- Annex E Acceptance in Operational Service Planning Guidance
- Annex F Project Office Management

Source: IPMP Template

1134

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

1135

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

1136

Section 3. IPMP Maintenance

- Identify the revision expectations for the IPMP eg following key milestones eg following solicitation outcomes.

Source: IPMP Template

1137

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

1138

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

1139

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

1140

ESM Example: PM Planning Guidance

- Way in which escalation will be managed eg through the Project Board.
- Management of IPMT:
  - frequency and place of meetings;
  - telecons (eg weekly telecons with US vendor); and
  - reporting requirements eg contractually required monthly reporting by vendors including invoicing status etc.

Source: IPMP Template

1141

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

1142

ESM Example: Eng Planning Guidance

- How the engineering efforts will be sequenced and integrated including:
  - system review activities;
  - baseline management (functional, acquisition, product baselines); and
  - configuration management.
- Technical 'protocols' and processes on engineering matters:
  - Level 1 and Level 2 Engineering Change Proposals requiring different obligations on advice.
  - Role of Commonwealth undertaking Judgements of Configuration (JOS).
  - Role of Regulators to approve with respect to performance and requirements including safety.

Source: IPMP Template

1143

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

1144

ESM Example: Sustainment Planning

- Defining the division and levels of maintenance on board and ashore and by whom it will be done:
  - organic, and
  - contracted.
- Establishing the Contractor Managed Commonwealth Asset (CMCA) eg warehousing and support agent (JEDS).
- Establishing the operator and maintainer training.

Source: IPMP Template

1145

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

1146

ESM Example: Commercial Planning

- How to conduct the tendering process including tender evaluation.
- How to implement the contractual arrangements with multiple vendors for systems and installation and integration.

Source: IPMP Template

Annex E: Acceptance into Operational Service Planning Guidance

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- 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

ESM Example: Acceptance into Operational Service Planning Guidance

1148

- Identify and plan elements needed to develop the Seaworthiness Case.
- Identifying artefacts and activities needed to present to Chief of Navy eg:
  - all the evidence of acceptability,
  - evidence that crews are available, and
  - support funds are available through a PDA/MSA.

Source: IPMP Template

1149

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

1150

ESM Example: Project Office Management

- How many people are needed in the Project Office eg AFS, APS, contractor.
- Location and required facilities for Project.
- Security arrangements and implementation timeline.
- ICT requirements and how they will be implemented.

Source: IPMP Template

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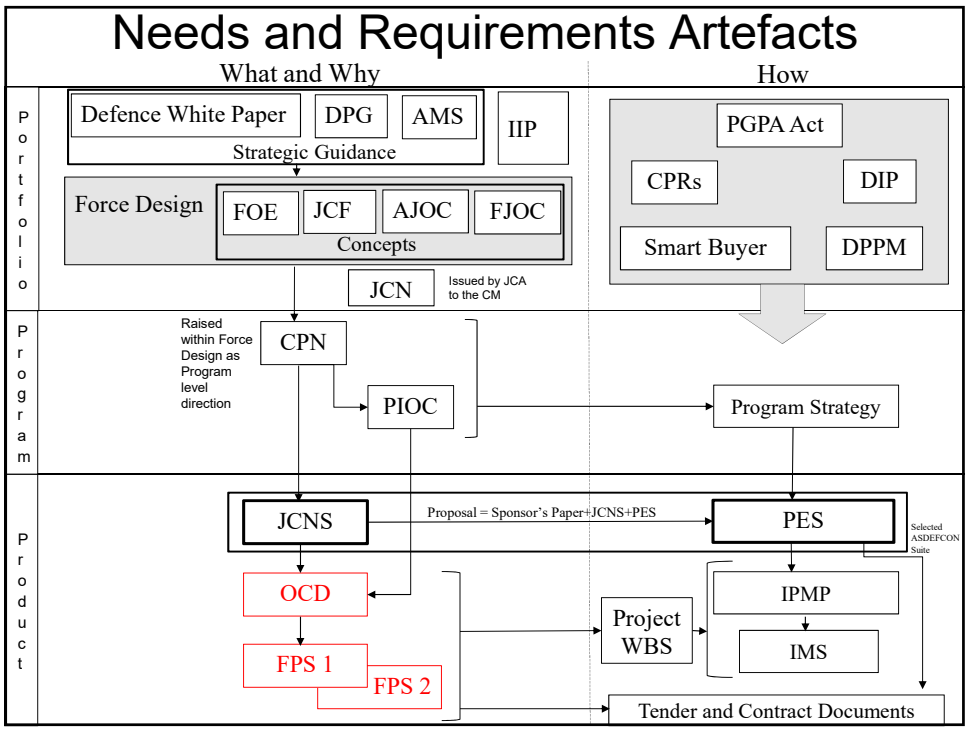
Capability Definition Documents (CDD)



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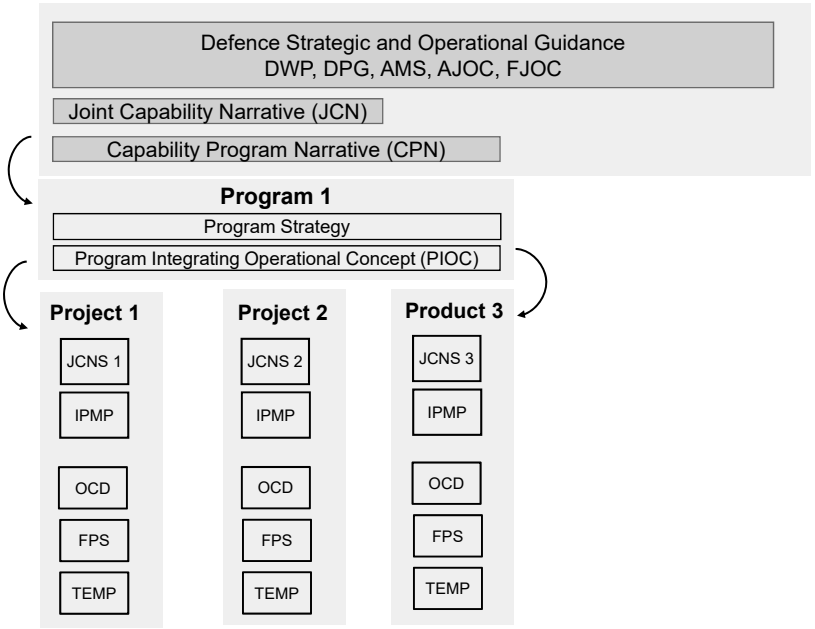
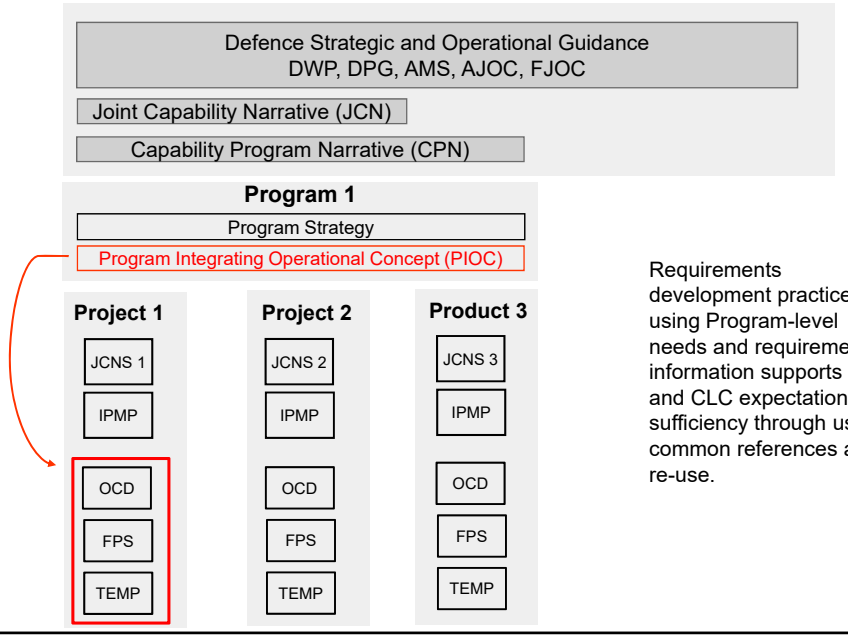
Capability Definition Documents (CDD)

- 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

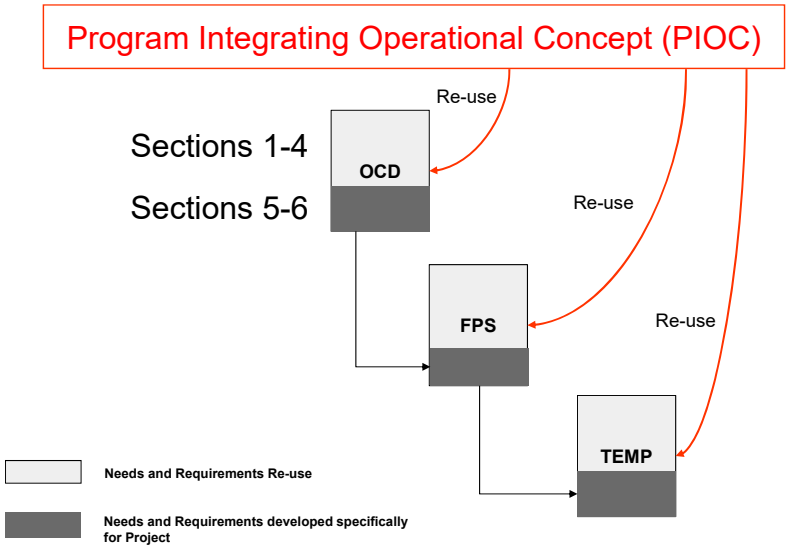


Program Level Supports Sufficiency Goal



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



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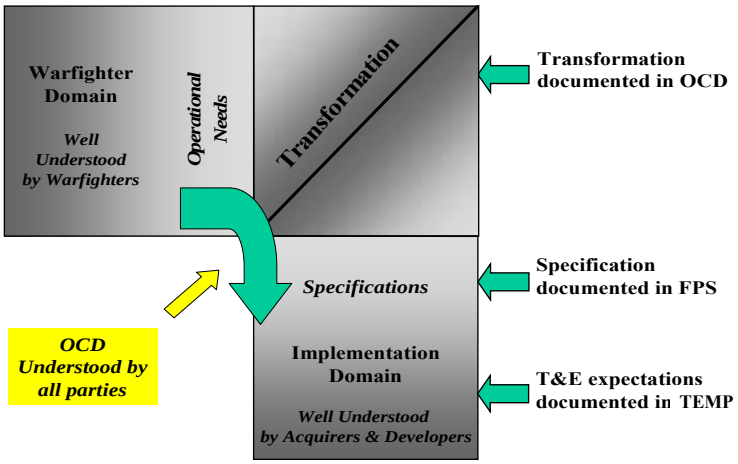
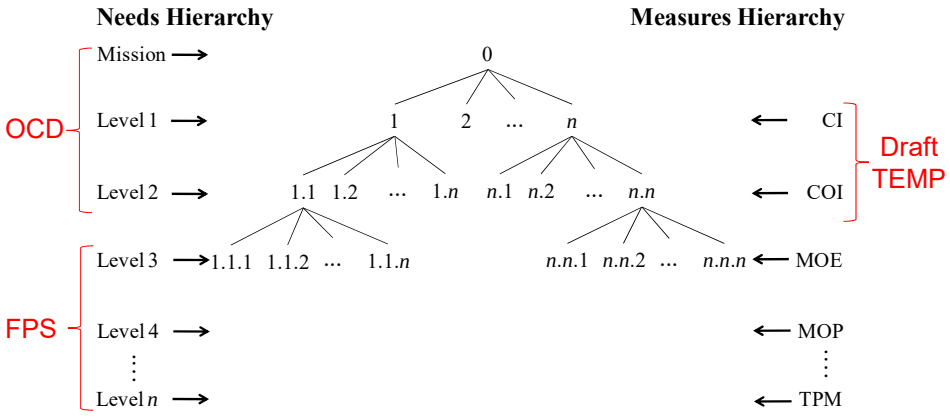
Transformation of Operational Needs



OCD, FPS, TEMP Relationship



Prepared by Stakeholders (CM)

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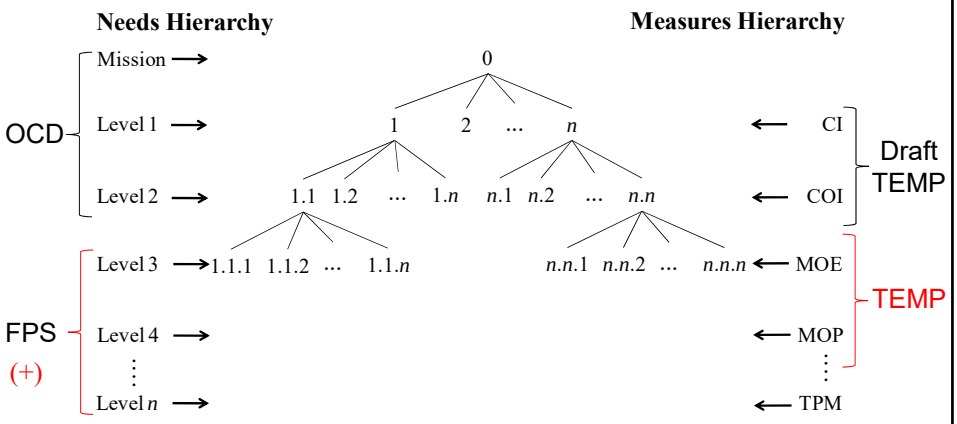
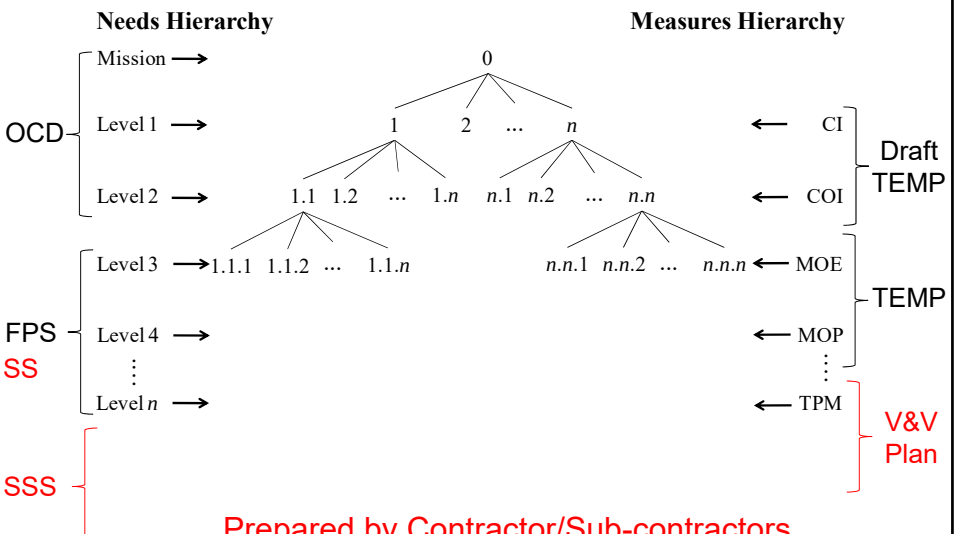
OCD, FPS, TEMP Relationship



Augmented/prepared by Acquirer (CASG)

OCD, FPS, TEMP Relationship



Prepared by Contractor/Sub-contractors

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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-INDEPENDENT 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

OCD Template

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

OCD Template

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

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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.

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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

TEMP Template

SECTION I - SYSTEM DESCRIPTION
1.1 Mission Description
1.1.1 Operational Need
1.1.2 Mission(s) to be Accomplished
1.1.3 Specified Environment
1.2 System Description
1.2.1 Key Functions
1.2.2 System Architecture and Interfaces
1.2.3 Unique System Characteristics
1.3 Critical Operational Issues (COI)
1.4 System Threat Assessment
1.5 Required Operational Characteristics
1.5.1 Key Operational Effectiveness Characteristics
1.5.2 Key Suitability Characteristics
1.5.3 Thresholds
1.6 Key Technical Characteristics

SECTION II - PROGRAM SUMMARY
2.1 Project Phases and V&V Phases
2.2 Stakeholder Responsibilities with respect to V&V
2.3 Integrated Schedule
2.4 Funding Aspects of the V&V process

SECTION III – DT&E OUTLINE
3.1 Critical DT&E Issues
3.2 DT&E to Date
3.3 Future DT&E
3.3.1 DT&E Phases and Objectives
3.3.2 DT&E Activities and Scope of Testing
3.3.3 Critical DT&E Resource Requirements
3.3.4 Constraints and Limitations associated with D&TE

SECTION IV – VALIDATION OUTLINE
4.1 Critical Validation Issues
4.2 Validation to Date
4.3 Future Validation
4.3.1 Validation Phases and Objectives
4.3.2 Validation Activities and Scope of Testing
4.3.3 Critical Validation Resource Requirements
4.3.4 Constraints and Limitations associated with Validation

SECTION V – ACCEPTANCE V&V (AV&V) OUTLINE
5.1 Critical AV&V Issues
5.2 AV&V to Date
5.3 Future AV&V
5.3.1 AV&V Phases and Objectives
5.3.2 AV&V Activities and Scope of Testing
5.3.3 Critical AV&V Resource Requirements
5.3.4 Constraints and Limitations associated with AV&V

SECTION VI - SAFETY
6.1 Assessment of Safety
6.2 Critical Safety Issues
6.3 Safety Management for V&V activities

SECTION VII - SPECIALTY TEST PROGRAMS
7.1 Specialty Test Program Requirements
7.2 Specialty Test Program - Critical Issues

SECTION VIII – SUPPORTABILITY TEST PLAN

SECTION IX – TRANSITION PLAN

SECTION X – SPECIAL RESOURCE SUMMARY
10.1 Schedule of V&V activities with special resource requirements
10.2 Special Resource Requirements for V&V activities

SECTION XI – HUMAN RESOURCE LIMITATIONS

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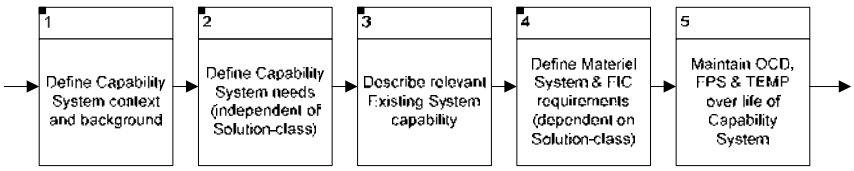
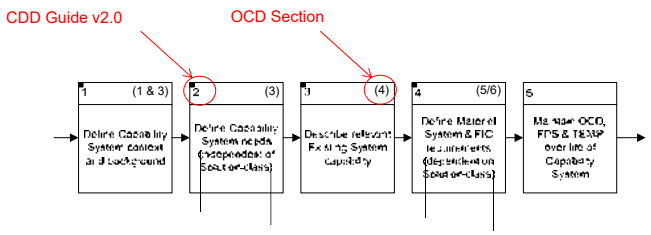
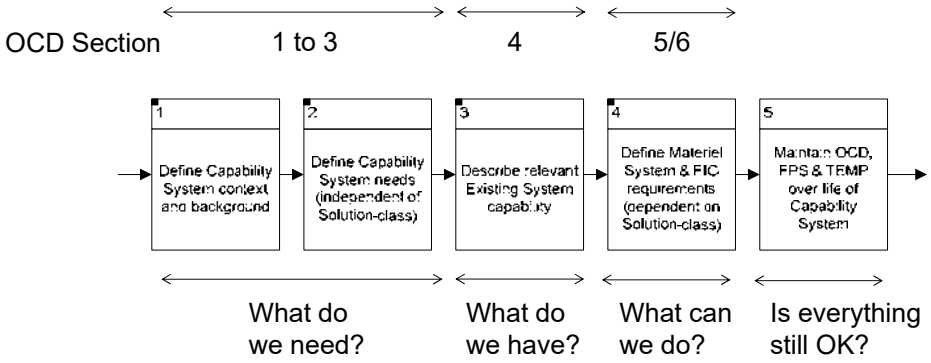
CDD Guide v2.2

Develop OCD, FPS, and TEMP

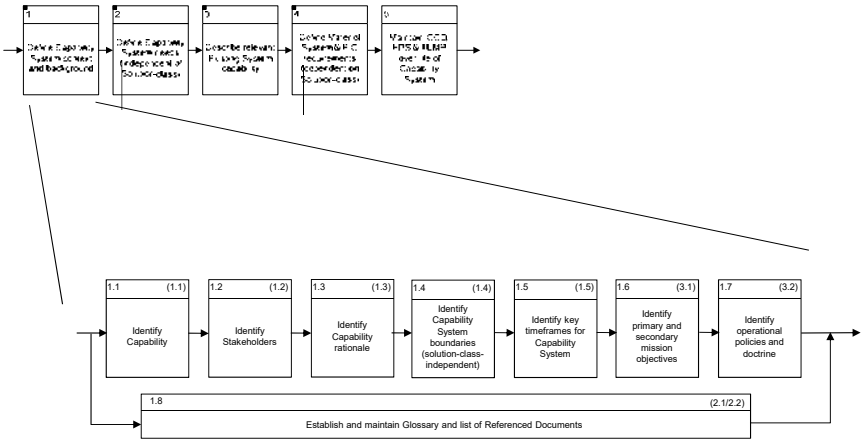




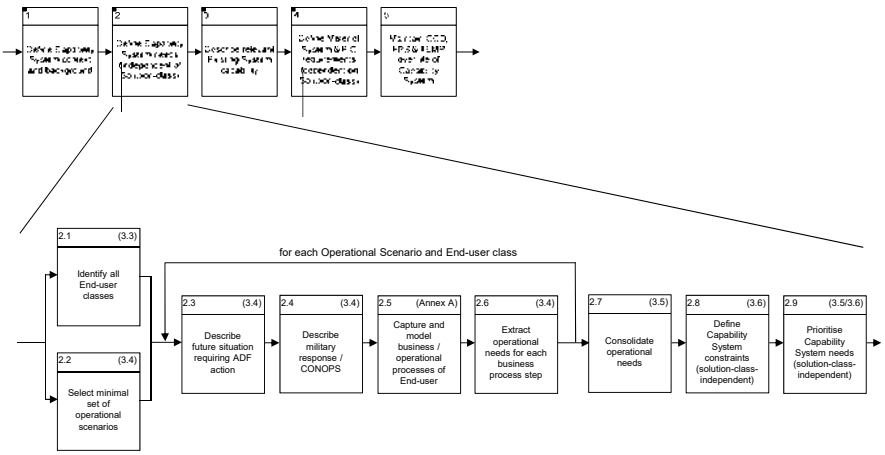
Develop OCD, FPS, and TEMP



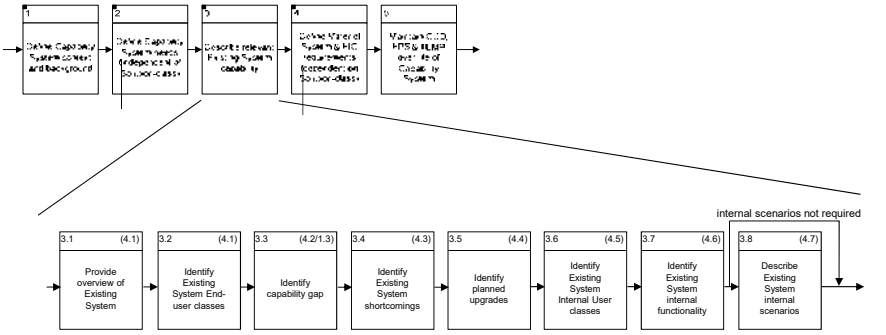
Define CS Context and Background



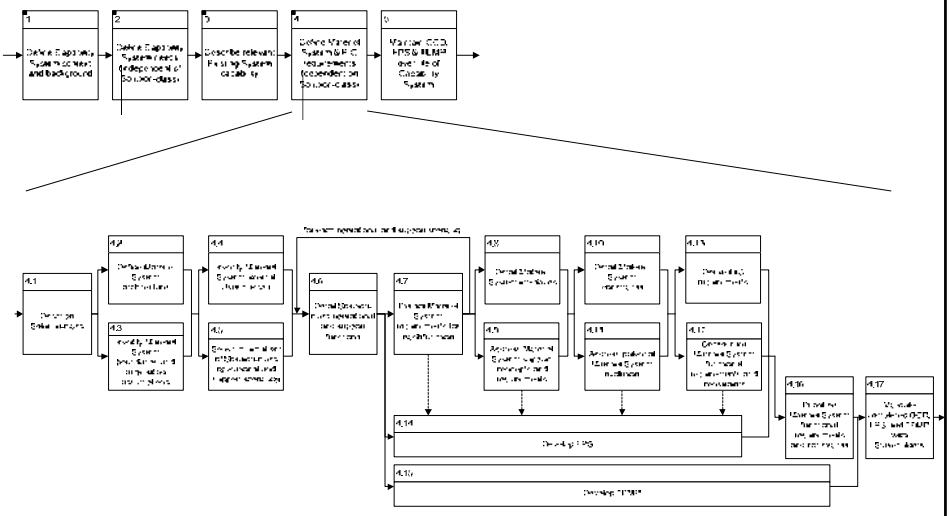
Define Capability System Needs



Describe Existing System Capability

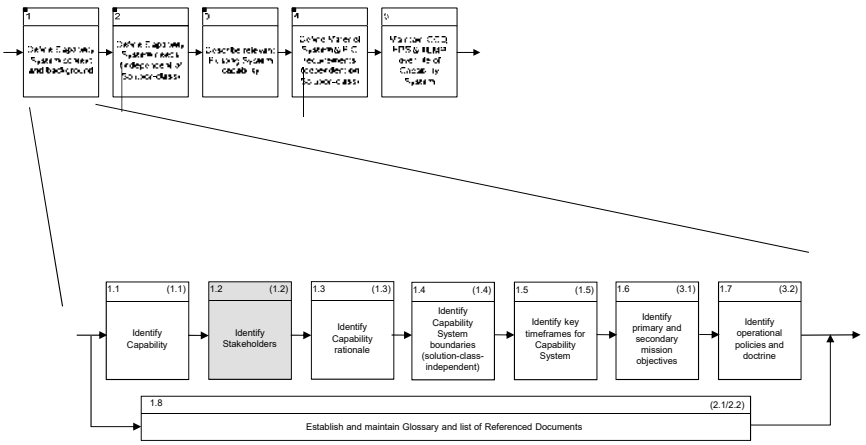


Define Materiel System Requirements



Selected Important Activities

1.2 Identify Stakeholders



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1.2 Identify Stakeholders

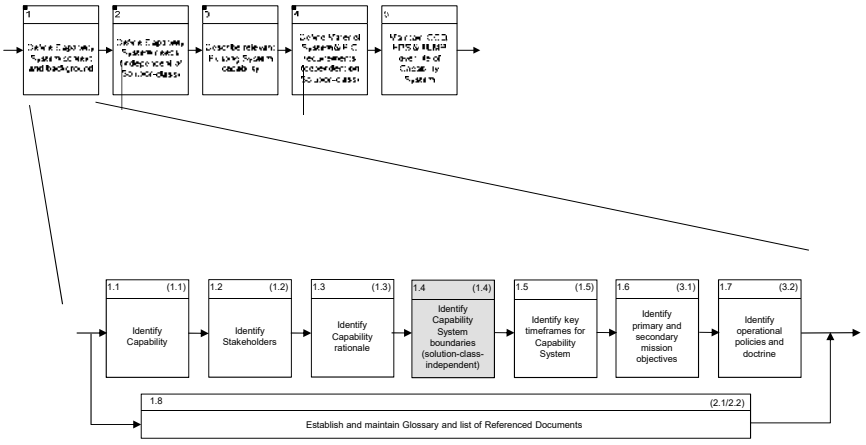
- Strictly speaking a stakeholder could be defined as someone who has a stake in the project—that is, someone who is affected by the system in some way, or can affect the system in some way.
- More usefully, a stakeholder is defined as someone (or some organisation) *who has a right to influence the outcome of the system*, rather than someone who is simply affected by the system.

1179

1.2 Identify Stakeholders

- 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



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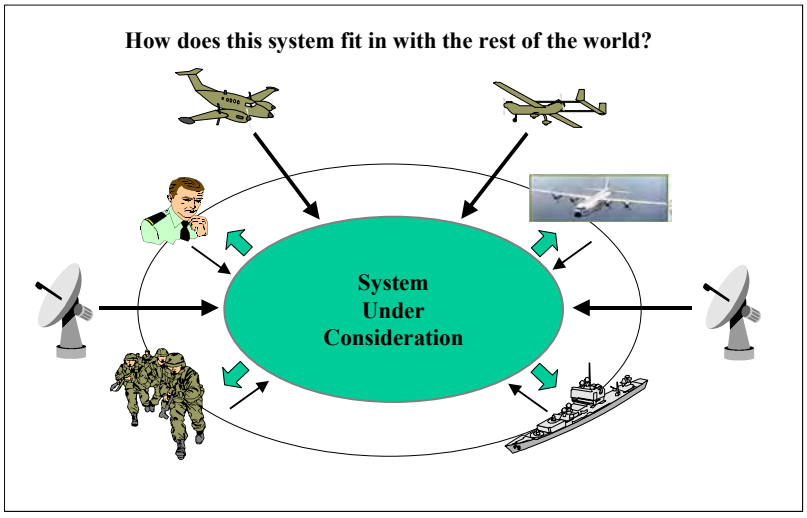
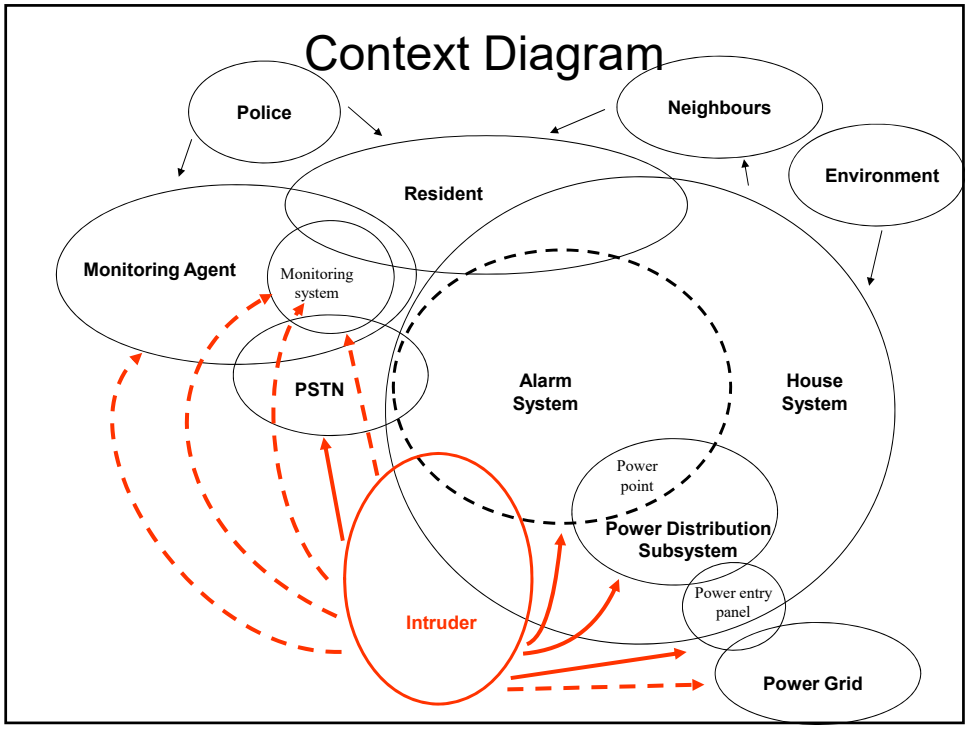
Context Diagrams

- 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





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Consider External Interfaces

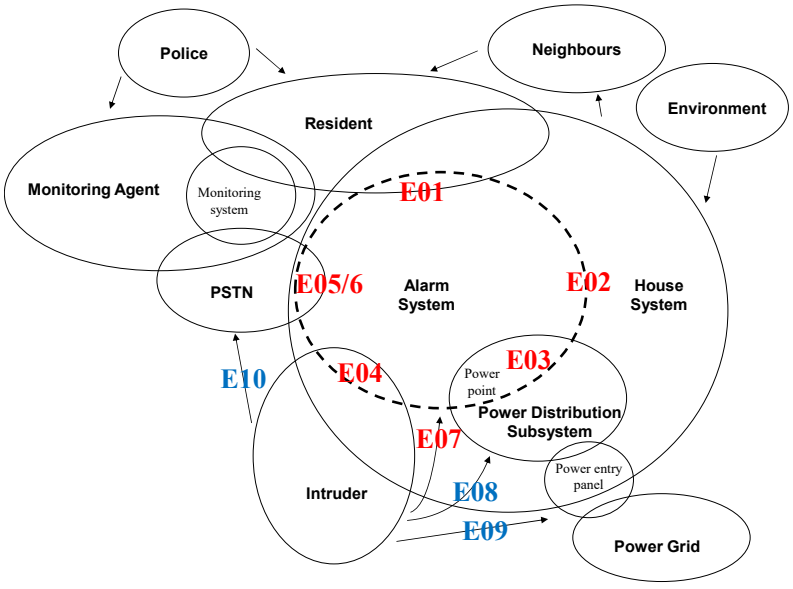
- Interfaces with existing or future external systems must also be defined as these will place considerable requirements on the system under development.
- While these external systems are not directly related to the system, the success of the fielded system is often determined by its ability to interface 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.

1185

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.

External Interfaces



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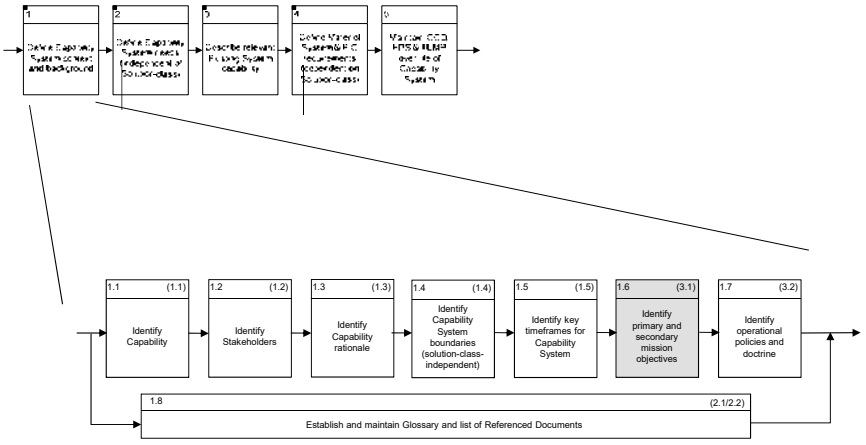
Consider External Interfaces

- 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



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Identify Mission (and Operational Needs)

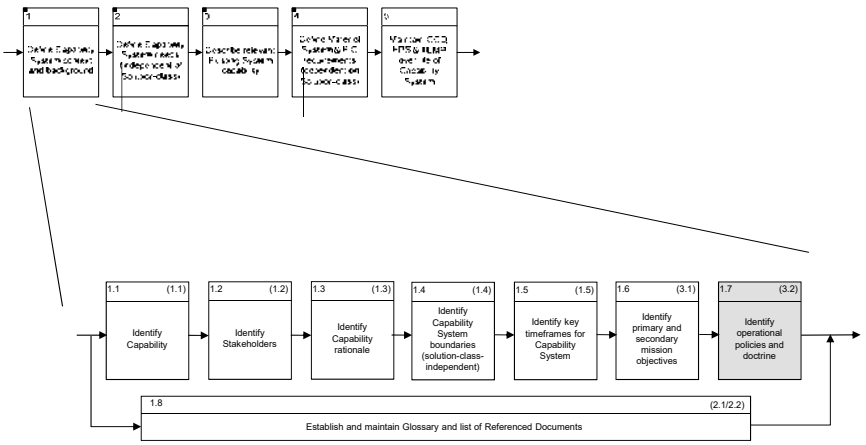
- Because the user has most probably stated the mission for the system in a fairly general way, every project should begin with a concise statement of the mission, elaborated by statements of the system-level needs.
- The mission statement is then expanded and qualified by short declarative statements 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).

1190

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



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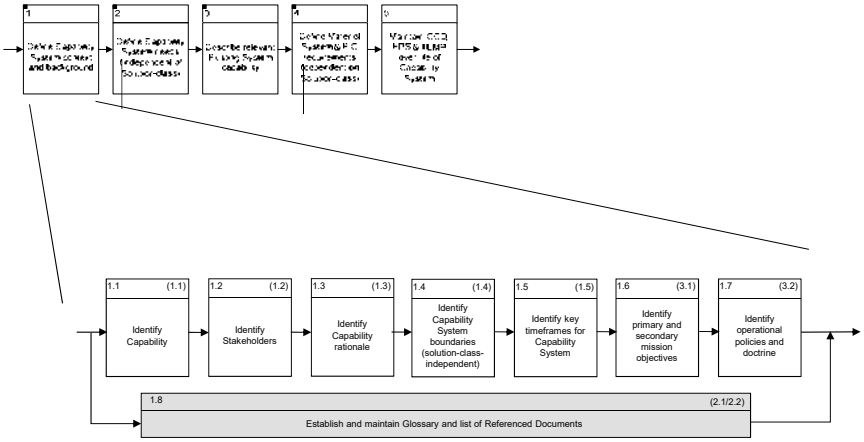
1.7 Identify Policies and Doctrine

- 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



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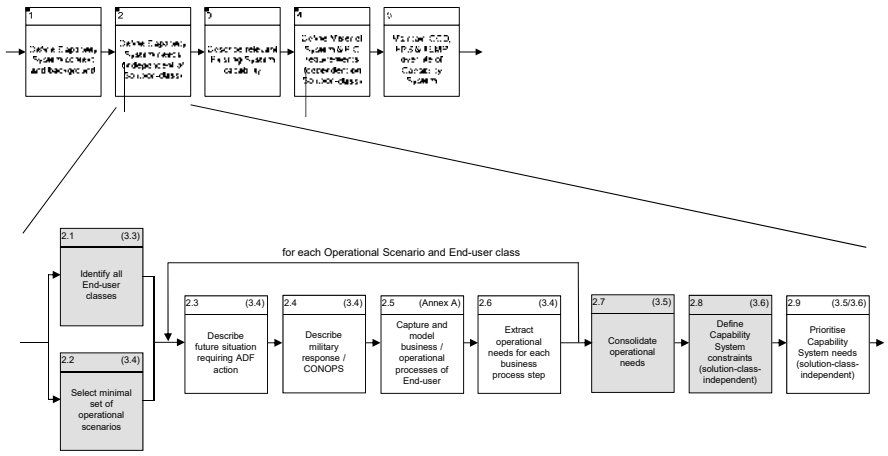
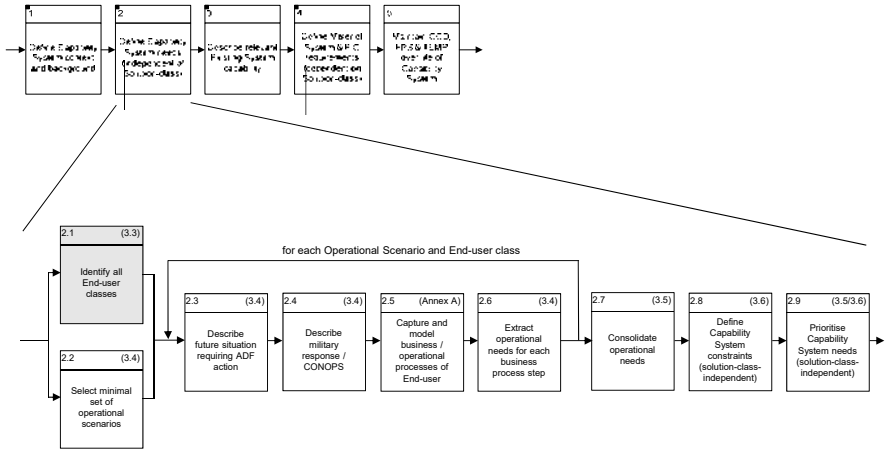
1.8 Glossary and Referenced Documents

- 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.

Define Capability System Needs



2.1 Identify all End-user Classes



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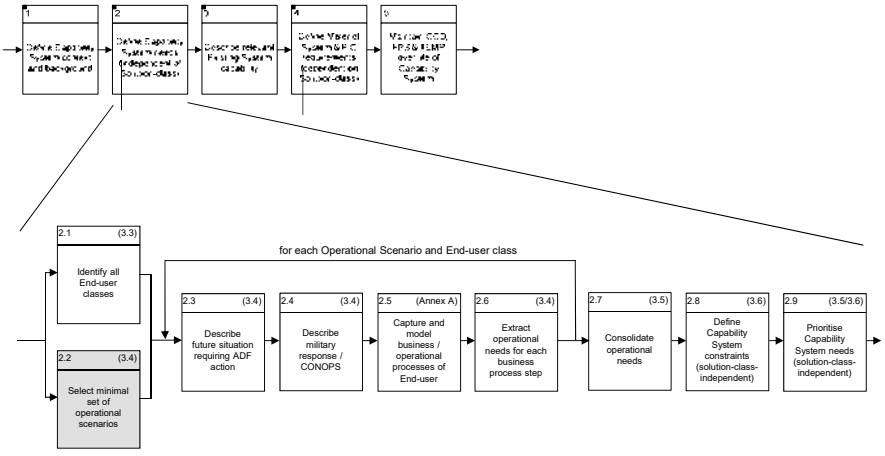
1197

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



1199

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.

1200

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.

1201

2.2 Select Operational Scenarios

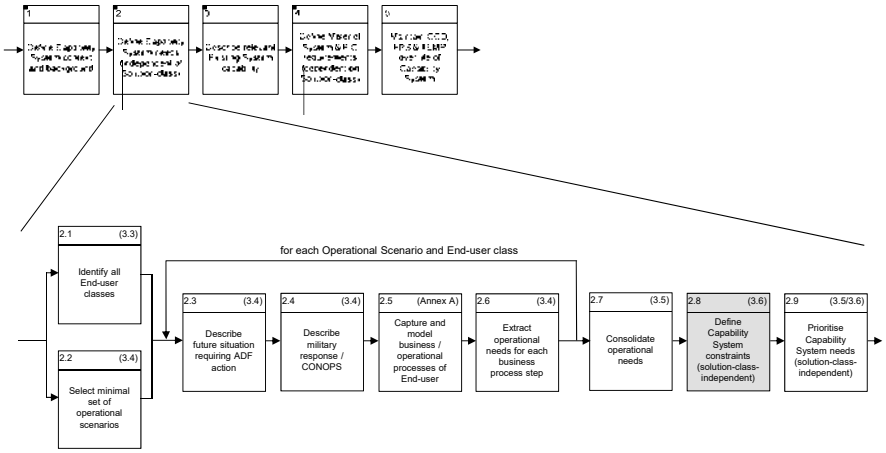
- Complex systems may have their requirements stated in a number of modes. For example, a modern fighter aircraft may have modes defined for air-to-air combat, ground attack, reconnaissance, naval operations, non-tactical flights, and so on. Each mode must be associated with the particular conditions (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.

1202

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?"

Define Capability System Constraints



1204

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.

1205

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.

1206

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.

1207

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.
  - …

1208

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.

1209

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.

… and finally

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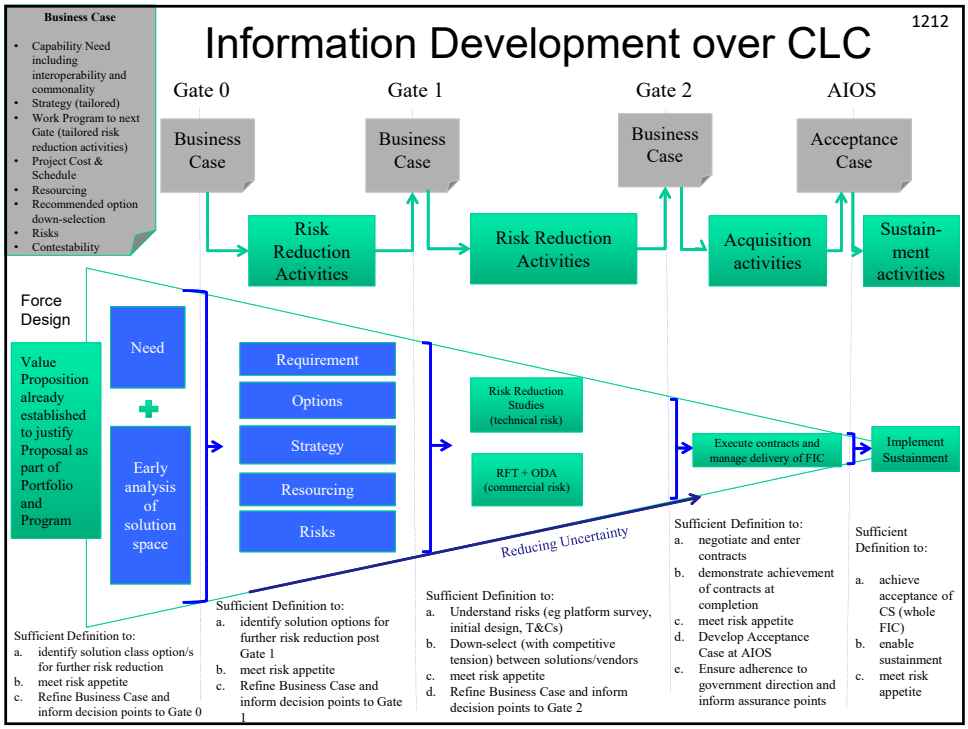
1211

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.

1212

Information Development over CLC



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Australian Government
Department of Defence
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IEEE (ISC)²

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Capability Systems Centre

Never Stand Still | School of Engineering and Information Technology

About the Capability Systems Centre

The Capability Systems Centre is an independent think tank that offers cutting edge research and analysis to government, defence and industry.

The Centre, through its research, publications, education, and events, combines world-class academic expertise across a range of disciplinary areas relevant to the delivery of capability systems, from conceptual design to acquisition and disposal.

The Centre's activities focus on systems acquisition and in particular on the application of systems science, systems thinking, complex systems, system of systems, systems engineering, requirements engineering, and systems engineering management and project management.

Centre Goals

1. Conduct research and analysis relevant to systems engineering and the delivery of defence capability.
2. Lead a national community of researchers and educators, focused on capability development challenges.
3. Contribute to undergraduate, postgraduate and professional education in systems engineering and capability development.

Centre Skill Sets

Our reasearch team at the Capability Systems Centre provide the following skill sets:

- Capability development and acquisition.
- Life cycle processes.
- Project management.
- Most engineering/IT/IS research domains.
- Space systems.
- Cyber security.
- Underwater networking.
- Modelling and simulation.
- Optimisation.
- Reliability engineering.

About UNSW Canberra

The Capability Systems Centre is an industry centre resident within UNSW Canberra, the only national academic institution with an integrated defense focus. Working at the intersection of a leading university and a military academy, UNSW Canberra has been educating defence, government and industry leaders for half a century.

The University is ranked 49th in the 2016 QS World University Rankings and leads all Australian universities in the field of Engineering/ Technology and Computer Sciences, moving to 41st in the world in the prestigious Academic Ranking of World Universities (ARWU).

UNSW Australia has more than 50,000 students from over 120 countries

UNSW AUSTRALIA | Capability Systems Centre UNSW Canberra

Research Areas

Modelling for Force Design

Models and simulations have always played an important role in engineering and systems engineering. Physical scale models, full-sized models, and computer models are commonly used in all forms of engineering and design. In recent times, interest in modelling has increased to span the full system lifecycle and there has been a significant focus on Model-based Systems Engineering (MBSE). The extension of formal modelling into all phases, and particularly the conceptual design phase, of a system development is a significant step and proponents of MBSE suggest that it will provide considerable benefits. However, modelling for conceptual design (for force design) requires a different approach since functions are being modelled, not physical system elements.

System Robustness and Future Proofing

System robustness and future proofing are two key aspects for any system design. Robustness ensures a system is operable in environments other than its primary and future-proofing ensures a system's future requirements are considered during conceptual design.

Complexity Measures for Systems Engineering

Complexity measures are informative indicators that may aid designers and system engineers in decision making process in all system life-cycle stages. A guiding principle is that "objects may not be multiplied beyond necessity" or "simple is better". A key question is how this principle is applied to capability systems?

Modularity

Modularity is the degree to which a system's components may be separated and recombined for a stated purpose. There will be a limit to the utility of modularisation in a context as it is a delicate balancing act – too few or too many modules may negatively impact system design or performance.

Holistic Project and Supply Chain Management

Project management for complex systems involve a multi-tiered and distributed network of processes, resources, information flows, managerial models, and decision making. A holistic approach extending project management to consider the whole supply chain, provides opportunities for improving the project's visibility, better integration and more efficient and effective delivery of products.

Capability Analytics

Capability based planning (CBP) facilitates organisations to systematically develop capacity to achieve their business objectives in highly uncertain, dynamic and competitive environments. Successful implementation of CBP requires sophisticated analysis techniques that can identify, model, optimise and subsequently support integration of the optimized models of all linear and non-linear processes, functions and operations within an organization. Our focus is the analysis frameworks, methods, techniques and tools.

Systems Thinking and System Dynamics

Systems Thinking and System Dynamics (ST/SD) present a holistic framework of concepts, methodologies, techniques, and tools that can be used to support problem solving in dynamic complex systems to understand the complex interrelationships between system components, processes, boundaries, objectives, and stakeholders.

Trade Space Exploration for Composable Systems

Composable design methods provide a systematic approach to the combination of existing system elements into a range of system alternatives that can be quickly evaluated and compared in the context of a nominated organisation cost function. Value driven design (VDD) is becoming increasingly prevalent in the development of complex materiel systems. This sees performance requirements replaced with objective functions that equate organisational value. By considering all possible options of each component, a multitude of system designs is implied and can be used to develop the 'Pareto frontier.' This enables potential optimal solutions to be quickly compared based on their organizational value. The design tradespace is dynamically updated throughout the design process as a design-change is identified or a 'value' feedback is acknowledged by the customer organisation.

Trade Space Exploration for Reliability Allocation

In conventional approaches to reliability allocation, a system-level reliability target is apportioned amongst known system components such that the system cost is minimized without violating any reliability constraints on the individual components. Several analytical and heuristic optimisation techniques are applied to a system model in order to achieve the desired target at the lowest perceived cost. However, the system-level reliability target itself is determined during early stages of the system life-cycle when the finer details of the desired system are unknown, and the decision is typically influenced by factors such as prevailing norms, data from a parallel existing system and engineering judgement. The conventionally established system-level reliability target may therefore be sub-optimal. We propose a tradespace- exploration based approach to cost-optimized reliability allocation, which offers a number of (otherwise non-obvious) interesting solutions for consideration of the designer, as opposed to the single static solution sought in the conventional approach.

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CRICOS Provider Code 00098G | C151377 | 11/2015

capabilitysystems.unsw.adfa.edu.au

Master of Systems Engineering (8567)

UNSW AUSTRALIA Canberra

Educating Future Global Leaders | School of Engineering and Information Technology

About UNSW Canberra

UNSW Canberra graduates shape Australia, the region and the international community as leaders in defence, government, and industry.

UNSW Canberra is the only national academic institution with an integrated defence focus. Working at the intersection of a leading university and a military academy, UNSW Canberra has been educating defence leaders for half a century.

Our graduate and doctoral research programs are open to qualified students from all walks of life and all parts of the world. UNSW Canberra graduates almost twice as many students in postgraduate programs than in undergraduate programs, reflecting our growth and strength as an excellent, full service university campus.

Our strength is in defence related, security and engineering research and UNSW Canberra engineering programs are accredited by Engineers Australia.

Program Description

The Master of Systems Engineering (MSysEng) is designed for postgraduate scholars who wish to develop a high level understanding of the principles and practices of systems engineering and to strengthen their skills in this area.

In addition to the stand alone MSysEng degree award, the following specialisations are also available in this program:

- Electronic Warfare
- Marine Engineering
- Networking
- Reliablilty Engineering
- Simulation
- Space Systems
- Test and Evaluation
- Weapons and Ordnance

The program aims to allow students to develop a high level of understanding of the principles that shape systems engineering and their implementation through the design, development and application phases.

Program Structure

Students undertaking the MSysEng are required to take eight coursework courses (48 UOC) from the courses listed in the handbook for the program. Students must complete four core courses, and four elective courses.

With the approval of the Program Coordinator students may take up to two elective courses (12 UOC) from other coursework programs. Not all elective courses will be available in a particular year.

Research Project

The option of undertaking a research project worth 12 UOC (ZEIT8297 Project - Systems Engineering F/T and ZEIT8296 Project - Systems Engineering P/T) is available to Masters students who obtain a high credit average or better in four courses and is subject to approval by the Program Coordinator.

The project is recommended for those with a strong interest in pursuing original research in a particular area or intending to undertake a higher research degree qualification.

Student undertaking a research project are unable to enrol in elective courses from other coursework programs.

Modes of Study

Distance and Intensive Delivery Mode

Postgraduate courses are delivered in the Distance or Intensive Delivery Mode (and sometimes in both modes).

Distance Mode: Distance students are not required to be physically present on campus throughout the semester. Many distance courses are often referred to as ‘online courses’, because this is the main method of delivering learning resources via the Learning Management System called MOODLE.

Intensive Delivery Mode (IDM): Students undertaking IDM courses will attend the UNSW Canberra campus for a period of face-to-face instruction with one full-time week intensive module during the semester (often at the start of the semester). This on-campus component is preceded and followed by a period of online interaction and assessment via MOODLE.

More Information

Entry to the program is available to those with a four year Bachelor degree, or a Bachelor degree with Honours, with a significant management component. Entry is also available to applicants without a first degree providing they have other acceptable academic qualifications and/or professional experience and/or related professional experience.

See course offerings at: **www.unsw.adfa.edu.au/msyseng**

Applications for Semester 1 close 8 March

Applications for Semester 2 close 17 July

Visit: **apply.unsw.edu.au**

If you require more information about the program, or are currently in a Masters program and would like to enquire if you are eligible to transfer into this program, please contact:

Postgraduate Administration Officer
Telephone: (02) 6268 8068 Email:
seit.teaching@adfa.edu.au

Courses within the program

Compulsory Courses

ZEIT8226 Systems Engineering Practice
ZEIT8230 Requirements Practice
ZEIT8231 Test and Evaluation
ZEIT8305 Systems Thinking and Modelling

General Electives

ZEIT8136 Software Project Management
ZEIT8236 System Safety
ZBUS8302 Logistics Management
ZEIT8302 Project Administration
ZEIT8303 Project Management Body of Knowledge
ZEIT8403 Capability Options Analysis

Electronic Warfare

ZEIT8015 Cyber Operations
ZEIT8102 C3I Systems
ZEIT8115 Information Operations
ZEIT8229 Non-Communications Electronic Warfare

Marine Engineering

ZEIT8010 Marine Technology*

Networking

ZEIT8015 Cyber Operations
ZEIT8102 C3I Systems
ZEIT8119 Internetworking
ZEIT8137 Systems Management and Security

Reliability Engineering

ZEIT8031 Reliability Engineering Fundamentals
ZEIT8152 Reliability Program Management
ZEIT8038 Probabilistic Risk Assessment
ZEIT8039 Reliability Engineering Assurance

Simulation

ZEIT8307 System Dynamics Modelling
ZEIT8412 Simulation
ZEIT8413 Simulations Applications

Space Systems

ZEIT8007 Space Operations
ZEIT8009 Global Navigation Systems**
ZEIT8011 Space Systems Technology
ZEIT8013 Space Applications 1
ZEIT8219 Satellite Communications
ZEIT8221 Spaceborne Imaging Technology**

Test and Evaluation

ZPEM8309 Application of Data Analysis
ZEIT8034 Advanced Test and Evaluation Techniques
ZEIT8402 Evidence-based Decision Making
ZEIT8404 Decision Analytics

Weapons and Ordnance

ZEIT8233 Explosive Ordnance Technology
ZINT8301 Firepower and Protection*
ZEIT8506 Weapons Engineering

Course Availability

See course availability at
www.unsw.adfa.edu.au/msyseng

* With approval

** Recommended only for students with an engineering or science undergraduate

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Professional Short Courses

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About the Capability Systems Centre

The Capability Systems Centre is an independent think tank that offers cutting edge research, analysis and education to government, defence and industry.

The Centre, through its research, publications, education, and events, combines world-class academic expertise across a range of disciplinary areas relevant to the delivery of Defence capability systems, from force design pre-Gate Zero to acquisition and disposal.

The Centre's activities focus on systems acquisition and in particular on the application of systems science, systems thinking, complex systems, system of systems, systems engineering, requirements engineering, and systems engineering management and project management.

We offer organisations the flexibility to choose unique solutions to fit organisational objectives:
- Custom Programs: Fully customised in-house development to align with your business education and training strategy
- Tailored on-campus programs.

We are now accepting registrations in the following disciplines:
- Communications and Information Systems
- Project Management
- Systems Engineering
- Satellite Communications
- Military Systems

Communications and Information Systems

Basic Communications Principles
Expressions of Interest (Canberra)

Project Management

Introduction to Project Management
Expressions of Interest (Canberra)

Systems Engineering

Introduction to Systems Engineering
Expressions of Interest (Canberra)
Systems Engineering Practice
Expressions of Interest (Canberra)
Requirements Practice
Expressions of Interest (Canberra)
Addressing Complex Problems
Expressions of Interest (Canberra)
Introduction to Capability Development
Expressions of Interest (Canberra)

Satellite Communications

Satellite Communications | Overview
Expressions of Interest (Canberra)
Satellite Communications | Intermediate
Expressions of Interest (Canberra)
Satellite Communications | Advanced
Expressions of Interest (Canberra)

Military Systems

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Introduction to Electronic Warfare
Expressions of Interest (Canberra)
Introduction to Guided Weapons
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Credit into UNSW Canberra Postgraduate Programs for Attendance at Professional Education Courses

UNSW Canberra allows students who have successfully completed approved professional education courses (PEC) to use those courses as credit in eligible postgraduate programs in one of two ways:

- **Credit for Professional Practice.** Prior successful completion of 12 days of approved PEC may be used as credit in a specified postgraduate course—*ZEIT8900 Professional Practice*.
- **Credit towards Micro-credential Postgraduate Courses.** Selected five-day PEC may be used as direct credit into specified micro-credential postgraduate courses.

Credit for Professional Practice

Students who have successfully completed a minimum of 12 days of approved PEC may use those courses as credit in a course in professional practice—*ZEIT8900 Professional Practice*—which has two main components:

- prior successful completion of 12 days of approved PEC, and
- an essay in approved form to explore issues related the professional practice.

What is an approved short course? An approved PEC:

- contains at least one day (at least six hours) of course work;
- is delivered by a presenter, or presenters, that would be eligible for appointment at an Australian university;
- is assessed by at least one hour of examination for every three days of course work; and
- is able to be verified by inspection of course and assessment materials.

Are approved short courses offered by any other service provider? A short course offered by a provider other than UNSW Canberra may be considered. An application for approval must contain at least the following:

- evidence of the number of hours of course work;
- evidence that the presenter(s) would be eligible for appointment at an Australian university (a brief CV of each presenter is required, providing qualifications, background, and experience);
- evidence of the assessment for the course (must be at least one hour of examination for three days of course work), including copies of previous tests and marking criteria; and
- a copy of the course materials (course notes, and text).

Which UNSW Canberra postgraduate programs are eligible? The following UNSW Canberra postgraduate programs are eligible: Systems Engineering, Project Management, Capability Management, and Engineering Science.

How is credit approved? Students seeking to obtain credit for successful completion of approved PEC are to contact the Director of Postgraduate Studies within the School of Engineering and IT. With approval of the School, students may then manually enrol in *ZEIT8900 Professional Practice*. Students then engage with Director of Postgraduate Studies to agree a topic for their essay—the essay is submitted by the end of the relevant session and a mark is recorded as satisfactory or unsatisfactory. Credit towards a UNSW Canberra postgraduate program expires after ten years.

Does enrolment in ZEIT8900 require fee payment? Yes, enrolment in ZEIT8900 requires payment of fees for that course.

Credit Towards Micro-credential Postgraduate Courses

In addition to offering credit for attendance at 12 days of accredited PEC, UNSW Canberra offers directed credit from specified PEC into selected mainstream postgraduate courses (called micro-credential courses).

What is a micro-credential course? Within a postgraduate program, each postgraduate course is worth 6 units of credit (UOC). At UNSW Canberra, selected 6-UOC courses are associated with two 3-UOC micro-credential courses that comprise the theoretical ('knowledge') and practical ('project') components, respectively, of a parent 6-UOC course.

How do micro-credential courses contribute to a postgraduate program? Each 'knowledge' micro-credential course is a prerequisite for a 'project' micro-credential course which provides the practical component of the parent 6-UOC course and completes the required course learning outcomes of that parent course. Within a program, both 3-UOC courses must be completed in combination in order to achieve the total learning outcomes of the parent 6-UOC course.

Table 1. Current micro-credential courses for UNSW Canberra programs.

Parent Course (6 UOC)	Micro-credential Courses (3 UOC)	Prerequisite
ZEIT8226 Systems Engineering Practice	ZEIT8238 Systems Engineering **Knowledge**	School Consent
	ZEIT8239 Systems Engineering **Project**	ZEIT8238
ZEIT8230 Requirements Practice	ZEIT8240 Requirements Practice **Knowledge**	School Consent
	ZEIT8241 Requirements Practice **Project**	ZEIT8240
ZEIT8305 Systems Thinking and Modelling	ZEIT8244 Systems Thinking and Modelling **Knowledge**	School Consent
	ZEIT8245 Systems Thinking and Modelling **Project**	ZEIT8244
ZEIT8231 Test and Evaluation	ZEIT8246 Test and Evaluation **Knowledge**	School Consent
	ZEIT8247 Test and Evaluation **Project**	ZEIT8246
ZEIT8219 Satellite Communication	ZEIT8242 Satellite Communication **Knowledge**	School Consent
	ZEIT8243 Satellite Communication **Project**	ZEIT8242

How do five-day PEC relate to micro-credential courses? Each 3-UOC 'knowledge' course has a corresponding five-day PEC. A student who wishes to obtain recognition of successful completion of the five-day PEC must complete the assessment requirements of the PEC (receiving a *Certificate of Successful Completion*), enrol in the corresponding 3-UOC 'knowledge' micro-credential course (no fees apply), and complete a final assessment while enrolled as either a non-award or postgraduate coursework student.

Table 2. Current micro-credential courses and equivalent UNSW Canberra five-day PEC.

Micro-credential Course (3 UOC)	UNSW Canberra Five-day PEC
ZEIT8238 Systems Engineering Knowledge	Systems Engineering Practice
ZEIT8240 Requirements Practice Knowledge	Requirements Practice
ZEIT8244 Systems Thinking and Modelling Knowledge	Systems Thinking and Modelling Practice
ZEIT8246 Test and Evaluation Knowledge	Test and Evaluation Practice
ZEIT8242 Satellite Communication Knowledge	Satellite Communications—Advanced

Are there any restrictions on the use of micro-credential courses? All micro-credential courses have an exclusion of the equivalent 6-UOC equivalent course to prevent students repeating the same 6-UOC combination—for example, students completing the combination of *ZEIT8238 Systems Engineering Knowledge* (3 UOC) and *ZEIT8238 Systems Engineering Project* (3 UOC) would be excluded from enrolling in the parent *ZEIT8226 Systems Engineering Practice* (6UOC).

Does enrolment in micro-credential courses require fees? Fees are not paid to enrol in the 3-UOC 'knowledge' micro-credential course in order to obtain credit for the corresponding PEC. However, enrolment in a subsequent 3-UOC 'project' micro-credential course does require payment of fees.