Introduction to Capability Management

Dr Mike Ryan
&
Dr Shari Soutberg
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](mailto: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](mailto:s.soutberg@adfa.edu.au))

**Books**


**Book Chapters**

Major Recent 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
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  HJCF I2 Framework (I2F) Development
2017  HJCF 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
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<td>Accountable Authority Instructions</td>
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<td>ABL</td>
<td>Allocated Baseline</td>
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<td>ACAT</td>
<td>Acquisition Category</td>
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<td>Australian Capability Context Scenarios</td>
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<td>Australian Defence Force</td>
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<td>ADFAC</td>
<td>Australian Defence Force Academy</td>
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<td>Australian Defence Organisation</td>
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<td>SAFS</td>
<td>Average Funded Strength</td>
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<td>Australian Industry Capability</td>
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<td>AIS</td>
<td>Acceptance into Operational Service Management</td>
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<td>Australian Joint Operating Concept</td>
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<td>ASDEFCON</td>
<td>Australian Standard for Defence Contracting</td>
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<td>AT&amp;E</td>
<td>Acceptance Test and Evaluation</td>
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<td>BBC</td>
<td>Better Business Case</td>
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<td>BC</td>
<td>Business Case</td>
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<td>BoE</td>
<td>Basis of Estimates</td>
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<td>BNR</td>
<td>Business Needs and Requirements</td>
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<td>C2</td>
<td>Command and Control</td>
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<td>C4</td>
<td>Command, Control, Communications and Computers</td>
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<td>C4ISR</td>
<td>Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance</td>
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<td>CabSub</td>
<td>Cabinet Submission</td>
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<td>CAM</td>
<td>Computer-aided design</td>
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<td>CAE</td>
<td>Computer-aided engineering</td>
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<td>CAM</td>
<td>Computer-aided manufacturing</td>
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<td>CASG</td>
<td>Capability Acquisition and Sustainment Group</td>
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<td>CASE</td>
<td>Computer-aided Support Environment</td>
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<td>CASSS</td>
<td>Capability Acquisition and Sustainment Support Services (Panel)</td>
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<td>CCB</td>
<td>Configuration Control Board</td>
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<td>Contract Change Proposal</td>
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<td>CDD</td>
<td>Capability Development Documents</td>
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<td>CDF</td>
<td>Chief of the Defence Force</td>
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<td>CDIC</td>
<td>Centre for Defence Industry Capability</td>
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<td>CDMRT2</td>
<td>Capability Development Management and Reporting Tool 2</td>
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<td>Critical Design Review</td>
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<td>Contract Data Requirements List</td>
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<td>Chief Finance Officer</td>
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<td>CI</td>
<td>Configuration Item</td>
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<td>Ci</td>
<td>Critical Issue</td>
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<td>CIIOG</td>
<td>Chief Information Officer Group</td>
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<td>CITE</td>
<td>Capability Integration, Test and Evaluation (Branch)</td>
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<td>CLC</td>
<td>Capability Life Cycle</td>
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<td>CM</td>
<td>Capability Manager</td>
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<td>CM</td>
<td>Configuration Management</td>
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<td>CMGR</td>
<td>Capability Manager Gate Review</td>
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<td>CMS</td>
<td>Contract Master Schedule</td>
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<td>CNC</td>
<td>Computer numerically controlled</td>
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<td>COD</td>
<td>Concept of Operations Document</td>
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<td>COE</td>
<td>Centre of Expertise</td>
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<td>COI</td>
<td>Critical Operational Issue</td>
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<td>CONOPS</td>
<td>Concept of Operations</td>
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<td>COTS</td>
<td>Commercial-off-the-Shelf</td>
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<td>CPN</td>
<td>Capability Program Narrative</td>
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<td>CPR</td>
<td>Commonwealth Procurement Rules</td>
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<td>CPSG</td>
<td>Capability Program Steering Group</td>
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<td>CSIC</td>
<td>Computer Software Configuration Item</td>
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<td>CSU</td>
<td>Computer Software Unit</td>
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<td>CWBS</td>
<td>Contract Work Breakdown Structure</td>
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<td>DA</td>
<td>Design Authority</td>
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<td>DA</td>
<td>Design Attribute</td>
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<td>DAF</td>
<td>Defence Architecture Framework</td>
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<td>DAR</td>
<td>Defence Aviation Safety Regulation</td>
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<td>DC</td>
<td>Defence Committee</td>
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<td>DCAP</td>
<td>Defence Capability Assessment Program</td>
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<td>DCBS</td>
<td>Design Control Basics System</td>
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<td>DDC</td>
<td>Defence Development Committee</td>
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<td>DDA</td>
<td>Defence Data Architecture</td>
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<td>DDO</td>
<td>Defence Development Organisation</td>
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<tr>
<td>DOR</td>
<td>Description of Requirement</td>
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<tr>
<td>DOTMLP</td>
<td>Doctrine, organization, training, materiel, leadership, personnel, facilities</td>
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<td>DWH</td>
<td>Defence White Paper</td>
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<td>DWP</td>
<td>Defence White Paper</td>
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<td>E&amp;I</td>
<td>Estate &amp; Infrastructure Group</td>
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<td>EBC</td>
<td>Enterprise Business Committee</td>
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<td>ECP</td>
<td>Engineering Change Proposal</td>
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<td>eFFBD</td>
<td>Enhanced Functional Flow Block Diagram</td>
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<tr>
<td>EIA</td>
<td>Electronics Industry Association</td>
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<td>EMC</td>
<td>Electromagnetic Compatibility</td>
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<td>EMI</td>
<td>Electromagnetic Interference</td>
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<td>EPBC</td>
<td>Environment Protection and Biodiversity Conservation Act 1999</td>
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<td>ETP</td>
<td>Endorsement to Proceed</td>
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<td>FACRR</td>
<td>Facilities Readiness Review</td>
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<td>FBL</td>
<td>Functional Baseline</td>
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<td>FCA</td>
<td>Functional Configuration Audit</td>
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<td>FDD</td>
<td>Force Design Division</td>
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<td>FEA</td>
<td>Finite element analysis</td>
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<td>FELS</td>
<td>Front-End Logistics Support Analysis</td>
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<td>FFBD</td>
<td>Functional Flow Block Diagram</td>
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<td>FFBNW</td>
<td>Fitted-for-but-not-with</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>FIC</td>
<td>Fundamental Inputs to Capability</td>
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<td>FJOC</td>
<td>Future Joint Operating Concept</td>
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<td>FMECA</td>
<td>Failure Modes, Effects and Criticality Analysis</td>
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<td>FOC</td>
<td>Final Operating Capability</td>
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<td>FOE</td>
<td>Future Operating Environment</td>
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<td>FOREX</td>
<td>Foreign Exchange</td>
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<td>FPC</td>
<td>Fixed price contract</td>
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<td>FPR</td>
<td>First Principles Review</td>
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<td>FPS</td>
<td>Function and Performance Specification</td>
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<td>FQR</td>
<td>Formal Qualification Review</td>
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<tr>
<td>FRACAS</td>
<td>Failure reporting, analysis and corrective action system</td>
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<td>FSR</td>
<td>Force Structure Review</td>
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<td>FTE</td>
<td>Full Time Equivalent</td>
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<td>G&amp;S</td>
<td>Goods and Services</td>
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<td>GOTS</td>
<td>Government off the Shelf</td>
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<td>HMI</td>
<td>Human Machine Interface</td>
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<td>HR</td>
<td>Human Resources</td>
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<td>HWCI</td>
<td>Hardware Configuration Item</td>
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<td>I2</td>
<td>Integration and Interoperability Framework</td>
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<td>I2F</td>
<td>Integration and Interoperability Framework</td>
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<td>IA</td>
<td>Independent Assurance</td>
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<td>IAR</td>
<td>Independent Assurance Review</td>
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<td>IBR</td>
<td>Integrated Baseline Review</td>
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<td>IC</td>
<td>Investment Committee</td>
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<td>ICD</td>
<td>Interface Control Document</td>
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<td>ICT</td>
<td>Information and Communications Technology</td>
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<td>ICWG</td>
<td>Interface Control Working Group</td>
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<td>IEC</td>
<td>International Electrotechnical Commission</td>
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<td>IEEE</td>
<td>Institute of Electrical and Electronics Engineers</td>
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<td>IIP</td>
<td>Integrated Investment Program</td>
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<td>ILS</td>
<td>Integrated Logistics Support</td>
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<td>ILSM</td>
<td>ILS Manager</td>
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<td>ILSP</td>
<td>ILS Plan</td>
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<td>IMS</td>
<td>Integrated Master Schedule</td>
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<tr>
<td>INCOSE</td>
<td>International Council on Systems Engineering</td>
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<td>IOC</td>
<td>Initial Operating Capability</td>
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<td>IOC</td>
<td>Integrating Operational Concept</td>
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<td>IPM</td>
<td>Integrated Project Manager</td>
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<td>IPMT</td>
<td>Integrated Project Management Team</td>
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<td>IPT</td>
<td>Integrated Project/Product Team</td>
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<td>IS</td>
<td>Interim Standard</td>
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<td>ISC</td>
<td>Integrated Support Contractor(s)</td>
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<td>ISO</td>
<td>International Standards Organisation</td>
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<td>ISREW</td>
<td>Intelligence, Surveillance, Reconnaissance and Electronic Warfare</td>
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<tr>
<td>ISREWCS</td>
<td>ISREW Cyber Space</td>
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<tr>
<td>ITR</td>
<td>Invitation to Register Interest</td>
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<td>IV&amp;V</td>
<td>Independent Verification and Validation</td>
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<td>JCA</td>
<td>Joint Capability Authority</td>
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<td>JCF</td>
<td>Joint Concepts Framework</td>
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<td>JCG</td>
<td>Joint Capability Group</td>
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</table>
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&D 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

SLDC 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 Preparation Plan

TIRA Technical Implementation Risk Assessment

TLS Through Life Support

TNARR 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 four of the six core recommendations of the First Principles Review (FPR).
2. List six of 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 role of Contestability.
10. Briefly describe the Smart Buyer framework.
11. Draw a simple diagram of the CLC Accountability Model.
12. Briefly describe the three CLC management layers (Answer: Portfolio, Program, Product/Project).
13. Briefly outline the purpose of each of the three CLC decision gates.
14. List the nine Fundamental Inputs to Capability (FIC).
15. Draw a simple hierarchical diagram of the principal CLC proposal artefacts (Answer: JCN, CPN, PIOC, JCNS, OCD, FPS).
16. List the ten knowledge areas of the Project Management Body of Knowledge (PMBOK).
17. List the five Support System Constituent Capabilities (SSCC).
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. A system can be described functionally and physically. Explain what each description provides and describe the relationship between the two descriptions.
20. Briefly outline the differences between a system and a system-of-systems.
21. Explain the relationship between an RBS and a WBS.
22. 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.
23. List and describe the three categories of Test and Evaluation (T&E) and describe the primary focus of each of them.
The aim of this course is to:

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

- 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
FPR: How did we get here?

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

Numerous Senate Reviews and Audits

Reason for First Principles Review (FPR)

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

Source: FPR Creating One Defence
FPR Recommendations

Six core recommendations:

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

First Principles

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

FPR – Key Messages

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

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

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

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

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

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

Relationship between FPR and the CLC

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

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

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

CLC – Principles

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

Source: Updated Interim CLC Manual
So ….

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

- Traceability to government direction.
- Requirements to be defined.
- Compliance with applicable legislation and regulations.
- Accountability for proper use of Commonwealth resources by Commonwealth officers (even if activities are contracted out).

Snapshot of key changes post-CLC

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

<table>
<thead>
<tr>
<th>Behaviours and Approach</th>
<th>Additional frameworks</th>
<th>New Management roles and ‘structures’</th>
</tr>
</thead>
<tbody>
<tr>
<td>• One Defence</td>
<td>• Force Design (incl DCAP)</td>
<td>• Investment Committee</td>
</tr>
<tr>
<td>• Joint/integrated</td>
<td>• Contestability</td>
<td>• Integrated Investment Program</td>
</tr>
<tr>
<td>• Transparency</td>
<td>• Smart Buyer</td>
<td>• Management layers: Portfolio (Capability Streams), Program, Product, Project</td>
</tr>
<tr>
<td>• Tailored</td>
<td>• Integration and Interoperability</td>
<td>• CLC Accountability Model: roles, responsibilities and relationships</td>
</tr>
<tr>
<td>• Sufficiency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Risk-based</td>
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</tr>
</tbody>
</table>

**New Artefacts**

Program: CPN, Program Strategy, PIOC
Proposal: JCN, JCNS, PES, Business Case, IPMP

**Industry Role**

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

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

CLC – Implementation

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

1. List 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

Revision

2. List 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

+ 

Technical endeavour to deliver and support capability

Accountability
Legal obligation
Govt processes

Significant Complexity
Science & Engineering
Precision and rigour

Intersection of Public Sector obligations and technical endeavour.
Capability Life Cycle (CLC) Management
Dr Mike Ryan & Dr Shari Soutberg

Capability Development Practices

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

Established, proven Practices that enable the CLC.

Context for CLC

Legislative, Regulatory, and Policy Context
Behaviours
CLC Process

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

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

Program Example: IAMD

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

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

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**Possible Components of IAMD**

[Diagram showing components of IAMD including Airborne Sensors, Joint Battle Management System, Deployable Ground Weapons, Mobile Ground Sensors, Airborne Relay, Eg HF, VHF, Frigates]
IAMD example

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

SEA 1448 Ph4A: Project Example

- 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.
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

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.
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.
• Artefacts and documents to be developed.

CLC Context and Behaviours
Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

Applying the CLC

Legislative, Regulatory, and Policy Context

Behaviours

CLC Process

Strategy and Concepts

Risk Mitigation and Requirements Setting

Acquisition

In-Service and Disposal

Gate 0

Gate 1

Gate 2

Capability Management Practices

Program, Product and Project Management

Systems Engineering

Logistics/ILS

Procurement and Contracting

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

**Key Commonwealth Legislation**

- 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
Key Commonwealth Legislation
Including but not limited to…

- Public Governance Performance and Accountability Act (PGPA) 2013
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- Archives Act 1983
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- Environment Protection and Biodiversity Conservation Act 1999

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
Key Commonwealth Policies

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

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

Key Defence Policies

- Including but not limited to …
  - Defence Environment Policy;
  - Defence Industry Policy Statement 2016;
  - Defence Procurement Policy Manual (DPPM); and
Key Defence Policies

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

Defence Procurement Policy

- Defence Procurement Policy Manual (DPPM) incorporates:
  - CPR, and
  - 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

• 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
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.

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.

CLC Behaviours

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

- Culture of wanting ideas, proposals and agendas contested.
- Makes proposals robust and helps improve decisions
- Establish trust with Government and Central Agencies.
- Engage early with Contestability so can be ‘built into’ brief.

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.
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.

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
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.

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
CLC Behaviours add to Extant Values

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

Defence-wide Values

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

- 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)

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

Practices: Codes of Ethics

Specialist practitioners are also subject to Codes of Ethics eg:

- **Project Management:**
  - AIPM Code of Ethics: Act with Integrity; Practice Competently; Demonstrate Leadership; Act with Responsibility.
- **Engineering:**
  - Engineers Australia Code of Ethics: demonstrate integrity; practice competently; exercise leadership; promote sustainability.
  - Source: Engineers Australia Code of Practice.
Specialist Practitioners: Common Features

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

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.
Capability Life Cycle (CLC) Management
Dr Mike Ryan & Dr Shari Soutberg

CLC Process

Implementing the CLC

Legislative, Regulatory and Policy Context

Behaviours

CLC Process

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

Gate 0
Gate 1
Gate 2

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

- 33 -
Overview: Phases of the CLC

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

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

CLC Gates

There are three decision gates:

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

• Our description of the CLC is structured as follows:
  – Frameworks, Roles, and Management Structures that are relevant to the CLC.
  – CLC Process including decision points.
  – Documents and Artefacts that are to be produced.

• This will be followed by a description on how to apply supporting ‘toolkit’ of Practices to implement the CLC.

Implementing the CLC

Legislative, Regulatory and Policy Context

Behaviours

Frameworks, Roles, and Management Structures

CLC Process

Documents and Artefacts

Strategy and Concepts

Risk Mitigation and Requirements Setting

Acquisition

In-Service and Disposal

Gate 0

Gate 1

Gate 2

Capability Management Practices

Program, Product and Project Management

Systems Engineering

Logistics/ILS

Procurement and Contracting

Risk Management and Assurance
3. Draw a diagram of the four phases of the CLC Process.

<table>
<thead>
<tr>
<th></th>
<th>Gate 0</th>
<th>Gate 1</th>
<th>Gate 2</th>
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<td>Strategy and Concepts</td>
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</tbody>
</table>

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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UNSW Canberra
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

- **Force Design Framework (DCAP)**

**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

- **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

- 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).
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,
  – Defence White Paper, and
  – new Integrated Investment Program (IIP).
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).

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.
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.

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.
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.

‘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.
Revision

9. Briefly describe the Smart Buyer framework.

- 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.

- 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

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

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.
Contestability

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

Contestability Model across the CLC

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

Source: Department of Defence
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.

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

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
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.

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**Portfolio**

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

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**Portfolio**

- All potential and approved investment
- Approved Investment
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)

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.
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).

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.
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:

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

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

### Capability Stream to Program Matrix

Source: Interim CLC Manual
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.

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.
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
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.

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).
Program Management across the CLC

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

Product

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

A **Project** is:

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

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**.
Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

Portfolio/Program/Product/Project

Capability Streams

Portfolio

Program

Project

Product

Activity: eg preparedness analysis
Activity: eg modelling

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

Product life cycle

Portfolio/Program/Product/Project

Capability Streams

Portfolio

Program

Project

Product

Activity: eg preparedness analysis
Activity: eg modelling

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

Product life cycle
Revision

11. Briefly describe the four CLC management layers.

Roles in the CLC
CLC Leadership

Two types of CLC leadership:

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

2. Implementing the CLC:
   - As per CLC Accountability Model.

CLC Accountability Model

IPT: Integrated Project/Product Team
SME: Subject Matter Expert
FIC: Fundamental Input to Capability

- Joint Team
- Enablers
- Delivery Group
- Strategy Policy Intelligence
- Sponsor

IPT:   Integrated Project/Product Team
SME: Subject Matter Expert
FIC:   Fundamental Input to Capability

Industry Representative
FIC SME
Acquisition or Aided Mgt Specialist
Government Submission SME
Requirements SME
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.

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.
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.

CLC Accountability Model

- Two vertical streams of accountability:
  - *Customer* – left.
  - *Supplier* (Delivery) – right.

- Integrated teams from both ‘sides’.

- Partnerships are key.
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.

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).
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.

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.
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.

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.

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.
**Project/Product Sponsor**

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

**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.**
Delivery Groups

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

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.
### 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.

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### 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.**
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.

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.
Integrated Project/ Product Teams

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

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

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

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.
Revision

12. Draw a diagram of the CLC Accountability Model.

Funding
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.

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.
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 Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

Capability Perspectives

Mission System
- truck
- radar
- ship

Support System: SSCC
- Operating Support
- Engineering Support
- Maintenance Support
- Supply Support
- Training Support

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

Sources of Supply
- Australian Industry
- ADO
- Overseas Industry
- Allies/Partners

Defence Capability

Force Structure

Force elements capable of delivering specific effects and countering threats

Defence Preparedness

Maintaining the force structure at an appropriate state of preparedness
Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

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
- Being ready to deploy on military operations.
- Being able to continue operating

Defence Preparedness

- Readiness
- Sustainability

UNSW Canberra

- 80 -
Defence Capability (System)

**Force Element**
- Truck

**What keeps the force element prepared**
- Eg trained personnel to keep truck maintained
- Eg trained personnel to operate truck
- Eg command structure for using truck
- Eg training for personnel who operate truck
- Not everything!

**Mission and Support System**

**Force Element**
- Truck (etc)

**What keeps the force element prepared**
- Eg facility in which to maintain the truck
- Eg maintenance training
- Not everything!

**Mission System**
- Focus on the equipment and its use

**Support System**
- Supporting it In-Service

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**Mission System**

**Support System**

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Mission and Support System Perspective

- Capability System
  - Mission System
    - Used to focus on bringing the system into being (centred on the equipment and its use)
  - Support System
    - What is needed to support it during the In-service Phase
Fundamental Inputs to Capability (FIC)

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.
Fundamental Inputs to Capability (FIC)

Comprehensive

- 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.
Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

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.


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.

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.


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)

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

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

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.
### SSCC Elements

- 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.

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

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 …
Support System Perspective

Capability System

Mission System
Support System

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

Mission and Support System Perspective

Capability System

Mission System
Support System

Support System Constituent Capabilities (SSCC)
- Operating Support
- Engineering Support
- Maintenance Support
- Supply Support
- Training Support
Fundamental Inputs to Capability (FIC)

Personnel
Organisation
Collective Training
Major Systems
Supplies

Facilities
Support
Command and Management
Industry

Capability (System)

Estate and Infrastructure Group (E&IG) organises
Capability Life Cycle (CLC) Management

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Supplier Perspective

Capability System

Mission System
Support System

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

Supplier Perspective

Facilities

Training Facilities
Garaging Facilities
Maintenance Facilities

Overseas Industry
Department of Defence
Australian Industry
Capability Perspectives

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

Effect / Outcome

- Mission System
- Support System (Materiel System)

SSCC

FIC

- Personnel
- Collective Training
- Facilities and Training Areas
- Supplies
- Support
- Organisation
- Command and Management
- Industry

Operating Support
Engineering Support
Maintenance Support
Supply Support
Training Support

(Major (Mission) System)
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.

Revision

14. List the five Support System Constituent Capabilities.

- Operating Support.
- Engineering Support.
- Maintenance Support.
- Supply Support.
- Training Support.
Integration and Interoperability Framework (I2F)

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
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.

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).
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.

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)

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

- Authorised Reference Designs
  - Concept Design
  - Standards

- Program Architectures

- System Architectures

- Product Realises

- Required I2 Practices:
  - Demonstrated Traceability
  - Use of SMILE
  - Consultation
  - Established I2 Agreements
  - Tailored Assurance Pathway
  - Configuration Control of I2 info

I2 Implementation
- PROGRAM
  - Drives Project/Product I2 requirements
- PROJECT
  - Decide Project I2 requirements
  - Systems and Interface Specifications
- PRODUCT
  - Product Baseline

I2 Assurance, Approval
- Assess Program compliance with I2 Reference Set Requirements
- Assess Project compliance with I2 Reference Set Requirements
- Assess ongoing I2 compliance of Products against approved I2 requirements

I2 Framework (I2F)

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

- Authorised Reference Designs
  - Concept Design
  - Standards

- Program Architectures

- System Architectures

- Product Realises

- Required I2 Practices:
  - Demonstrated Traceability
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- Assess Program compliance with I2 Reference Set Requirements
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- Assess ongoing I2 compliance of Products against approved I2 requirements
Capability Life Cycle (CLC) Management

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I2 Framework (I2F)

Joint Force Guidance

Definition of assets/systems which need to interact (in theatre/battlespace) including information exchange and performance attributes

I2 Assurance, Approval

Assess Program compliance with I2 Reference Set Requirements

Assess Project compliance with I2 Reference Set Requirements

Assess ongoing I2 compliance of Products against approved I2 requirements

I2 Implementation

Program

Drives Project/Product I2 requirements

Project

Decide Project I2 requirements Systems incl Interface Specifications

Product

Product Baseline

I2 Reference Set

Authorized I2 Requirements

• Joint Force Objectives
• Supporting Joint Concepts
• Integrating I2 Objectives
• Directed I2 requirements

Authorized Reference Designs

Compliant with

• C4ISR Design
• Program Architectures
• System Architectures
• Product Baseline

Required I2 Practices:

• Demonstrated Traceability
• Use of I2RM
• Consultations
• Established I2 Agreements
• Tailored Assurance Pathways
• Configuration Control of I2 info.

I2 Framework (I2F)

Joint Force Guidance

Program

Drives Project/Product I2 requirements

Project

Decide Project I2 requirements Systems incl Interface Specifications

Product

Product Baseline

I2 Reference Set

Authorized I2 Requirements

• Joint Force Objectives
• Supporting Joint Concepts
• Integrating I2 Objectives
• Directed I2 requirements

Authorized Reference Designs

Compliant with

• C4ISR Design
• Program Architectures
• System Architectures
• Product Baseline

Required I2 Practices:

• Demonstrated Traceability
• Use of I2RM
• Consultations
• Established I2 Agreements
• Tailored Assurance Pathways
• Configuration Control of I2 info.

I2 Assurance, Approval

Assess Program compliance with I2 Reference Set Requirements

Assess Project compliance with I2 Reference Set Requirements

Assess ongoing I2 compliance of Products against approved I2 requirements
C4ISR Design

• C4ISR Design 2025 v0.6 was endorsed by the Joint warfare Council as at 24 Nov 16.
• Basis for defining C4ISR requirements, informing capability experimentation, integration, and assuring the joint war-fighting environment through eg test and evaluation.
• C4ISR Design Authority is accountable for defining and assuring the joint war-fighting environment, architecture and setting military I2 requirements.
• ...

C4ISR Design

• ...
• Defines I2 for Networked Joint Force (NJF) C4 and ISR functions.
• Provides endorsed joint operational, capability and mission/platforms’ systems (interoperability) design patterns and guidance to:
  – enable alignment and integration with existing and future systems, and
  – trusted, relevant and timely decision quality information.
Assess Program compliance with I2 Reference Set Requirements
Assess Project compliance with I2 Reference Set Requirements
Assess ongoing I2 compliance of Products against approved I2 requirements

I2 Framework (I2F)

I2 Reference Set

Joint Force Guidance

I2 Implementation

Program

Drives Project/Product I2 requirements

Project

Decide Project I2 requirements Systems and Interface Specifications

Product

Product Baseline

I2 Assurance checks the I2 design and implementation using knowledge of interdependencies and interface requirements that will support Integration and Interoperability

I2 Reference Set

Authorized I2 Requirements

- Joint Force Outcomes
- Supporting Joint Concepts
- Integrating I2 Objectives
- Directed I2 requirements

Authorized Reference Designs

- Cross Domain Standards
- Program Architectures
- System Architectures
- Product Baselines

Required I2 Practices:

- Demonstrated Traceability
- Use of I2Mx
- Consultation
- Established I2 Agreements
- Tailored Assurance Pathways
- Configuration Control of I2 info

I2 Assurance, Approval

Assess Program compliance with I2 Reference Set Requirements
Assess Project compliance with I2 Reference Set Requirements
Assess ongoing I2 compliance of Products against approved I2 requirements

Captures ‘design’ for the Program, Project, or Product in an architecture or baseline to be used as reference for other Programs, Projects, Products

Program

Drives Project/Product I2 requirements

Project

Decide Project I2 requirements Systems and Interface Specifications

Product

Product Baseline

Unauthenticated | Copyrighted Material

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I2 is Addressed Across the CLC

PREVIEW OF COMING COURSE CONTENT
PHASES OF THE CLC

Overview: Phases of the CLC

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

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

**What and Why**

- **Defence White Paper**
- **DPG**
- **AMS**
- **IIP**
- **Force Design**
  - **FOE**
  - **JCF**
  - **AJOC**
  - **FJOC**
  - **JCN**
- **CPN**
- **PIOC**
- **JCNS**
  - **OCD**
  - **FPS 1**
  - **FPS 2**

**How**

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

Proposed changes to JCN and PIOC raised within Force Design as Program level direction.

**WHAT AND WHY**

**What and Why**

- **Defence White Paper**
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Proposed changes to JCN and PIOC raised within Force Design as Program level direction.

Issued by JCA to the CM.
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.
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.
- ....
Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

Program Layer as ‘Umbrella’ Reference

- Defence Strategic and Operational Guidance
  - DWP, DPG, AMS, AJOC, FJOC

- Joint Capability Narrative (JCN)

- Capability Program Narrative (CPN)

Program 1

Program Strategy

Program Integrating Operational Concept (PIOC)

Project 1

JCNS 1

IPMP

OCD

FPS

TEMP

Project 2

JCNS 2

IPMP

OCD

FPS

TEMP

Project 3

JCNS 3

IPMP

OCD

FPS

TEMP

Efficient: leverage common content in ‘parent’

Aligned: Related Projects and Products have common reference

Proposal-level Artefacts

What and Why

- Defence White Paper
  - Strategic Guidance

- Force Design
  - FOE
  - JCF
  - AJOC
  - FJOC
  - Concepts

How

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

- JCN

- Program Strategy

- JCNS

- OCD

- FPS 1

- FPS 2

- Project WBS

- Tender and Contract Documents
Proposal Artefacts

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

Revision

15. Draw a simple hierarchical diagram of the principal CLC proposal artefacts.
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 endeavor
CLC, Capability Development Context

- 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.

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.
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.

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
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

Capability Lifecycle

Project Lifecycle

Product Lifecycle

System Engineering Lifecycle

Procurement Lifecycle

PROGRAM MANAGEMENT
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).

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

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.
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

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

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

Optimises Value of Asset to Organisation

Asset Management

Is applied across the whole Asset Lifecycle

Asset Lifecycle

Planning Acquisition Operation and Sustainment Retirement/Disposal
Asset Management

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

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

Defence Project Management

- Structured and reliable means to deliver a Product.
- CASG Project Management follows principles from:
  - Project Management Body of Knowledge (PMBOK®).
  - Managing Successful Programs (MSP).
Integrated Project Management: Dimensions

Project Management is an integrating discipline which ensures:

- consideration of Whole of Lifecycle

Diagram: [Unspecified]
Integrated Project Management: Dimensions

Project Management is an integrating discipline which ensures:

• consideration of Whole of Lifecycle

• Joint Force Integration.

• coordinating and integrating FIC.
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
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.

Systems Engineering

Systems Engineering is a *technical management framework*:

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

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

• trusted method for deriving 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
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”

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.

ANAO Report No.2 2017–18,
Performance Audit Defence's Management of Materiel Sustainment.
PROCUREMENT AND CONTRACTING

CLC: Tender and Contract Documents

What and Why
- Defence White Paper
- DPG
- AMS
- IIP
- Force Design
- FOE
- JCF
- AJOC
- FJOC
- Concepts

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

Defence White Paper

PGPA Act

CPNs

PIOC

JCN

JPNS

JCF

AJOC

FJOC

Concepts

Issued by JCA

 raisd within force

Design as

Program

level

direction

Program

Strategy

Proposal = Sponsor's Paper + JCNS + PES

IPMP

IMS

FPS 1

FPS 2

Project WBS

Tender and Contract Documents

What and Why

How

- Defence White Paper
- DPG
- AMS
- IIP
- Force Design
- FOE
- JCF
- AJOC
- FJOC
- Concepts

Issued by JCA

raised within force

Design as

Program

level
direction

Program

Strategy

Proposal = Sponsor's Paper + JCNS + PES

IPMP

IMS

FPS 1

FPS 2

Project WBS

Tender and Contract Documents
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
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

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.
Use of the word ‘system’

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

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

• So, what is a ‘system’ in the context of ‘systems engineering’?

Definition of a system

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


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

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

The mission of the system

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

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

Definition of a system

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

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

A system as a capability

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

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

Logical and physical descriptions

- A system can be described in two broad ways:
  - Logical (or functional)—what the system will do, how well it will do it, how it will be tested, under what conditions it will perform, and what other systems will be involved with its operation.
  - Physical—what the system elements are, how they look, and how they are to be manufactured, integrated, and tested.
- Both the logical and physical descriptions of a system comprise a series of statements called requirements.
Logical and physical descriptions

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

Logical and physical descriptions

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

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

Logical (functional) hierarchy

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

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

- 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).
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.

Hierarchy of an SOI

• It is probably better, therefore, to consider an SOI to comprise a combination of interacting system elements, some of which may be systems in their own right.
A system is an integration of a number of co-dependent subsystems that are interconnected permanently to achieve a common purpose.

An SoS is an integration of a number of independent systems that are interconnected for a period of time to achieve a common purpose.
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
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 |

Pre-acquisition Phase

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

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

Utilization Phase

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

- The system is in service during the Utilization Phase until:
  - the business has no further need for the system, or
  - it no longer can meet the functions required of it by the organisation, or
  - it is no longer cost-effective to keep it in service.

- If the business need for the capability still exists in the organisation, the conclusion of one system life cycle marks the start of another and the process begins again.

Revision

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

- Throughout the system life cycle, there are a number of parties involved.
- The customer organization is managed by:
  - enterprise management who set the direction for the organisation and for
  - business management who are responsible for the activities conducted by
  - the operations element of the organisation which is run by
  - the operators—sometimes called the users.

Parties involved

- The systems used within the organisation are acquired by:
  - the acquisition element (also called the acquirer, or tasking activity) of the organisation under the auspices of
  - a project, which is typically managed by
  - a project manager.
- Project managers are supported by a number of related disciplines including:
  - systems engineering,
  - requirements engineering,
  - specialist engineering disciplines,
  - quality assurance, and
  - integrated logistic support.
Parties involved

- Operators are supported in their operation of the system by the support element of the organisation, which supports, sustains, and maintains the system throughout its life.

- In addition to the operational, acquisition, and support staff, there are many others within the customer organization who have a stake in the successful implementation of the project.

- These stakeholders can include representatives from the management, financial, operations, supply, maintenance, and facilities areas of the organisation.

Parties involved

- The system is obtained from a supplier (also called the performing activity) who may deliver the system off-the-shelf or may develop it, in which case they are often called the developer.

- The supplier (developer) may be an internal part of the customer (acquirer) organisation.

- It is increasingly common these days for the supply or development to be undertaken by an outside organisation called a contractor.

- The relationship between the customer and the contractor is defined by the terms and conditions of the contract.

- Often the contractor is not able to perform all of the work required and devolves packages of work to a number of subcontractors through a number of subcontracts.
Responsibilities of the parties involved

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

Activities in Acquisition and Utilization Phases

- Systems engineering is predominantly related to the Acquisition Phase of the system life cycle and, to a lesser extent, the Utilization Phase.
- For these two major phases, we use the life-cycle activities based on those defined by Blanchard and Fabrycky.

Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

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.

Conceptual Design

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

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

Conceptual Design

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

• Converts the logical architecture in the initial FBL into a 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).

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).
Construction and/or Development

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

Utilization and Retirement Phases

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

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

Introduction to Systems Engineering
What is systems engineering?

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

Top-down approach

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

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

---

**Top-down design**
Bottom-up integration

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

Requirements engineering

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

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

Life-cycle focus

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

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

System optimisation and balance

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

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

Management

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

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

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

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Conceptual Design

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

Conceptual Design

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

- The BNR, SNR and the SyRS are key elements of what is called the Functional Baseline (FBL).
- Conceptual Design ends with the System Design Review (SDR), which finalizes the initial FBL.
- SDR confirms the BNR, SNR and the SyRS, and provides a formal record of design decisions and design acceptance.
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- C1.1.3 Identify external constraints
- C1.1.4 Identify design constraints

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- C1.4.5 Define business requirements (BRC)

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C2. Define stakeholder needs and requirements

BNR (PLCD and BRS)

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BNR (PLCD and BRS)
Identify major stakeholders

- Since their input to the system life cycle is crucial, careful selection of appropriate stakeholders is fundamental to the success of the project.
- It follows that, if a different set of stakeholders is nominated, the process will most likely end with a different set of system requirements.

Identify major stakeholders

- A stakeholder is commonly defined as someone who has a stake in the project—that is, someone who is affected by the system in some way, or can affect the system in some way.
- In most systems this is not a useful definition since it is often difficult to find someone who is not affected by the system in some way.
- Even in a simple system such as an automatic teller machine (ATM) network for a bank, there may be millions of stakeholders by such a definition.
- In committee-based organizations such as public service organizations, the number of potential stakeholders is almost limitless.
Identify major stakeholders

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

Identify major stakeholders

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

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

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

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

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

Business and project constraints

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

- Project constraints include budget and schedule constraints, but also the resource allocations to the project as well as any externally imposed deliverables and acquisition timeframes.
- Many companies have enterprise-wide standards for processes such as quality assurance and systems engineering and these methodologies guide the manner in which projects can operate.
- Additionally, the enterprise may require the project to report progress in a particular way or to implement particular metrics, tools and documentation procedures.
Identify external constraints

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

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

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

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

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

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

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

A cautionary note WRT constraints

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

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

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

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

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

- Every project should begin with a concise statement of the mission, elaborated by statements of the system-level goals and objectives.
- “A problem is half-solved if properly stated.” John Dewey.
Define mission, goals and objectives

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

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

Mission statement for the Aircraft System

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

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

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

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

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

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

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

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

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

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

Requirements Hierarchy

Measures Hierarchy

Level 1 → 1 2 ... n → CI

Level 2 → 1.1 1.2 ... 1.n n.1 n.2 ... n.n → COI

Level 3 → 1.1.1 1.1.2 ... 1.1.n n.n.1 n.n.2 ... n.n.n → MOE

Level 4 → ...

Level m → ...

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BNR (PLCD and BRS)
Define Preliminary Lifecycle Concepts

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

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

Define Preliminary Lifecycle Concepts

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

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

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

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

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

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

Preliminary Deployment Concept

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

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

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

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

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

Preliminary Retirement Concept

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

- We will discuss the retirement phase later.
Context diagram

- Collectively, these previous few activities are called scoping the system.
- To assist with the scoping process, a tool called a context diagram may be used to illustrate the related systems, relevant regulatory environments, stakeholders, external systems, interfaces, and so on.
- Different systems may of course have significantly different context diagrams.
This is NOT a context diagram

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

System Under Consideration

Context diagram

Police

Resident

Monitoring Agent

PSTN

Alarm System

House System

Power Distribution Subsystem

Power point

Power entry panel

PowerGrid

Maintainers?

Environment

Neighbours
Guidance for context diagrams

- Identify all the possible candidate elements for the context diagram (textual list, sticky paper on a board).
- Group similar elements in accordance with their relationship with / impact on / interface with the SOI.
- The SOI is shown as a goose-egg in the centre of the diagram—nothing inside the system is shown.
- The groupings are then drawn as goose-eggs:
  - two overlapping goose-eggs represent an interface,
  - an arrow between illustrates an influence of one group over the other (in the direction of the arrow).
- Move around the boundary verifying each relationship as it is depicted. The diagram is adjusted as necessary and the process continues until the diagram is complete.
Define system boundary

- Definition of the system boundaries is also critical to the success of the fielded system.

- It is essential that these boundaries are defined early in the Acquisition Phase so that it is clear which system elements are under the design control of the project and which are outside the control.

- This is also particularly important to the project manager who is vitally concerned with defining what is to be included in the system as well as what is to be excluded.
System boundary

- The boundary of a system is normally straightforward to describe in physical terms (such as a fence line, or external building walls), but it is often necessary to describe the boundary in conceptual or logical terms as well.
- Additionally, although we traditionally describe the boundary in terms of what is inside the boundary—that is, what is included inside the system—it is often useful to describe what isn’t inside the boundary.
- This is particularly useful when there are a number of elements that may commonly be assumed to be part of the system but are not in this particular case.
Define external interfaces

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

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

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

Consider external interfaces

- The definition of an interface requires considerably more detail than simply identifying and naming the interface. Broadly there are three main steps in interface definition:

  - **Interface description.** The interface is given a name, short title and identifier. The nature of the interface is described in terms of who, what, when, where, why, how.

  - **Interface impact analysis.** The interface is analyzed in terms of its impact on the system. In particular, any constraints imposed by the system are identified. A risk analysis is conducted to determine the impact of the interface on the operation and design of the system.

  - **Interface control analysis.** Each external interface must be analyzed to determine the extent to which it can be controlled so that designers and operators of the system are not at the mercy of its external interfaces.
Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

External interfaces

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

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- C1.5.4 Revise preliminary validation criteria
- C1.5.5 Endorse business needs and requirements (BNR)

- C2. Define stakeholder needs and requirements
System feasibility analysis

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

Feasibility analysis—solution class

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

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<td>Microwave radio relay</td>
<td>Surface-wave radar</td>
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<td>HF Communications</td>
<td>Airborne sensors</td>
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<tr>
<td>Satellite</td>
<td>Satellite sensors</td>
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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.
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
Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

Conceptual Design

- C1. Define business needs and requirements
- C2. Define stakeholder needs and requirements
- C3. Define system requirements
- C4. Conduct system-level synthesis
- C5. Conduct System Design Review (SDR)

To Preliminary Design

Define stakeholder needs and reqts

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Define stakeholder needs

C1. Define business needs and requirements

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  C2.1.4 Develop life-cycle concepts
  C2.1.5 Endorse stakeholder needs

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

C2.3 Finalise stakeholder needs and requirements (SNR)
  C2.3.1 Revise operational scenarios
  C2.3.2 Revise life-cycle concepts
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C3. Define system requirements

Trade studies

C1. Define business needs and requirements

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SNR (LCD and SNRS)

C3. Define system requirements
Trade studies

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

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

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

- Informed choices in design are made through trade studies.

Trade study process

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

A reader of the StRS should be able to understand completely:

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

In our aircraft development example, the StRS will contain such statements as:

- The Aircraft shall be capable of operating from a Class X airport.
- The Aircraft shall provide class-leading comfort for passengers.
- The Aircraft shall be turned around to its next flight within 30 minutes.

StRS example for ACME Air

The Aircraft shall provide class-leading comfort for passengers.

Note that the StRS requirement statements are similar in construction and language to those that will follow in the SyRS, but they do not have to be as precise and the verification requirements can be less stringent.

That is, for example, class-leading comfort is not directly verifiable, but it is sufficiently bounded for the next level of design (conducted by the system designers) to understand what quantitative statements must be made that, when implemented, will lead to ‘class-leading’ comfort.
Finalise & Endorse SNR

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 Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

Capability system

Conceptual Design

Conceptual Design

C1. Define business needs and requirements

C2. Define stakeholder needs and requirements

C3. Define system requirements

C4. Conduct system-level synthesis

C5. Conduct System Design Review (SDR)

To Preliminary Design
Define requirements

C2. Define stakeholder needs and requirements

C3. Define system requirements

C3.1 Establish system requirements framework

C3.2 Perform requirements analysis and allocation

C3.2.1 Define functional / non-functional requirements

C3.2.2 Define performance requirements

C3.2.3 Define verification requirements

C3.2.4 Assign rationale

C3.3 Draft System Requirements Specification (SyRS)

C3.4 Define Technical Performance Measures (TPM)

C3.5 Conduct System Requirements Review (SRR)

C4. Conduct system-level synthesis

System Requirements Analysis

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

Turning around in 30 minutes:

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

3.1 Unload passengers, freight, luggage (PFL)
3.2 Load PFL
3.3 Conduct refueling
3.4 Maintain aircraft
3.5 Other turn-around functions

Define performance requirements

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

C4. Conduct system-level synthesis
Define performance requirements

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

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

Define verification requirements

C2. Define stakeholder needs and requirements

C3. Define system requirements

C3.1 Establish system requirements framework

C3.2 Perform requirements analysis and allocation

C3.2.1 Define functional / non-functional requirements

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C3.5 Conduct System Requirements Review (SRR)

C4. Conduct system-level synthesis

Draft SyRS

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Define verification requirements

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

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

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

Define verification requirements

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

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

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

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

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

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

Assign rationale
Assign rationale

- The rationale explains why each requirement is necessary and the logic behind performance imperatives assigned to the requirement.

- It is also useful to record the rationale behind each requirement, because:
  - The requirement should be able to be justified.
  - It helps explain the requirement which may avoid ambiguity.
  - Communicates intent to lower-level designers.
  - Assists in the tracing required for requirements management.

- Example: Rear Windscreen Design

Analysis and allocation
Analysis and allocation example

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

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

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

<table>
<thead>
<tr>
<th>Analysis and allocation example</th>
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<tbody>
<tr>
<td>1. Operate from Class X Airports</td>
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<tr>
<td>1.1 Operate from specified minimum runway length</td>
</tr>
<tr>
<td>1.2 Operate from specified runway surface</td>
</tr>
<tr>
<td>1.3 Operate with specified maximum allowable aircraft weight</td>
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<tr>
<td>1.4 Operate with specified essential navigation aids</td>
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<tr>
<td>1.5 Operate with specified essential automatic landing systems</td>
</tr>
<tr>
<td>1.6 Operate with specified essential communications systems</td>
</tr>
</tbody>
</table>

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

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

Analysis and allocation example

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

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

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

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

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

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

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

Conduct System Requirements Reviews (SRR)
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.
Conceptual Design

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

- **C2. Define stakeholder needs and requirements**
  - SNR (LCD & StRS)

- **C3. Define system requirements**
  - Draft SyRS

- **C4. Conduct system-level synthesis**
  - SyRS

- **C5. Conduct System Design Review (SDR)**
  - Initial FBL

  To Preliminary Design

System-level synthesis

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

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

System-level synthesis

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

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

System-level synthesis

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

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

Conceptual Design

- C1. Define business needs and requirements
- C2. Define stakeholder needs and requirements
- C3. Define system requirements
- C4. Conduct system-level synthesis
- C5. Conduct System Design Review (SDR)

To Preliminary Design
System Design Review (SDR)

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

System Design Review (SDR)

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

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

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

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

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

Subsystem requirement analysis

Remember our example FFBD for turning around in 30 minutes:

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

- Aircraft turns around in 30 minutes
- Unload passengers, freight, baggage (PFL)
- Load PFL
- Conduct refuelling
- Maintain aircraft
- Other turn-around functions
Subsystem requirement analysis

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

![Diagram showing the detailed functions of refueling a system]

Configuration items (CI)

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

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

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

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

CI selection

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

- The determination and selection of CIs is a design decision made by the design team (contractor) in their attempt to satisfy the system level requirements in the best possible way.
- The customer sometimes influences the decision, especially if there are mandated solutions or constraints involving customer-furnished equipment that must be used in the design.
- Even if the customer does not influence the decision, the customer needs to be aware of the CI selection process because it impacts on:
  - acquisition activities such as documentation, design reviews, configuration audits and test and evaluation; and
  - operational use and system support activities such as maintenance and modification programs.

Requirements allocation

- We have our subsystems and we have our sets of requirements.
- We now “join the dots” and allocate requirements to subsystems (which represents the translation of functional design into physical design).
- Our requirements set will be larger following our subsystem requirements analysis task but for the sake of the example, we will allocate system-level requirements only.
RBS vs WBS (an aside)

• Early on, we justified the invention of a new term (RBS) by stating that the term was used to differentiate it from a well-known project management term (WBS).

• We are now in a position to investigate the relationship between the RBS and the WBS in order to emphasise the differences between the two structures.

• The concept of the WBS is closely related to the physical structure shown (horizontally) in the allocation matrix.

• WBS documents the work and products necessary to produce the system, which necessarily includes all the CIs listed in our allocation matrix.
RBS vs WBS (an aside)

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

RBS vs WBS—Aircraft example

[Diagram showing aircraft system with various components such as systems engineering, project management, operational activation, support equipment, facilities, spares, etc.]

[UNSW Canberra logo]
Revision

19. Explain the relationship between an RBS and a WBS.
Use of architectures

Problem space (in which stakeholders’ business exists)

Stakeholder’s Operational Environment

Stakeholder Requirements

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

—stable architectural building blocks

Architectural Family

Logical to Physical Translation

CI

Influences

Requirements Engineering

Logical Architecture

SyRS

StRS

Constrains

Preliminary Design Review (PDR)

• The major PDR task is to investigate each CI.

• Ensure that all system-level requirements have been allocated appropriately.

• Ensure that the system-level requirements have been allocated and derived to sufficient levels of detail to support detailed design and development

• Ensure that CI to CI (internal) interfaces have been identified and documented.

• Ensure CI to environment (external) interfaces have been addressed.
Preliminary Design Review (PDR)

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

Preliminary Design Review (PDR)

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

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

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

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

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

- UNSW Canberra
Detailed Design & Development

The major technical activities undertaken during Detailed Design and Development include:

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

Integration

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

These components need to be:

- Procured (in the case of COTS equipment).
- Procured and modified (for modified COTS).
- Constructed (in the case of developmental items)

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

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

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

Critical Design Review (CDR)

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

- At the end of Detailed Design and Development, the PBL has been established and the production process is in place and has been proven (most likely with the trial production of selected system elements).
- The system can now move into Construction and/or Production.
Capability Life Cycle (CLC) Management
Dr Mike Ryan & Dr Shari Soutberg

Construction and/or Production

- As with all other system requirements, Construction and/or Production requirements need to be considered early in the system development.
- Issues that need to be addressed include:
  - material availability (lead times), ordering, and handling;
  - availability of skill sets (including any training);
  - availability of production tools and equipment;
  - fabrication requirements including production requirements, assembly drawings and instructions;
  - processing and process control;
  - assembly, inspection and test; and
  - packaging, storage, and handling.

The Production Plan

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

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

Test Readiness Review (TRR)

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

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

Utilization Phase
(Operational Use and System Support)
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

Operational Use and System Support

• Operational Use
  – Deployment and operation of the system against the original requirements
  – Note that requirements and use of the system may well change as time goes on
• System Support
  – Maintenance and support activities designed during Acquisition Phase
  – Aims to ensure that system is capable of fulfilling operational requirements
  – Support can become challenging as the system ages
Operational Use and System Support

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

Modifications

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

- A failure reporting, analysis, and corrective action system (FRACAS) is a closed-loop system designed to continually maintain visibility into system operation and support.

- The FRACAS is put in place to record, analyze and rectify the cause of system failures, especially recurring or related failures.

- The important difference between a maintenance system and a FRACAS is that the maintenance system rectifies the failure and the FRACAS attempts to rectify the cause.

FRACAS

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

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

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

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

Retirement Phase

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

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

First life cycle

Second life cycle

Final life cycle

Disposal

Systems Engineering Management
Technical reviews and audits

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

Technical reviews and audits

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

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

Technical reviews and audits

• We have already discussed the following reviews and audits discussed in MIL-STD-499B:
  – System Requirements Review
  – System Design Review
  – Preliminary Design Review
  – Critical Design Review
  – Test Readiness Review
  – Functional Configuration Audit
  – Physical Configuration Audit
  – Formal Qualification Review
  
| Conceptual Design |
| Preliminary Design |
| Detailed Design & Development |
| Construction and/or Production |
# Technical reviews and audits

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<tr>
<td>Synthesis &amp; Evaluation</td>
<td>Functional Analysis</td>
<td>Development Specifications</td>
<td>Product Specifications</td>
<td>Formal Qualification Review</td>
</tr>
</tbody>
</table>

### Technical review and audit management

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

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

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

System T&E

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

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

Verification and Validation (V&V)

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

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

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.
- Operational Test and Evaluation (OT&E):
  - Focuses on functional or operational testing of the system.
  - Generally undertaken by users following acceptance.
  - Some OT&E—called Preview T&E (PT&E)—can occur earlier during Acquisition Phase, particularly for large, phased projects.
Developmental Test and Evaluation (DT&E)

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

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

Operational Test and Evaluation (OT&E)

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

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

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

Test and Evaluation Master Plan (TEMP)

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

SE Standards Evolution

Integration & Planning
Integration Management

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

SE Management Plan (SEMP)

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

**Dr Mike Ryan & Dr Shari Soutberg**

### Major Plans

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<tr>
<th>Missions</th>
<th>Conceptual Design</th>
<th>Preliminary Design</th>
<th>Detailed Design &amp; Development</th>
<th>Construction and/or Production</th>
<th>Operational Use and System Support</th>
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<tr>
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<td>System Synthesis &amp; Evaluation</td>
<td>Detailed Design Requirements</td>
<td>System Prototype Development</td>
<td>Modifications</td>
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<tr>
<td>Subsystem Level</td>
<td>Subsystem Functional Analysis</td>
<td>Requirements Allocation</td>
<td>Detailed Design Requirements</td>
<td>System Prototype Development</td>
<td>Modifications</td>
</tr>
<tr>
<td>Component Level</td>
<td>Component Functional Analysis</td>
<td>Component Synthesis &amp; Evaluation</td>
<td>System Prototype Development</td>
<td>System Prototype Development</td>
<td>Modifications</td>
</tr>
</tbody>
</table>

- **BNR/SNR**
- **Function**
- **Baseline**
- **Allocated Baseline**
- **Development Specifications**
- **Product Baseline**
- **Product Specifications**
- **Process Specifications**
- **Material Specifications**

- **System Requirements Review**
- **Preliminary Design Review**
- **System Design Review**

- **Critical Design Review**
- **Functional Configuration Audit**
- **Physical Configuration Audit**
- **Test Readiness Review**
- **Formal Qualification Review**

- **Technical Review and Audit Plan (TRAP)**
- **Test and Evaluation Master Plan (TEMP)**
- **Risk Management Plan (RMP)**
- **Configuration Management Plan (CMP)**
- **Systems Engineering Management Plan (SEMP)**

### Introduction to Project Management
Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

Introduction

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


What is a project?

• Normally within an organisation there are the people who conduct the normal operations of an organisation (the tellers in bank, for example) and those that perform projects undertaken to improve the organisation and its services (the project managers who roll out the new ATM network, for example).
• While the distinction between the two is occasionally blurred, operations tend to be ongoing and repetitive, while a project is:

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

What is a project?

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

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

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Project size

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

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

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

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

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

What is a project?

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

What is project management?

• Project management is:

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

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

Program and portfolio management

- A **program** is defined as a group of related projects managed in a coordinated way to obtain benefits and control not available from managing them individually.

- A **portfolio** is a collection of projects or programs and other work that are grouped together to facilitate effective management of that work to meet strategic business objectives.

Who is the project manager?

- The project manager is the single point of responsibility for a project.

- The project manager integrates and coordinates all the contributions of the project team and guides them successfully to completion.

- Project managers need good:
  - General management and administration skills
  - Leadership skills
  - Planning, problem-solving and decision-making ability
  - Communications (written and verbal) skills
  - Negotiation skills
  - Technical skills
Capability Life Cycle (CLC) Management

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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

Project Integration Management

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

1.1 Develop Project Charter

- Inputs
  - Business documents
  - Agreements
  - Enterprise environmental considerations
  - Organisational process assets

- Tools and Techniques
  - Expert judgement
  - Data gathering
  - Interpersonal and team skills
  - Meetings

- Outputs
  - Project charter
  - Assumption log

1.2 Develop Project Management Plan

- Inputs
  - Project charter
  - Outputs from other processes
  - Enterprise environmental considerations
  - Organisational process assets

- Tools and Techniques
  - Expert judgement
  - Data gathering
  - Interpersonal and team skills
  - Meetings

- Outputs
  - Project management plan

1.3 Direct and Manage Project Execution

- Inputs
  - Project management plan
  - Project documents
  - Approved change requests
  - Enterprise environmental considerations
  - Organisational process assets

- Tools and Techniques
  - Expert judgement
  - PMIS
  - Meetings

- Outputs
  - Deliverables
  - Work performance data
  - Issue log
  - Change requests
  - PMP updates
  - Project documentation updates
  - Organisational process assets updates

1.4 Manage Project Information

- Inputs
  - Project management plan
  - Project Documents
  - Deliverables
  - Enterprise environmental considerations
  - Organisational process assets

- Tools and Techniques
  - Expert judgement
  - Knowledge management
  - Information management
  - Interpersonal and team skills

- Outputs
  - Lessons learned register
  - Project management plan updates
  - Organisational process assets updates

1.5 Monitor and Control Project Work

- Inputs
  - Project management plan
  - Project documents
  - Approved change requests
  - Work performance documentation
  - Agreements
  - Enterprise environmental factors
  - Organisational process assets

- Tools and Techniques
  - Expert judgement
  - Data analysis
  - Decision making
  - Meetings

- Outputs
  - Work performance reports
  - Change requests
  - Project management plan updates
  - Project document updates

**Project Scope Management**

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

2.1 Plan Scope Management
  .1 Inputs
    1. Project charter
    2. Project management plan
    3. Enterprise environmental factors
    4. Organisational process assets
  .2 Tools and Techniques
    1. Expert judgement
    2. Analysis
    3. Meetings
  .3 Outputs
    1. Scope management plan
    2. Requirements management plan

2.2 Collect Requirements
  .1 Inputs
    1. Project charter
    2. Project management plan
    3. Project documents
    4. Business documents
    5. Agreements
    6. Enterprise environmental factors
    7. Organisational process assets
  .2 Tools and Techniques
    1. Expert judgement
    2. Data analysis
    3. Decision making
    4. Data representation
    5. Interpersonal and team skills
    6. Prototypes
  .3 Outputs
    1. Requirements documentation
    2. Requirements traceability matrix

2.3 Define Scope
  .1 Inputs
    1. Project charter
    2. Project management plan
    3. Project documents
    4. Business documents
    5. Agreements
    6. Enterprise environmental factors
    7. Organisational process assets
  .2 Tools and Techniques
    1. Expert judgement
    2. Data analysis
    3. Decision making
    4. Interpersonal and team skills
    5. Product analysis
  .3 Outputs
    1. Project scope statement
    2. Project documentation updates

Project Scope Management

2.4 Create WBS
  .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. Decomposition
  .3 Outputs
    1. Scope baseline
    2. Project documentation updates

2.5 Validate Scope
  .1 Inputs
    1. Project management plan
    2. Project documents
    3. Work performance data
  .2 Tools and Techniques
    1. Inspection
    2. Decision making
  .3 Outputs
    1. Accepted deliverables
    2. Work performance information
    3. Change requests
    4. Project document updates

2.6 Control Scope
  .1 Inputs
    1. Project management plan
    2. Project documents
    3. Work performance data
    4. Organisational process assets
  .2 Tools and Techniques
    1. Data analysis
  .3 Outputs
    1. Work performance information
    2. Change requests
    3. Project management plan updates
    4. Project document updates
Project Schedule Management

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

Project Schedule Management

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

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

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

**Outputs**
1. Schedule management plan

3.2 Define Activities

**Inputs**
1. Project management plan
2. Enterprise environmental factors
3. Organisational process assets

**Tools and Techniques**
1. Expert judgement
2. Decomposition
3. Rolling wave planning
4. Meetings

**Outputs**
1. Activity list
2. Activity attributes
3. Milestone list
4. Change requests
5. Project management plan updates

3.3 Sequence Activities

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

**Tools and Techniques**
1. Precedence diagramming method
2. Dependency determination and integration
3. Leads and lags
4. PMIS

**Outputs**
1. Project schedule network diagrams
2. Project documentation updates

3.4 Estimate Activity Durations

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

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

**Outputs**
1. Duration estimates
2. Basis of estimates
3. Project document updates

3.5 Develop Schedule

**Inputs**
1. PMP, 2 Project documents
2. Agreements
3. Enterprise environmental factors
4. Organisational process assets

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

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

3.6 Control Schedule

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

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

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

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

Total Cost of Ownership

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

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

Costing activities across CLC

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

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

4.2 Estimate Costs
- Inputs
  1. Project management plan
  2. Project documents
  3. Enterprise environmental factors
  4. Organisational process assets
- Tools and Techniques
  1. Expert judgement
  2. Analogous/parametric estimating
  3. Bottom-up estimating
  4. Three-point estimating
  5. Data analysis
  6. PMIS
  7. Decision making
- Outputs
  1. Cost estimates
  2. Basis of estimates
  3. Project document updates

4.3 Determine Budget
- Inputs
  1. Project management plan
  2. Project documents
  3. Business documents
  4. Agreements
  5. Enterprise environmental factors
  6. Organisational process assets
- Tools and Techniques
  1. Expert judgement
  2. Cost aggregation
  3. Data analysis
  4. Historical information review
  5. Funding limit reconciliation
  6. Financing
- Outputs
  1. Cost baseline
  2. Project funding requirements
  3. Project document updates

4.4 Control Costs
- Inputs
  1. Project management plan
  2. Project documents
  3. Project funding requirements
  4. Work performance data
  5. Organisational process assets
- Tools and Techniques
  1. Expert judgement
  2. Data analysis
  3. To-complete performance index
  4. PMIS
- Outputs
  1. Work performance information
  2. Cost forecasts
  3. Change requests
  4. Project management plan updates
  5. Project document updates
Project Quality Management

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

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**5.1 Plan Quality Management**

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<th>Outputs</th>
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<td>.1 Quality management plan</td>
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<td>.6 Test and inspection planning</td>
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<tr>
<td>.7 Meetings</td>
<td>.6 Test and inspection planning</td>
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**5.2 Manage Quality**

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<td>.1 Data gathering</td>
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<td>.7 Meetings</td>
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**5.3 Control Quality**

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<th>Inputs</th>
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</tr>
</thead>
<tbody>
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<td>.1 Data gathering</td>
<td>.1 Quality control measurements</td>
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<td>.2 Project documents</td>
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<tr>
<td>.7 Organisational process assets</td>
<td>.7 Change requests</td>
<td>.7 Project document updates</td>
</tr>
</tbody>
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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

#### 6.4 Develop Team

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

**Tools and Techniques**
1. Co-location
2. Virtual teams
3. Communication technology
4. Interpersonal and team skills
5. Recognition and rewards
6. Training
7. Individual and team assessments
8. Meetings

**Outputs**
1. Team performance assessments
2. Change requests
3. Project management plan updates
4. Project documents updates
5. Enterprise environmental factors updates
6. Organisational process assets updates

#### 6.5 Manage Team

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

**Tools and Techniques**
1. Interpersonal and team skills
2. PMIS

**Outputs**
1. Change requests
2. Project management plan updates
3. Project documents updates
4. Enterprise environmental factors updates

#### 6.6 Control Resources

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

**Tools and Techniques**
1. Data analysis
2. Problem solving
3. Interpersonal and team skills

**Outputs**
1. Change requests
2. Project management plan updates
3. Project documents updates

---

**Communications Management**

- Starts with communications planning to determine the overall communications requirements—who needs what, when and how.
- Information is then disseminated in accordance with the findings of the first step.
- Must be done in a timely manner.
- Reporting the performance and status of the project is an important part of communications.
- An important communications aspect is reporting the closure of project phases or the project itself.
Project Communications Management

7.1 Plan Communications Management

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

2. Tools and Techniques
   - Expert judgement
   - Communications requirements analysis
   - Communications technology
   - Communication models
   - Communication methods
   - Interpersonal and team skills
   - Data representation
   - Meetings

3. Outputs
   - Communications management plan
   - Project management plan updates
   - Project documentation updates

7.2 Manage Communications

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

2. Tools and Techniques
   - Communications technology
   - Communications models
   - Communications skills
   - PIMS
   - Project reporting
   - Interpersonal and team skills
   - Data representation

3. Outputs
   - Project communications
   - Project management plan updates
   - Project documentation updates
   - Organizational process assets updates

7.3 Monitor Communications

1. Inputs
   - Project management plan
   - Project documents
   - Work performance data
   - Enterprise environmental factors
   - Organizational process assets

2. Tools and Techniques
   - Expert judgement
   - PIMS
   - Data representation
   - Interpersonal and team skills
   - Meetings

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


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

6.1 Plan Risk Management
1. Inputs
   - Project scope
   - Project management plan
   - Project documents
   - Enterprise environmental factors
   - Organisational process assets
2. Tools and Techniques
   - Expert judgment
   - Data analysis
   - Meetings
3. Outputs
   - Risk management plan

6.2 Identify Risks
1. Inputs
   - Project management plan
   - Project documents
   - Agreements
   - Procurement documentation
   - Enterprise environmental factors
   - Organisational process assets
2. Tools and Techniques
   - Expert judgment
   - Data gathering
   - Data analysis
   - Interpersonal and team skills
   - Prompt lists
   - Meetings
3. Outputs
   - Risk register
   - Risk reports
   - Project documents updates

6.3 Perform Qualitative Risk Analysis
1. Inputs
   - Project management plan
   - Project documents
   - Agreements
   - Enterprise environmental factors
   - Organisational process assets
2. Tools and Techniques
   - Expert judgment
   - Data gathering
   - Data analysis
   - Interpersonal and team skills
   - Risk categorisation
   - Data representation
   - Meetings
3. Outputs
   - Risk register
   - Risk reports
   - Project documents updates

6.4 Perform Quantitative Risk Analysis
1. Inputs
   - Project management plan
   - Project documents
   - Enterprise environmental factors
   - Organisational process assets
2. Tools and Techniques
   - Expert judgment
   - Data gathering
   - Interpersonal and team skills
   - Representation of uncertainty
   - Data analysis
3. Outputs
   - Risk register
   - Risk reports
   - Project documents updates

6.5 Plan Risk Responses
1. Inputs
   - Project management plan
   - Project documents
   - Enterprise environmental factors
   - Organisational process assets
2. Tools and Techniques
   - Expert judgment
   - Data gathering
   - Interpersonal and team skills
   - Strategies for threats
   - Strategies for opportunities
   - Contingent response strategies
   - Strategies for overall project risk
   - Data analysis
   - Decision making
3. Outputs
   - Change requests
   - Project management plan updates
   - Project documents updates

8.6 Implement Risk Responses
- Inputs
  - Project management plan
  - Project documents
  - Organisational process assets
- Tools and Techniques
  - Expert judgement
  - Interpersonal and team skills
  - PMIS
- Outputs
  - Change requests
  - Project documents updates

8.7 Monitor Risks
- Inputs
  - Project management plan
  - Project documents
  - Work performance data
  - Work performance reports
- Tools and Techniques
  - Data analysis
  - Audits
  - Meetings
- Outputs
  - Work performance information
  - Change requests
  - Project management plan updates
  - Project documents updates
  - Organisational process assets updates

Procurement Management
- Responsible for obtaining materials and services for the project from outside the organisation.
- Planning must be conducted to determine what is required and when.
- Solicitation planning—these requirements must be documented and potential sources identified.
- Solicitation involves obtaining quotes and offers etc.
- Source selection determines the best offer.
- Contract administration—put in place to manage the procurement contract with the source.
- Contract close-out—completion and settlement of the contract.
### 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.
10.1 Identify Stakeholders

1. Inputs
   - Project charter
   - Procurement documents
   - Project management plan
   - Agreements
   - Enterprise environmental factors
   - Organizational process assets

2. Tools and Techniques
   - Expert judgment
   - Data gathering
   - Data analysis
   - Meetings

3. Outputs
   - Stakeholder register
   - Change requests
   - Project management plan updates

10.2 Plan Stakeholder Engagement

1. Inputs
   - Project charter
   - Project management plan
   - Agreements
   - Enterprise environmental factors
   - Organizational process assets

2. Tools and Techniques
   - Expert judgment
   - Data gathering
   - Decision making
   - Meetings

3. Outputs
   - Stakeholder engagement plan

10.3 Manage Stakeholder Engagement

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

2. Tools and Techniques
   - Expert judgment
   - Communications skills
   - Interpersonal and team skills
   - Meetings

3. Outputs
   - Change requests
   - Project management plan updates
   - Project documents updates

10.4 Monitor Stakeholder Engagement

1. Inputs
   - Project management plan
   - Project documents
   - Work performance data
   - Enterprise environmental factors
   - Organizational process assets

2. Tools and Techniques
   - Data analysis
   - Decision making
   - Communications skills
   - Interpersonal and team skills
   - Meetings

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

- Because each project is unique we must be careful to manage it since there is always at least some part of the project that we have never done before.
- To assist in managing projects we normally break the activities up into a number of phases.
- Phases are important because:
  - They allow for finer control and management.
  - Projects are easier to describe and communicate.
  - Decision points at the end of phases allow us the opportunity to review progress and make decisions about future work.
  - Phases of activity can be associated with broader organisational financing and scheduling arrangements.

Project Life Cycle

- Phases normally end with some form of deliverable.
- In some respects, then, we can consider a phase as a mini-project that has resources, a beginning and an end, and so on—we can therefore manage it properly.
- The set of all phases is called the project life cycle.
- There are a number of project life-cycle models adopted by different organisations. While they are largely very similar, they have slightly different phases, end points, reviews, and so on, depending on the unique needs of the industry and the organisation.
- All project life cycles have a number of common elements.
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.
The Importance of Project Definition

% of Potential Cost or Efficiency Gains Achieved or Lost

65% 25% 10%

Requirements Identification, Strategy Development, and Initial Risk Assessment

Systems Design and Development

Build and Introduction Into Service

% of Total Project Cost for Typical Project

The Importance of Project Definition

Impact of problem definition (ease of making changes)

Resource levels (cost of making changes)

High

Low

Time
# Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

## Typical Project Life Cycles

<table>
<thead>
<tr>
<th>Conceive</th>
<th>Develop</th>
<th>Implement</th>
<th>Terminate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gather data</td>
<td>Appoint team</td>
<td>Set up organisation</td>
<td>Finalise products</td>
</tr>
<tr>
<td>Identify need</td>
<td>Conduct studies</td>
<td>Set up communications</td>
<td>Review and accept</td>
</tr>
<tr>
<td>Establish: Goals, objectives</td>
<td>Develop scope</td>
<td>Motivate team</td>
<td>Transfer responsibility</td>
</tr>
<tr>
<td>Basic economics</td>
<td>Establish: Master plan</td>
<td>Detail technical requirements</td>
<td>Evaluate product</td>
</tr>
<tr>
<td>Feasibility</td>
<td>Budget</td>
<td>Establish</td>
<td>Document results</td>
</tr>
<tr>
<td>Stakeholders</td>
<td>Cash flow</td>
<td>Work packages</td>
<td>Release/redirect resources</td>
</tr>
<tr>
<td>Risk level</td>
<td>WBS</td>
<td>Detailed schedule</td>
<td>Reassign project team</td>
</tr>
<tr>
<td>Strategy</td>
<td>Policies</td>
<td>Information control systems</td>
<td></td>
</tr>
<tr>
<td>Team</td>
<td>Procedures</td>
<td>Procure goods and services</td>
<td></td>
</tr>
<tr>
<td>Estimate resources</td>
<td>Assess risks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify alternatives</td>
<td>Confirm justification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present proposal</td>
<td>Present brief</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Simple Project Life-cycle Phases

- Conceive
- Develop
- Implement
- Terminate

## Typical Project Life Cycles

- **Conception**
- **Development**
- **Implementation**
- **Termination**

### Level of Effort

- **Conception**
- **Development**
- **Implementation**
- **Termination**

### Time

- **Conception**
- **Development**
- **Implementation**
- **Termination**
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Typical Project Life Cycles

ACQUISITION PHASE

Conceptual Design

Preliminary Design

Detailed Design and Development

Construction and/or Production

Operational Use and System Support

UTILISATION PHASE

Systems Engineering—Blanchard, et al

Typical Project Life Cycles

Need

Requirements

Acquisition

In Service

Disposal

Pre-FPR

Strategy and Concepts

Risk Mitigation & Requirements Setting

Acquisition

In Service & Disposal

Post-FPR

Australian Department of Defence
### Typical Project Life Cycles

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept and Technology Development</td>
<td></td>
</tr>
<tr>
<td>Pre-Systems Acquisition</td>
<td></td>
</tr>
<tr>
<td>Systems Acquisition (Engineering Development, Demonstration, Production, and Deployment)</td>
<td></td>
</tr>
<tr>
<td>Production and Deployment</td>
<td></td>
</tr>
<tr>
<td>Support</td>
<td></td>
</tr>
<tr>
<td><strong>US Department of Defense</strong></td>
<td></td>
</tr>
</tbody>
</table>

#### Software Development—Waterfall Model

- **REQTS ANALYSIS**
- **SYSTEM DESIGN**
- **PROGRAM DESIGN**
- **CODING**
- **TESTING (Unit, Integration, System, Acceptance)**
- **OPERATION & MAINT**
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Waterfall—Overlapping builds

Incremental Approach
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Iterative Approach

Evolutionary Approach
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Spiral Development

Project Scope Management
Project Scope Management

- Project scope management articulates the processes required to make sure that the project undertakes all of the work required, and no more than the work required, to complete the project.

### 2.2 Collect Requirements

**Inputs**
- 1. Scope management plan
- 2. Requirements management plan
- 3. Stakeholder management plan
- 4. Project charter
- 5. Stakeholder register

**Tools and Techniques**
- 1. Interviews
- 2. Focus groups
- 3. Facilitated workshops
- 4. Group creativity techniques
- 5. Group decision making techniques
- 6. Questionnaires and surveys
- 7. Observations
- 8. Prototypes
- 9. Benchmarking
- 10. Context diagram

**Outputs**
- 1. Requirements documentation
- 2. Requirements traceability matrix

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

2.4 Create WBS
   - Inputs
     1. Scope management plan
     2. Project scope statement
     3. Requirements documentation
     4. Enterprise environmental factors
     5. Organisational process assets
   - Tools and Techniques
     1. Decomposition
     2. Expert judgement
   - Outputs
     1. Scope baseline
     2. Project documentation updates

2.5 Validate Scope
   - Inputs
     1. Project management plan
     2. Requirements documentation
     3. Requirements traceability matrix
     4. Verified deliverables
     5. Work performance data
   - Tools and Techniques
     1. Inspection
     2. Group decision-making techniques
   - Outputs
     1. Accepted deliverables
     2. Change requests
     3. Work performance information
     4. Project document updates

2.6 Control Scope
   - Inputs
     1. Project management plan
     2. Requirements documentation
     3. Requirements traceability matrix
     4. Work performance data
     5. Organisational process assets
   - Tools and Techniques
     1. Variance analysis
   - Outputs
     1. Work performance information
     2. Change requests
     3. Project management plan updates
     4. Project document updates
     5. Organisational process assets updates

Work Breakdown Structures (WBS)

- A WBS is a deliverable-oriented grouping of project components that provides a hierarchical description of the whole project—if it isn’t in the WBS, it isn’t in the project’s scope.
- The WBS is therefore a graphical overview of the project that helps verify as well as communicate the project scope.
- The WBS is normally presented in chart form—each item is uniquely identified.
- The lowest level of the WBS contains what are normally called work packages.
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Dr Mike Ryan & Dr Shari Soutberg

Work Breakdown Structures (WBS)

Aircraft system
- Air vehicle
  - Undercarriage CI
  - Wing/fuselage CI
  - Tail system CI
  - Systems test & evaluation
  - Engine CI
  - Airframe CI
  - Systems engineering/project management

Systems test & evaluation
- Developmental test & evaluation
- Acceptance test & evaluation
- T&E support
- Test facilities
- Aircraft systems
- Support services
- Facilities

Training
- Aircraft equipment
- Support services
- Facilities

Data
- Technical publications
- Engineering data
- Management data
- Support data
- Data repository

Support equipment
- Test & measurement equipment
- Support & handling equipment

Operational activation
- System-level assembly, installation & checkout
- Technical support
- Site construction

Spare parts

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

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
Program Management

A program is a group of related projects managed in a coordinated manner to obtain benefits not available from managing them individually.

Program management is the application of knowledge, skills, tools and techniques to meet program requirements.

Source: PMI website

Program Management

• Who needs to know how Programs work:
  – those responsible for Programs eg Program Sponsors and Managers
  – those who are part of a Program eg Project and Product Managers
CLC Programs

• The common features of Programs:
  – Group of related interdependent Projects, Products and activities that are expected to contribute to an overarching objective.
  – Constituent Products, Projects, and activities are managed mostly separately and will likely be at different phases of the capability lifecycle.
  – The Program authority (Sponsor or Manager) is accountable for the combined outcomes.

System of Systems Engineering

• Program Management can be aided by System-of-Systems thinking
• System-of-Systems problems have been described (by DeLaurentis and Maier) as problems which exhibit a number of the following traits:
  – Operational Independence of Elements
  – Managerial Independence of Elements
  – Evolutionary Development
  – Emergent Behaviour
  – Geographical Distribution of Elements
  – Interdisciplinary Study
  – Heterogeneity of Systems
  – Networks of Systems
System of Systems Engineering

- The aims of the Systems Approach and SoSE are to:
  - optimise the outcomes delivered through the new systems (Projects) and legacy (Products) which together satisfy the Program objectives.
  - provide techniques that enable decision-makers to make informed decisions on architectural solutions for System-of-Systems problems across e.g., technical performance, costs.
  - provide a deliberately managed approach to the definition, design and delivery of capability systems in a Program across Projects and Products.

SoS Architecture Practice for Programs

- “An architecture is the structure of components, their relationships, and the principles and guidelines governing their design evolution over time” (IEEE 610.12-1990).
- The application of architectures for SoS is directly applicable to CLC Programs.
- SoS (and therefore Program) architectures provide:
  - details on how constituent systems will be used (CONOPS)
  - internal and external operational, functional and technical relationships and dependencies among the constituent systems
  - end-to-end functionality and flows of information and data (and other resources)

Source: Based on SEBoK Architecting approaches for SoS
SoS/Program Architectures

- Provides a common and enduring reference for decisions for Proposals, Projects and Products.

- “From the single-system community's perspective, its part of the SoS capability represents additional obligations, constraints and complexities. Rarely is participation in an SoS seen as a net gain from the viewpoint of single-system stakeholders”
  (Source: Rebovich 2009)

- SEBoK raises the practical problems and potential solutions for situations in which the SoS architecture may be constrained by a reluctance to make changes or invest in the constituent systems, which could be very mature (e.g. in sustainment) or currently productively supporting other uses.
  (Source: SEBoK Architecting approaches for SoS)

Integrated Logistics Support
Support Elements Addressed through ILS

The support elements are all functions and resources necessary to ensure that each mission system is effectively supported during the in-service phase:

- engineering support;
- maintenance support;
- supply support;
- training support;
- packaging, handling, storage and transportation (PHS&T);
- facilities;
- support and test equipment (S&TE);
- personnel;
- technical data; and
- computer support.

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

Source: DEFLOGMAN Part 2 Vol 10 Chapter 3
### 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.

3. **Maintenance Support Capability.** Maintenance support is the capability which includes the support elements necessary to develop, establish and integrate a maintenance support system capable of sustaining a system throughout its life. The capability comprises the elements of: maintenance facilities, maintenance personnel, maintenance support and test equipment, maintenance technical data, maintenance processes, and maintenance information management system.
SSCC Elements

4. **Supply Support Capability.** Supply support encompasses the following support elements: supply facilities, supply personnel, supply support equipment, supply technical data, supply processes, supply information management system, spares, and packaging.

5. **Training Support Capability.** The training support capability includes the support elements: training facilities training personnel, training equipment, training materials and other technical data, training processes, and training information management system.
Supportability Analysis (SA)

- The principal analytical tool of ILS, is **Supportability Analysis (SA)** which is a structured and tailored process of defining Supportability requirements throughout the Materiel System life cycle.
- Supportability significantly influences both Materiel System preparedness, operational and support requirements, and LCC/TCO.
- SA addresses the inter-related issues of Mission System design, Support System development and optimising resources.
- SA provides interaction between the engineering and logistic support processes.

Source: DEFLOGMAN Volume 2 Volume 10 Chapter 15

Logistics Support Analysis (LSA)

- In more detailed and structured applications of SA, the tailored application of DEF(AUST) 5691 is required.
- LSA provides an analytical foundation to achieve Supportability and ILS objectives.
- LSA is the analytical tool that integrates ILS and the engineering functions to ensure that the system design and operational requirements have been properly applied through a single analytical approach.
- LSA is used to optimise LCC and system performance (including reliability and availability) therefore related analyses are RAM and LCCA.

DMH (LOG) 04-01-002
Analyses Related to LSA

- Early LSA is referred to as Front End Logistic Support Analysis (FELSA), which provides analytical support for the investigation of alternate support concepts in the early phases of the CLC.
- LSA has a close relationship with Reliability, Availability and Maintainability (RAM) and Life Cycle Costing Analysis (LCCA).

Source: DMH (LOG) 04-01-002
DMSP (LOG) 04-0-004

Life Cycle Costing Analysis (LCCA)

- LCCA is the identification and analysis of all costs incurred in acquiring, operating and supporting, and disposing of a Materiel System.
- LCCA is used to identify the budget implications of capital investment decisions and the cost impact of various design and support options for Materiel Systems.
- LCCA is a key analytical tool used by ILS personnel, In-Service Support staff, and engineers in the development, production, and through-life support of Materiel Systems.
LCCA

- LCCA is used to identify LCC estimates and cost drivers.
- Each LCC estimate represents a range of plausible costs for an asset (or Materiel System), where the range is influenced by the possible variations of the key cost drivers.
- LCC can be used for comparative assessment of alternative design and support options as part of SE and LSA processes.
- LCCA can be used to improve sustainment by conducting trade-off and sensitivity analysis.

Source: DMH (LOG) 04-01-002

Simulation and Modelling for Support Concepts
Modelling and Simulation

- A model is: a simplified representation of a system:
  - real system,
  - proposed system,
  - futuristic system design,
  - past system, and
  - Phenomenon.
- A simulation is an experimentation with a model of a system as it progresses through time, for the purpose of better understanding and/or improving that system.

Benefits of Modelling and Simulation

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

Design a fleet management variant

- Acquisition and retirement decisions
- Operational requirements
- Loss and failure risks
- Lifetime extension and upgrade programs
- Maintenance activities and resources
Modelling for Force Design

Design and compare different variants

UNCLASSIFIED
Capability Life Cycle (CLC) Management

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LCCA

Lifetime extension decision
Capability Life Cycle (CLC) Management

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LCCA

![Graph of Fleet condition showing new, midlife, and old conditions]

Effect on acquisition of boosting of fleet condition

Trade-off analysis

![Graph of Average Achieved Flying Hours showing different maintenance lines]

- 302 -
Trade-off analysis

Invest in new maintenance line vs buying a new aircraft.

No performance difference between 13 and 14 aircrafts.

Model use: Options evaluation

- Fleet capability is the total number of weeks where the fleet size is less than 2.
Model use: Options evaluation

- Investigation of options performance over time.

The Best Case Performance of Option 12 with respect to M1

Risk of capability gaps is growing exponentially

- Investigate and quantify the effects of uncertainty about resource availability, and vulnerability of options to this uncertainty.
Model use: Options comparison and trade-off

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

**Set of options dominated by Option 2**

**Example of option analysis**

- Minimum number of ships: 10 PV shown for the CAPS (till 2022)
- Ship lift 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
Model use: baseline comparison

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

Dynamic lifecycle analysis

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

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

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.
**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.

---

**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.
Overview: Phases of the CLC

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

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

There are three decision gates:

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

In the diagram:

- **Investment Approval Pathway**
- **Strategy and Concepts** (Gate 0)
- **Risk Mitigation and Requirements Setting** (Gate 1)
- **Acquisition** (Gate 2)
- **In-Service and Disposal**
Strategy and Concepts Phase: Force Design

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**:  
  - 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.

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.
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Strategy and Concepts Phase: Force Design

Need defined: What?

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

Strategy and Concepts Phase: Smart Buyer

- Output: Joint Capability Narrative (JCN)
- Capability Manager (CM) assigned
- Output: Joint Capability Needs Statement (JCNS)
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**Smart Buyer Framework**

- **Capability Need**
  - JCNS

- **Risk/Driver Profile**
  - Requirements
  - Technology
  - Schedule
  - Commercial
  - Project Integration
  - Defence Integration
  - Financial
  - Strategic
  - In-Service
  - Obsolescence...

- **Analysis/Tailoring**

- **Strategy**
  - PES
    - Approvals Strategy
    - Project Mgt Strategy
    - Acquisition Strategy
    - Sustainment Strategy

**Strategy and Concepts Phase: Smart Buyer**

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

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

**Strategy defined: How?**

- **Gate 2**

- **In-Service and Disposal**
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Strategy and Concepts Phase: Contestability

<table>
<thead>
<tr>
<th>Gate 0</th>
<th>Gate 1</th>
<th>Gate 2</th>
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<tbody>
<tr>
<td>Strategy and Concepts</td>
<td>Risk Mitigation and Requirements Setting</td>
<td>Acquisition</td>
</tr>
<tr>
<td>Force Design Framework (DCAP)</td>
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<tr>
<td>Smart Buyer Framework</td>
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<tr>
<td>Contestability Framework</td>
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<td>• Output: Project Execution Strategy</td>
</tr>
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</table>

Contestability Model across the CLC

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

Source: Department of Defence
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Strategy and Concepts Phase: Contestability

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

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

Gate 2
- Contestability Framework
  - Contestability Division engaged
  - Output: Assurance statement

Assurance: Is proposal OK?

Strategy and Concepts Phase: Gate 0

Gate 0 Proposal

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

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

Gate 2
- Contestability Framework
  - Contestability Division engaged
  - Output: Assurance statement
Gate 0 Proposal: Features

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

Gate 0 Proposal: Components

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<th>Why?</th>
<th>Sponsor Paper</th>
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Gate 0 Proposal: Components

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<th>How?</th>
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Gate 0 Proposal: Components

**Why?**
- **Sponsor Paper**
  - *Overarching business argument for investment*
- **Joint Capability Needs Statement (JCNS)**
  - *What is the capability need (gap)*

**What?**
- **Joint Capability Needs Statement (JCNS)**
  - *What is the capability need (gap)*

**How?**
- **Project Execution Strategy (PES)**
  - *How will investment (Project) be undertaken*

---

**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.
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.

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.
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

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

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

- Contestability Division engaged
- Output: Assurance statement

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

Proposal submitted: Business Case
### Strategy and Concepts Phase: IC consideration

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<tr>
<td><strong>Gate 0 Proposal</strong></td>
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<td><strong>Project Proposal</strong></td>
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</tbody>
</table>

### 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.
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.

Strategy and Concepts Phase: IC consideration

- Output: Joint Capability Narrative (JCN)
- CM assigned
- Output: Joint Capability Needs Statement (JCNS)
- Delivery Group assigned
- IPM assigned and IPMT initiated
- Output: Project Execution Strategy
- Contestability Division engaged
- Output: Assurance statement
- Output: Gate 0 Proposal comprising: Submission; JCNS; PES
- Output: Project Direction
- Output: Product Delivery Agreement
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).
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.
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.
RM & RS Activities are Interdependent

Interdependent activities (broadly a cycle):
- improve understanding of what is needed;
- reduce or eliminate risky aspects;
- make choices (e.g., ‘design’ decisions, options); and
- define requirements in greater detail.
RM&RS Activities are Interdependent

Lower Risk + More specific requirements = Greater certainty

- Confidence to spend
- Defendable

RM&RS – Progressive Commitment

- 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

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

- Gate 1: risk or uncertainty must be reduced so that there is confidence to approve funds in IIP.
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**RM&RS – Progressive Commitment**

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

**RM&RS – Sufficient Definition to Contract**

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

- Establishing the Context
- Risk Assessment
  - Risk Identification
  - Risk Analysis
  - Risk Evaluation
  - Risk Treatment

Monitoring and Review

Communication and Consultation

Reference: AS/NZS ISO 31000:2018

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

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).
3. Capture risk profile:
   – risk rating; and
   – ranking.
Risk Mitigation and Smart Buyer

Smart Buyer is a structured approach for this process:
1. Define risk and drivers categories for Project & Product.
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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;
   – ranking.
5. Get approval and funding for risk reduction work.

Implementing Risk Mitigation
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**.
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.

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
Capability Life Cycle (CLC) Management

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Overview: CLC Artefacts and Relationships

What and Why

- Defence White Paper
- DPG
- AMS
- IIP

Strategic Guidance

- FOE
- JCF
- AJOC
- FJOC

Concepts

- JCN

How

- PGPA Act
- CPRs
- Smart Buyer
- DIP

- DPPM

- Issued by JCA to the CM

- Raised within Force Design as Program level direction

Program Strategy

- Proposal + Sponsor’s Paper + JCNS + PES

Product

- PES

- Project WBS

- IPS

- IMS

Tender and Contract Documents

Requirements Traceability

What and Why

- Defence White Paper
- DPG
- AMS
- IIP

Strategic Guidance

- FOE
- JCF
- AJOC
- FJOC

Concepts

- JCN

How

- PGPA Act
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- Smart Buyer
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- DPPM

Program Strategy

- Proposal + Sponsor’s Paper + JCNS + PES

Product

- PES

- Project WBS

- IPS

- IMS

Tender and Contract Documents
Overview: CLC Artefacts and Relationships

What and Why

Program-level assists efficiency

Needs and requirements ‘delta’ developed only
Program-level assists efficiency

**Defence Strategic and Operational Guidance**
DWP, DPG, AMS, AJOC, FJOC, etc

<table>
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<tr>
<th>Capability Stream 1</th>
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<tbody>
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<td>Program 1</td>
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<td>Program Strategy</td>
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Program-level assists efficiency

**Defence Strategic and Operational Guidance**
DWP, DPG, AMS, AJOC, FJOC, etc

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Needs and requirements ‘delta’ developed only

Planning documents also leverage Program-level
Requirements Scope

- All FIC Elements.

Fundamental Inputs to Capability

Personnel → Organisation → Collective Training → Major Systems → Supplies

Facilities ← Support ← Command and Management ← Industry
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

Capability System

Mission System

Support System

Requirements for Mission System

Capability System

Mission System

Support System
Requirements for Mission Systems

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

Systems Engineering and Requirements Engineering practice.
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.
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Requirements Effort Across the CLC

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

Gate 0  Gate 1  Gate 2

Develop and refine requirements based on JCN, CPN, PI0C, JCNS
Refine requirements through solicitation activities
Ongoing management of requirements as reference for sustainment activities

Level of effort

Use of Requirements
- Down Select solution classes
- Cost, Schedule Estimates
- Value Proposition
- Down Select to a solution class
- Cost/Capability tradeoffs
- Analyses of alternatives
- Down Select solution options
- Discriminate between vendor solutions
- Cost/Capability tradeoffs
- Requirements monitoring throughout
- Refinement as a result of SRR
- Government endorsed requirements as reference for upgrades etc.

Requirements Expertise

Engineering Function
- Policy and Practice
- Requirements Advice
- Engagement of Industry support
- Requirements Service

Delivery Group Head
Program Manager
Integrated Project/Product Manager
Project/Product Sponsor
Industry Representative
FIC SME
Acquisition or Asset Mgt Specialist
Government Submission SME
Requirements SME

IPT
RISK MITIGATION AND REQUIREMENTS SETTING (Gate 1)

RM&RS

- Reduced risk profile
- Better defined requirements
- Options selected
**RM&RS**

- Reduced risk profile
- Better defined requirements
- Options selected

**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.
Gate 1 Proposal: components may include

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<tr>
<td>Why? Draft Submission to Government</td>
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<tr>
<td>What? Requirements Statement</td>
<td>+</td>
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<td></td>
<td>Updated PES</td>
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<tr>
<td>How? Integrated Project Management Plan (IPMP) to Gate 2</td>
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</table>

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.
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

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

Solicitation and Source Selection

- Pre-Gate 2, industry engagement often called solicitation.
- Form of risk mitigation:
  - understanding possible solutions,
  - narrowing options,
  - choosing best solution, and
  - defining contracted requirements.
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).

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).
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**.

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.
Solicitation and Source Selection Documents

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

Source Evaluation

- Tender Evaluation
- Source Evaluation Report

Must be robust and fully defendable

RISK MITIGATION AND REQUIREMENTS SETTING (Gate 2)
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.

Gate 2 Proposal

- Proposal:
  - Final PES.
  - Draft Government Submission.
  - Contestability Statement.
  - Solicitation outcomes: Preferred Contractor.

- IC considers the proposal before Government
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

- Output:
  - reduced risk profile including options
  - final requirements docs (OCD, FPS, TEMP)
## Gate 1 to Gate 2: Summary

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

### Risk Reduction /Requirements Definition
- reduced risk profile including options
- final requirements docs (OCD, FPS, TEMP)

### Solicitation
- Source Evaluation Report: preferred solution / tenderer
- Negotiating position

### Output
- Contestability statement
Gate 1 to Gate 2: Summary

**Gate 0**
- Risk Reduction
  - Risk Reduction
    - Requirements Definition
  - Solicitation

**Gate 1**
- Output:
  - reduced risk profile including options
  - final requirements docs (OCD, FPS, TEMP)
- Output:
  - Source Evaluation Report: preferred solution / tenderer
  - Negotiating position
- Output: Contestability statement

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

**Gate 2 Proposal**

**Investment Committee**

**Government Approval**

**Output: approval to acquire**

---

**Gate 1 to Gate 2: Summary**

- Output: reduced risk profile including options
- Output: Source Evaluation Report: preferred solution / tenderer
- Output: Contestability statement
- Output: Gate 2 Proposal including:
  - draft Approval Submission to Govt
  - final PES
  - preferred contractor
  - updated PES
  - cost, schedule estimates

**Output: approval to acquire**
Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

Gate 1 to Gate 2: Summary

<table>
<thead>
<tr>
<th>Gate 0</th>
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<td><strong>In-Service and Disposal</strong></td>
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<td><strong>Output</strong>:</td>
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<td><strong>Output</strong>:</td>
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<td>Contestability statement</td>
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</tbody>
</table>

**Proposition**

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

**Output**: approval to acquire

Summary of what to take to the IC

<table>
<thead>
<tr>
<th>Use</th>
<th>Gate 0</th>
<th>Gate 1</th>
<th>Gate 2</th>
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<tbody>
<tr>
<td>Government</td>
<td>CabSub or MinSub</td>
<td>CabSub or MinSub</td>
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<td>• IC Synopsis</td>
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<td>- Sponsor Paper:</td>
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<td>- Business Case argument</td>
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<td>- Contestability Statement</td>
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<td>- Industry considerations</td>
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<td>- JCNS</td>
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<td>Key Considerations</td>
<td>Business Case, Risk Assessment and mitigation actions, Acquisition and Sustainment Strategies, IPMP, Cost Estimates, Workforce Estimates, Whole FIC</td>
<td>Business Case, Risk Assessment and mitigation actions, costs and schedule estimates, IPMP, Requirements (OCD, FPS, TEMP)</td>
<td>Business Case, Risk Assessment and mitigation actions, costs and schedule estimates, IPMP, Requirements (OCD, FPS, TEMP), Source Evaluation</td>
</tr>
</tbody>
</table>

- Draft Approval Submission to Government either Ministerial submission or Cabinet Submission
ACQUISITION

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.
Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

Acquisition key documents

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

Gate 0  Gate 1  Gate 2

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

Gate 2 Outcomes
PES
IPMP
IMS
Contracts
Other approved agreements

Integrated Project Management Plan (IPMP)
Integrated Master Schedule (IMS)

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

Material (CASG)
ICT (CIOG)
Facilities (E&IG)
Training (CM)

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).
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.

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
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.

• 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.
Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

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.

In-Service and Disposal: Key Documents

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

IPdM
IPdMT
PDA
PdS
IPdMP

Can be established earlier if appropriate
Must be established before IOC, FOC
Evolved from IPMP during the Acquisition Phase
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

- 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

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.

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.
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

Sustainment Business Cycle: Annual Review

Agreement

Planned vs Actual Performance

Re-prioritised sustainment funds

CM revises annual bid to Defence Enterprise Business Committee (EBC)

Sustainment Data

Sustainment Performance Measurement System (SPMS)
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.

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.
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).

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.
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          – Gifting
  – Scrap         – Conversion/re-use
  – Transfer      – Destruction

Recap
Capability Life Cycle (CLC) Management
Dr Mike Ryan & Dr Shari Soutberg

CLC Overview

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

• Frameworks
  - Force Design Framework
  - Smart Buyer Framework
  - Contestability Framework
  - CLC Management Layers
  - CLC Accountability Model

• Practices: SE, PM, ILS…

CLC: Documents

<table>
<thead>
<tr>
<th>What and Why</th>
<th>How</th>
</tr>
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<tbody>
<tr>
<td>Defence White Paper</td>
<td>PGPA Act</td>
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<tr>
<td>Strategic Guidance</td>
<td>CPRs</td>
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<td>Force Design</td>
<td>DIP</td>
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<td>Smartbuyer</td>
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<td>JCF</td>
<td>DPPM</td>
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<td>Proposal + Sponsor’s Paper+JCNS+PES</td>
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<td>OCD</td>
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<td>FPS 1</td>
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<td>Tender and Contracting Docs</td>
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<td>Project WBS</td>
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<td>IMS</td>
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</table>
Applying the CLC: Practices

**Legislative, Regulatory, and Policy Context**

**Defence Behaviours** (etc)

**CLC Process**

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

**Capability Management Practices**

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

What and Why

- Defence White Paper
- DPG
- AMS
- IIP
- Force Design
- FOE
- JCF
- AJOC
- FJOC
- Concepts
- JCN

Issued by JCA to the CM

How

- PGPA Act
- CPRs
- Smartbuyer
- DIP
- DPPM

Program Strategy

Proposal + Sponsor’s Paper + JCNS + PES

JPNS

OCD

FPS 1

FPS 2

Project WBS

IPMP

IMS

Tender and Contracting Documents

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

---

Legislative and Policy Context
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

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

Source: DPPM April 2017
Defence Proc & Contracting Policy Context

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

- **Commonwealth Procurement Rules (CPRs)**
- **Defence Accountable Authority Instructions (AIIs)**
- **Defence Procurement Policy Manual (DPPM)**
- **CPRs**
- **Defence Directives**

Source: DPPM
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

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
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.

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
Defence Procurement Policy Manual

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

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.
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.

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.
Procurement: Core Principles

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.
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

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
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

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
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

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
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

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*
### 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*

### 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*
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.

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.
Procurement-related Delegations

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.
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.

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.
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).

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.
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)

Sequence for Exercising Delegations

Commitment Approval  
Section 23(3)  

Enter into an Arrangement  
Section 23(1)
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.

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.
Planning the Procurement:

Method of Procurement, Approach to Market and Delivery Model

Considerations for Procurement

Three considerations when deciding how to proceed with a procurement:

1. Method of Procurement – open or limited tender.
3. Delivery Model – type of contract arrangement with supplier.
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).

---

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).
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.

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.
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

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’. 
3. Project Delivery Model

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

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
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.
Smart Buyer

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

Smart Buyer Framework

<table>
<thead>
<tr>
<th>Capability Need</th>
<th>Risk/Driver Profile</th>
<th>Analysis/Tailoring</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirements</td>
<td>Technology</td>
<td>Schedule</td>
<td>PES</td>
</tr>
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<td>Commercial</td>
<td>Approvals</td>
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<td>In-Service</td>
<td>Sustainment</td>
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<td>In-Service</td>
<td>Obsolescence...</td>
<td>Strategy</td>
</tr>
</tbody>
</table>

Source: Smart Buyer Kick-off Meeting Pack
Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

Smart Buyer Framework

**Capability Need**
- Technology
- Industry
- Capability
- Schedule
- Commercial
- Project & FIC

**Context**

**Risk/Driver Profile**
- Requirements
- Technology
- Schedule
- Commercial
- Project Integration
- Defence Integration
- Financial
- Strategic
- In-Service
- Obsolescence...

**Analysis/Tailoring**

**Strategy**
- PES
  - Approvals Strategy
  - Project Mgt Strategy
  - Acquisition Strategy
  - Sustainment Strategy

**Smart Buyer Framework**

**Capability Need**

**Risk/Driver Profile**

**Analysis/Tailoring**

**Strategy**
- PES
  - Approvals Strategy
  - Project Mgt Strategy
  - Acquisition Strategy
  - Sustainment Strategy

**Smart Buyer Framework**

**Capability Need**

**Risk/Driver Profile**

**Analysis/Tailoring**

**Strategy**
- PES
  - Approvals Strategy
  - Project Mgt Strategy
  - Acquisition Strategy
  - Sustainment Strategy
Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

Smart Buyer Framework

Capability Need

Risk/Driver Profile

Analysis/Tailoring

Strategy

JCNS

Requirements
Technology
Schedule
Commercial
Project Integration
Defence Integration
Financial
Strategic
In-Service
Obsolescence...

Environmental Profile
Strategic Analysis
Informed Decisions
Tailoring

PES

Approvals Strategy
Project Mgt Strategy
Acquisition Strategy
Sustainment Strategy

Smart Buyer Framework

Capability Need

Risk/Driver Profile

Analysis/Tailoring

Strategy

JCNS

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Environmental Profile
Strategic Analysis
Informed Decisions
Tailoring

PES

Approvals Strategy
Project Mgt Strategy
Acquisition Strategy
Sustainment Strategy

UNSW Canberra

- 407 -
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.

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.
## 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).

## Smart Buyer – Implementation Steps

**Process steps** (scalable):
- Kick-Off meeting (1.5 hrs).
- Risk and Drivers workshop (1 day).
- Strategy Development workshop (1 day).
- Project team drafts the PES.
- Red Team Review (1.5 hrs).
- Approval by Delivery Group Division or Branch Head.

**Facilitated and supported using members of the CASG IAR team who are independent and possess significant experience.**

Source: Smart Buyer Kick-off Meeting Pack
Categorisation and Classification

• CASG 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.
CASG Sustainment Categories Framework

- **Sustainment Category (SCAT):** four levels of complexity (SCAT I, II, III, and IV), for Sustainment Products within CASG.
- Guides management, reporting, reviews, competencies.
- Sustainment Products assessed and classified based on six sustainment attributes:
  - Sustainment Budget.
  - Management Complexity.
  - Technical Difficulty.
  - Life Cycle Stage.
  - Demand and Availability.
  - Commercial.

Implementing Defence Procurement and Contracting
Generic Life Cycles

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

System Life Cycle

<table>
<thead>
<tr>
<th>Pre-acquisition Phase</th>
<th>Acquisition Phase</th>
<th>Utilization Phase</th>
<th>Retirement Phase</th>
</tr>
</thead>
</table>

Project Life Cycle

- Conceive
- Develop
- Implement
- Terminate

Procurement Life Cycle

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

Source: DPPM

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
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.

Source: DPPM
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
    7. Disposal.

Source: DPPM
Relationship to CLC

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

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

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).

Source: DPPM April 2017 Paras 96
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.

DPPM: Paras 98 and 99

2. Request Documentation

• Request documentation normally includes:
  – **Statement of Work**: Requirements incl any essential requirements.
  – **Conditions for Participation**: minimum content and format.
  – **Evaluation Criteria**: including methodology.
  – **Draft Contract**.
2. Request Documentation: SOW

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.

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.

DPPM: Paras 102
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.

DPPM: Paras 105, 106

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.

DPPM: Paras 107, 108
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.

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.
Sourcing: 4. Evaluation

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

• 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.

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


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.
4. Evaluation: Notifying Tenderers

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

DPPM: Paras 119-120

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**.

DPPM: Paras 119-120
5. Negotiation and Award of Contract

- Final stage of procurement process is negotiation and award of the contract with the preferred tenderer.
- During contract negotiations, Defence officials seek to resolve issues identified during the evaluation.

DPPM: Paras 121-123

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.

DPPM: Paras 121-123
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.

---

Tendering and Contracting Templates
Contracting Templates

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

Contracting Templates

• Templates include:
  – Commonwealth Contracting Suite.
  – Defence Suite of Facilities Contracts.
• ASDEFCON used in Capability Management.
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

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
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
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

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<td>Simple Procurement</td>
</tr>
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</table>

Source: Contract Template Selection and Tailoring Guide Version 2.1 April 2016
Why have ASDEFCON Templates?

- 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

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
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

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
ASDEFCON Template Selection

Nature of technical endeavour → Level of acquisition risk and complexity → Best fit ASDEFCON Template → Level of Contract Mgt and Assurance

- 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

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
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

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
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

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.**
Choosing the Right ASDEFCON Template

SOW

Understand risk and complexity (esp technical)

Materiel
Non-Materiel

Goods
Services

Acquisition Templates
Support Templates

Select and tailor right template

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
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

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
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

Materiel Acquisition Contracting Spectrum

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Source: Contract Template Selection and Tailoring Guide Version 2.1 April 2016
Capability Life Cycle (CLC) Management
Dr Mike Ryan & Dr Shari Soutberg

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

Contents of ASDEFCON Templates

Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

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

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.
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.

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
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.
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)

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.**
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)

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)
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)

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)
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).

- 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)
**Capability Life Cycle (CLC) Management**

Dr Mike Ryan & Dr Shari Soutberg

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**Tailoring the ASDEFCON Template**

- **Template**
  - Work to be done
    - **SOW**
      - • CoA requirements standards for work
      - • allocate work responsibilities to CoA & Contractor
  - Information to be provided by Tenderer/Contractor
    - **TDRL/CDRL**
      - List of Data Requirements: Data Items
  - Reviews to be conducted during contract
    - **MSR**
      - Mandated, Highly Desirable

---

**RISK MANAGEMENT AND ASSURANCE**
Governance

Public sector governance covers:

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

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

Source: Building Better Governance, Commonwealth of Australia 2007

Interrelated Concepts

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

Essential to good governance are robust regimes for:

• Risk Management.
• Assurance.
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

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
Defence Risk Management

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

Defence Risk Management: evidence

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

Reference: AS/NZS ISO 31000:2018
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.
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.
Capability Life Cycle (CLC) Management
Dr Mike Ryan & Dr Shari Soutberg

Smart Buyer Framework

Capability Need
- Context
  - Technology
  - Industry
  - Capability
  - Schedule
  - Commercial
  - Project & FIC

Risk/Driver Profile
- Requirements
- Technology
- Schedule
- Commercial
- Project Integration
- Defence Integration
- Financial
- Strategic
- In-Service
- Obsolescence...

Analysis/Tailoring

Strategy

PES
- Approvals Strategy
- Project Mgt Strategy
- Acquisition Strategy
- Sustainment Strategy

Understand and Assess

Smart Buyer Framework

Capability Need
- Context
  - Technology
  - Industry
  - Capability
  - Schedule
  - Commercial
  - Project & FIC

Risk/Driver Profile
- Requirements
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Analysis/Tailoring

Strategy

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- Approvals Strategy
- Project Mgt Strategy
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Understand and Assess
**Capability Life Cycle (CLC) Management**

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### Smart Buyer Framework

- **Capability Need**
  - JCNS

- **Risk/Driver Profile**
  - Technology
  - Industry
  - Capability
  - Schedule
  - Commercial
  - Project & FIC

- **Analysis/Tailoring**
  - Requirements
  - Technology
  - Schedule
  - Commercial
  - Project Integration
  - Defence Integration
  - Financial
  - Strategic
  - In-Service
  - Obsolescence...

- **Strategy**
  - Plan
  - PES
    - Approvals Strategy
    - Project Mgt Strategy
    - Acquisition Strategy
    - Sustainment Strategy

---

### 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
### Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

#### CLC Risk Management: Acquisition Categories

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>Risk Event</th>
<th>Treatment/ Mitigation</th>
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<td>Additional requirements development</td>
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<td>Unproven</td>
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<td>Schedule not achievable</td>
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CLC Risk Management: Acquisition Categories

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Implementing Risk Mitigation
Implementing Risk Mitigation

Expectations of Risk Approach to CLC

- A **structured and deliberate approach** to risk management processes supports PGPA duties through:
  - reducing and controlling risk; and
  - 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

Meaning of Assurance

• Assurance:  
  – a positive declaration intended to give confidence; a 
    promise.  
  – grounds for justified confidence that a claim has been or 
    will be achieved.  

  Source: Oxford Dictionary  
  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 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

- 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.

Assurance in Capability Management

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

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.
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’.

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.
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.

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.
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.

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.
Capability Life Cycle (CLC) Management
Dr Mike Ryan & Dr Shari Soutberg

SCRAM

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

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.
Technical Regulation

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

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):
• Explosive Ordnance Regulation:
  – DI (G) LOG 4-1-006 - Safety of Explosive Ordnance.
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.

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.
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 (e.g., ISO 9001).

• …

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.
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.

ANAO

• Relevant activities of ANAO:
  – Performance audits of Australian Government programs and entities; and
  – Assurance reviews of Australian Government entities.
**ANAO**

- Relevant activities of ANAO:
  - Performance audits of Australian Government programs and entities;
  - Assurance reviews of Australian Government entities.

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

---

**Implementing Risk Mitigation**

<table>
<thead>
<tr>
<th>Strategy and Concepts</th>
<th>Risk Mitigation &amp; Requirements Setting</th>
<th>Acquisition</th>
<th>In-Service and Disposal</th>
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<tbody>
<tr>
<td>Gate 0</td>
<td>Gate 1</td>
<td>Gate 2</td>
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Mandated System Reviews provide assurance for satisfaction of acquisition activities.

**Smart Buyer Risk Profile**

- Risk Reduction Activities
- Risk Reduction Studies (technical and implementation risks)
- Requirements Definition
- RFI, RDA, O&A (technical risks)
- Gates - O&A, RFI (commercial risks)
- System Engineering Activities
- System Reviews

---

**Capability Life Cycle (CLC) Management**

Dr Mike Ryan & Dr Shari Soutberg
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)

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).

Source: ASDEFCON (Strategic Materiel)
T&E Categories

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

- **Acceptance Test and Evaluation (AT&E)**
  - Formal acceptance testing on behalf of customer.
  - Between the Acquisition and Utilisation Phases.
T&E Categories

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

Verification and Validation (V&V)

- 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.
Methods of V&V

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


V&V
CLC ARTEFACTS AND DOCUMENTS

CLC: Artefacts and Documents

<table>
<thead>
<tr>
<th>What and Why</th>
<th>How</th>
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<tr>
<td><strong>Portfolio</strong></td>
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<tr>
<td>Defence White Paper</td>
<td>Strategic Guidance</td>
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<td>Force Design</td>
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<td>FOE, JCF, AJOC, FJOC</td>
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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.

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)

Gate 0
- Define Need: JCN
- Smart Buyer Risk Profile and Strategy definition: PES
- Contestability

Gate 1
- Risk Reduction Studies (technical, commercial risks)
- Requirements Definition: OCD, FPS, TEMP
- Planning definition: IPMP, IMS

Gate 2
- Risk Reduction, Requirements Definition: OCD, FPS, TEMP
- Solicitation: RFT, SER

In-Service and Disposal
- Contract Mgt
- SE Review
- Risk Mgt
- Risk and Assurance Mgt
- Assurance Reports

Acquisition
- Risk and Assurance Mgt

Risk Mitigation & Requirements Setting
- Risk Mgt

Strategy and Concepts
- Product Mgt
- Project Mgt

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
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.

Meaning of Artefact

• We will use artefact as any means of communicating information associated with the CLC including documents, models, plans, architectures, and proposals.
Scope of Artefacts Being Covered

- Many artefacts are created through the CLC from early 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.

Scope of Artefacts Being Covered

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.
**Artefacts being Covered**

**What and Why**
- Defence White Paper
- Force Design
- Program Design

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

**Key CLC Artefacts**

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

- ...  
- Proposal Artefacts at Program, Project, or Product level:  
  - Joint Capability Narrative (JCN).  
  - 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 EXAMPLE:
Integrated Air and Missile Defence (IAMD)

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).
Program Example: IAMD

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

Program Example: IAMD

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

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

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.
Australian Defence Force IAMD

- **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

- Good reference: The Sir Richard Williams Foundation.

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**).

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.


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).

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.

**RECAP OF PROGRAM LAYER**
Program

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

Source: PMI website

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


Objectives of Programs

- 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.
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.
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.

Program Refs: Aligning Project/Products

- Common ‘umbrella’ reference
- Aligning Project and Product requirements
- Supports integration and interoperability
- ‘Town Plan’
# Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

## Program References: Reducing Project/Product Documents

<table>
<thead>
<tr>
<th>Capability Stream 1</th>
<th>Program 1</th>
<th>Capability Program Narrative 1</th>
<th>Program Strategy</th>
<th>PIOC</th>
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<td>Capability Program Narrative 2</td>
<td>Program Strategy</td>
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## Program References & Project/Product Documents

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<th>FPS 1</th>
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<tr>
<td>Project</td>
<td>IPIMP</td>
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[Note: The diagrams illustrate the relationships between different streams and programs, showing how program references and project/product documents are managed throughout the Capability Life Cycle (CLC).]
Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

PROGRAM-REFERENCE ARTEFACTS

Capability Program Narrative (CPN)
Program Refs: Aligning Project/Products

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

Capability Program Narrative (CPN)

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

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.
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

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
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

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:

- Integrated Air and Missile Defence Study: The Challenge of Integrated Force Design Air Vice-Marsh John Blackburn April 2017
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

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
Program Integrating Operational Concept (PIOC)

Program Ref: Integration & Interoperability

Defence Strategic and Operational Guidance
DWP, DPG, AMS, AJOC, FJOC

Program 1
- Capability Program Narrative (CPN)
- Program Strategy
- Program Integrating Operational Concept (PIOC)

Project 1
- JCN 1
- JCNS 1
- IPMP 1
- OCD 1
- FPSs
- TEMP

Project 2
- JCN 2
- JCNS 2
- IPMP 2
- OCD 2
- FPSs
- TEMP

Product 3
- JCN 3
- JCNS 3
- IPMP 3
- OCD 3
- FPSs
- SPECs

Configuration Baselines
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

PIOC: Intent

• 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

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

PIOC: Architecture Information

Operational View
Warfighter Relationships and Information Needs

Processing and Levels of Information Exchange Requirements
Systems Associations to Nodes, Activities, Needlines, and Requirements

Technical View
Prescribes Standards and Conventions

Technical Criteria for implementing interoperability

Systems View
Relates Capabilities and Characteristics to Operational Requirements
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)

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.
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

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
**PIOC: Specify Technical Requirements**

**Coalition Interoperability “Tolk” Model**

- Political Objectives
- Harmonized Strategy/Doctrines
- Aligned Operations
- Aligned Procedures
- Knowledge Awareness
- Information Interoperability
- Data/Object Model Interoperability
- Protocol Interoperability
- Physical Interoperability

**Open Systems Interconnection (OSI) model**


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

**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.
Program Ref: Integration & Interoperability

Program 1

- Capability Program Narrative (CPN)
- Program Strategy
- Program Integrating Operational Concept (PIOC)

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

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.

Eg Current Air Defence Systems

System 1 + System 2 + System 6 + System 7

+ System 2 + System 6 + System 7

Technology
Obsolescence
and replacement

Respond to
threat changes

2019 2025 2030 2035
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.

IAMD Program: Project Elements

- AIR 6500 Phase 1
  - Upgraded or Replaced C4I
  - IOC FY22/23
  - FOC FY28/29
  - Ground Based Sensors

- AIR 6500 Phase 2
  - IOC FY25/26
  - FOC FY28/29
  - Medium-Range Ground Based Air and Missile Defence Effector

- Land19 Phase 7B
  - IOC 2023
  - FOC 2025
  - Short-Range Ground Based Air and Missile Defence Effector

Contributing Projects: SEA4000, SEA5000, AIR5077, AIR6000...

Overlapping FIC requirements and planning
- Common training and workforce
- Coordinated Sustainment
IAMD Program Strategy

• “The critical issue is that an IAMD Program cannot be built purely bottom-up if it is to be both effective and affordable; a top-down direction and focus is essential. There is a need for an IAMD Program Roadmap, that is a Directive and not only a recommendation.”

Reference: Williams Foundation Integrated Air and Missile Defence Study 2017

Program Strategy Content

• Identifies applicable Govt direction, strategic guidance (DWP, IIP), narratives eg JCN, CPN.

• Defined outcomes and outputs (including priorities).

• Resource, funding, FIC allocation requirements & priorities.

• Key risks, risk 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
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

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.
### Program CLC Artefacts

<table>
<thead>
<tr>
<th>Artefact</th>
<th>Description</th>
<th>Developed by</th>
<th>Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPN:</td>
<td>Narrative which inform required capability of the subject group of capability systems</td>
<td>Force Design Division</td>
<td>Force Design Division</td>
</tr>
<tr>
<td>PIOC:</td>
<td>Operational and other features of the capability grouping both within the Program and relationships with other Programs</td>
<td>Program Sponsor</td>
<td>Program Sponsor/Endorsed by Joint Capability Authority</td>
</tr>
<tr>
<td>Program Strategy:</td>
<td>Activities, management arrangements, including integrated schedule across related Projects and Products within the Program</td>
<td>Program Sponsor</td>
<td>Program Sponsor</td>
</tr>
<tr>
<td>Program Architectures:</td>
<td>Program features using Defence Architecture Framework (DAF) conventions</td>
<td>Program Sponsor/C4ISR Design Authority</td>
<td>Program Sponsor/C4ISR Design Authority</td>
</tr>
</tbody>
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### PROPOSAL-LEVEL ARTEFACTS
Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

Proposal Artefacts

<table>
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<td>JCF</td>
<td>DPPM</td>
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<tr>
<td>AJOC</td>
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<tr>
<td>EJOC</td>
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</table>

Issued by JCA to PMO

CPN

PIOC

Program Strategy

JCNS

Proposal = Sponsor's Paper/JCNS/PES

OCD

FPS 1

FPS 2

Project WBS

IPMP

IMC

Tender and Contract Documents

CLC Case Study
CLC Proposal Case Study

• Aspects of CLC re-design have been implemented in successful projects.
• This Case Study based on an actual Defence project that has used elements of CLC approach.
• We will look at how CLC may have been applied for an actual project focussing on S&C and RM&RS Phases:
  – approach to be adopted;
  – activities to be undertaken; and
  – documents to be produced.

SEA 1448 Ph4A Project: ESM

• Electronic Support Measures (ESM):
  – Used on RAN ships to detect and identify (classify) adversary’s radars.
  – A bit like a music recognition application.
• Comprises antenna and processing equipment.
• Integrates and displays on the Combat System.
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
Case Study: SEA 1448 Phase 4A

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

• CLC **process, frameworks and management constructs** eg Programs, Smart Buyer etc.

• Enabling **Practices**:
  – Systems Engineering.
  – Project Management.
  – ILS.
  – Procurement and Contracting.

• Then we will look at it in terms of **artefacts** and documents to be developed

Joint Capability Narrative (JCN)
## Proposal Artefacts

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<td>Issued by JCA to the CM</td>
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<tr>
<td>Raised within Force Design as Program level direction</td>
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</table>

## 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.
JCN

- What is in a JCN?
  - Provides a conceptual framework for a defined gap or opportunity and ensures joint needs are clearly aligned with strategic guidance.
  - Articulates gaps, risks, issues or opportunities and the CM’s plan to meet the problem posed.
  - Articulates time, resource constraints and strategic considerations.

Identifying a Capability Gap

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

In the case of the ESM...
Navy recognised a vulnerability for their platforms.

JCN to JCNS Pathway

- Pathways:
  - JCN is presented to Joint Warfare Council (JWC) if risk, cost or complexity is of concern; and
  - generally directs the CM to nominate a Program Sponsor to develop a JCNS.
JCN

- In the absence of JCN, use FSR Narratives and IIP funding profiles as reference.
- Contestability reviews the JCN as one of the Force Design outputs.
- JCNs are still being developed.

Joint Capability Needs Statement (JCNS)
Proposal Artefacts

**What and Why**

- Defence White Paper
- FOE
- JCF
- AJOC
- EJOC

**How**

- PGPA Act
- CPRs
- Smart Buyer
- DIP

**JCN**

- Issued by JCA to the CM
- Raised within Force Design as Program level direction

**CPN**

- Program Strategy

**PIOC**

- Project Strategy

**JCNS**

- Proposal = Sponsor’s Paper/JCNS/PES

**PES**

- OCN
- FPS 1
- FPS 2

- Tender and Contract Documents

**JCNS**

- Who develops it?
  - Program Sponsor as tasked by CM through a tasking statement.
- When is it developed?
  - When a capability need or enabling gap or opportunity identified through a JCN and the CM assigns a Program Sponsor.
  - 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
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

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

Higher performance expected due to:
• more challenging threats
• Improved available technology

Level of Capability

Past Acceptable Capability

Extent Capability

Future Required Capability

Replacement Capability

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
  – ...

• 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

Source: Update Interim CLC Manual
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;

JCNS: Hierarchy of Objectives

- Ability to detect radars
- Provide data to combat system
- Ability to classify radars
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

JCNS: System characteristics

- What is in it?
  - ...
  - System characteristics;
JCNS: System Characteristics

- Frequency Spectrum
- Dynamic Range
- Bearing

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

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
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.

JCNS: Relationship with other Programs

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

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
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.

Project Execution Strategy (PES)
Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

Proposal Artefacts

<table>
<thead>
<tr>
<th>What and Why</th>
<th>How</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defence White Paper</td>
<td>PGPA Act</td>
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<tr>
<td>Strategic Guidance</td>
<td>CPRs</td>
</tr>
<tr>
<td>Force Design</td>
<td>Smart Buyer</td>
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<tr>
<td>FOE JCF AJOC EJOC Concepts</td>
<td>DIP</td>
</tr>
<tr>
<td>JCN</td>
<td>DPPM</td>
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</tbody>
</table>

Defence White Paper

- Issued by JCA to the CM

Program Strategy

- Program Strategy

Product

- JCNS
- OCD
- FPS 1
- FPS 2
- Tender and Contract Documents

Strategy and Concepts Phase: Contestability

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

- Gate 1: Smart Buyer Framework
  - Delivery Group assigned
  - IPM assigned and IPMT initiated
  - Output: Project Execution Strategy
Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

Smart Buyer Framework

Need  Risk/Driver Profile  Analysis/Tailoring  Strategy

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.
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.

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.
  – …
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).

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.
Smart Buyer ‘Risk and Drivers’
Categories

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

- Sustainment
  - In-Service Requirements
  - Obsolescence
  - Commercial
  - FIC
  - Financial
  - Strategic
  - Operational
  - Industry

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

PES: 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.
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.

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.
PES: ESM Context

- Electronic Support Measures system is based on integration of a number of sub-systems.
- Installation on different classes of ships.
- Some of the sub-systems are still under development.
- Sub-systems developed by different vendors.

Case Study: ESM Risks and Drivers

- Technical:
  - Installation/Platform Integration complexity.
  - Different parts of the system being developed to different timelines.
  - Structural and other issues unknown (antenna mast).
  - Combat system integration (software & hardware issues).
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.

• 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.
Case Study: Risk Reduction Activities

Targeted and funded risk reduction activities:

• 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)

  – …

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).
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.

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.
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.

Docking for ASMD upgrade

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

Delivery of ES Systems

2011 ... 2017
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.

Docking for ASMD upgrade

**Delivery of ES Systems**

2011 2017
Case Study: Risk Reduction Activities

Targeted and funded risk reduction activities:

• **Implementation:**

Docking for ASMD upgrade

- Establish System Integration Lab (SIL)

- Delivery of ES Systems

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

- Delivery of ES Systems

2011 … 2017
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).

---

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**
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.

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.
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.

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.
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.

• **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.
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.

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.
**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.

---

**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.
Case Study: Approvals Strategy

- Common ES system for RAN – AWD, ANZAC, LHD, Subs.
- Under the CLC, SEA 1448 Phase 4A could have potentially had approval at Gate 0 to seek next approval to acquire at Gate 2.
- Government approval documented in Project Direction.

6. Project Management Strategy

- Project Management as **integrating discipline** address all FIC:
  - Delivery.
  - Coordination.
  - Integration
- Overview provides basis for IPMP and IMS.
- Key information gathering activities (including risk mitigation activities).
- Resources (including enabling budget for delivery groups).
- Governance bodies, roles and responsibilities.
- Schedule.
# Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

## 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.

<table>
<thead>
<tr>
<th>Navy to:</th>
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<tbody>
<tr>
<td>- provide x platforms on an agreed timeline;</td>
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<tr>
<td>- provide y crews for training; and</td>
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<tr>
<td>- other sea assets for test program eg other vessels to test ES system performance.</td>
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<thead>
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<th>DSTG to:</th>
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<tr>
<td>- provide advice on the maturity of the technology by a certain date; and</td>
</tr>
<tr>
<td>- help develop the test program and analyse the results.</td>
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<table>
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<th>Airforce to:</th>
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<tr>
<td>to provide test assets for sea trials.</td>
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<tr>
<th>Joint Organisations (JEWOSU) to:</th>
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<tbody>
<tr>
<td>to provide test libraries and operational libraries.</td>
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</table>
Integrated Project Management Plan (IPMP)

IPMP provides guidance for subordinate plans including:

- **Project Management** Planning Guidance.
- **Engineering Planning** Guidance (for Systems Engineering Management Plan (SEMP)).
- **Sustainment** Planning Guidance.
- **Commercial** Planning Guidance.
- **Acceptance into Operational Service** Planning Guidance.
- **Project Office Management**.
Case Study: 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 e.g. physical mounting of antenna on mast, radio frequency (RF) interference with other emitters.
  - **Integration planning:**
    - ES system integration.
    - Shipboard integration (e.g., power, combat system).
    - Staged to fit platform availability.

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.
Gate Business Case/ Proposal
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.

Better Business Case (BBC)

- Building Better Business Case:
- 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 distinct
- Does not matter if Defence document guidance varies: the five cases remain valid.

Source: http://www.treasury.govt.nz/statesector/investmentmanagement/plan/bbc/framework
Summary of Five ‘Cases’

- **Strategic Case**: Proposal aligns with strategic intent and priorities.
- **Economic Case**: Consideration of options and value proposition for the proposed investment is sound.
- **Financial Case**: Resourcing provisions are addressed.
- **Commercial Case**: Requirements, execution strategy including acquisition and sustainment strategy, risk.
- **Management Case**: Management arrangements.

Case Study: Business Cases

- **Strategic Case**:
  - Proposal aligns with strategic intent and priorities.
  - Contained in JCNS.
- **Economic Case**:
  - Options and value proposition for the proposed investment are sound.
  - Spend $10m to protect $1bn.
  - Need to be able to use the asset in the necessary environments i.e., can’t be constrained.
  - Standardised ES system across fleet so economies of scale for acquisitions, training, support.
Case Study: Business Cases

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

- **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

What and Why

- Defence White Paper
- Strategic Guidance

How

- PGPA Act
- CPRs
- DIP

JCN

- Issued by JCA to POC

Program Strategy

Gate 0 Business Case

- Gate 0 Business Case is presented to the Investment Committee by the Capability Manager to inform an investment decision and identifies a set of feasible and achievable options.

- The purpose of the Gate 0 Business Case is to provide a sufficient argument for the Investment Proposal and a strategy for its implementation.

- Level of detail in the Gate 0 Business Case is determined by the level of complexity of the proposal.
Gate 1 Submission

- Decision making at Gate 1 is based around the government submission.
- The Submission is prepared by CM and summarises the Business Case which:
  - focuses on the risk treatment activities that have taken place since Gate 0;
  - describes progress in reducing options;
  - defines the requirements statement; and
  - outlines the plan and risk mitigation activities to progress to Gate 2.

Gate 1 Submission

- The Business Case and Submission includes:
  - assessment of risk;
  - initial independently tested cost and schedule estimates;
  - TEMP; and
  - IPMP and stage plan to progress to Gate 2.
Gate 2 Submission

- Decision making at Gate 2 is based around a single Gate 2 Business Case, which forms the basis of the proposal to government for approval.
- The CM is responsible for producing the Gate 2 submission which is informed by the Business Case signed off jointly by the CM and the Delivery Group.
- The submission is reviewed by Contestability Division and any contestability advice on outstanding issues is embedded into the submission.
- The Business Case includes detail within which the IPMT is authorised to negotiate a contract post Gate 2.

Gate 2 Submission

The final submission and business case includes:

1. Residual risk and mitigation plans for that risk.
2. Confirmation that investment satisfies Defence policy and priorities, and is value for money.
3. Schedule, whole of life costing and approval limit.
4. Updated TEMP.
5. Analysis of preferred contractor and summary of intended contractual terms.
Better Business Case Framework

Better Business Case (BBC)

- Defence CLC Business Case development is based on the Better Business Case (BBC) framework as described on the NZ Treasury website (http://www.treasury.govt.nz).
- BBC is a systematic method which is used to develop business cases for programmes or projects.
- The benefits of BBC are that each of the key aspects of a robust investment proposal are explicitly and systematically addressed through five distinct cases.

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

- **Strategic Case** provides a compelling case for change and ensures a strategic fit and meets business needs.
- **Economic Case** demonstrates that the preferred option provides value for money.
- **Financial Case** confirms that the proposal is affordable within available funding.
- **Commercial Case** confirms that the proposal and its various elements are commercially viable.
- **Management Case** demonstrates that the proposal is achievable and can be successfully delivered.

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

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
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 e.g.
    - spend $10m to protect $1bn
    - need to be able to use the asset in necessary environments i.e., can’t be constrained
    - standardised ES system across fleet economies of scale for:
      - acquisitions,
      - training, and
      - support.
  - Supported by JCNS and PES.

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 e.g., training, maintenance; and
  - supported by PES.

Source: Defence VCDF website
**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

**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
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.

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

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
IPMP Structure

Section 1. Project Summary
Section 2. IPMP Authority
Section 3. IPMP Maintenance
Section 4. Project Execution Strategy Summary
Section 5. Project Management Approach

...
Section 1. Project Summary

- IIP Value
- Project Staffing
- Schedule Summary
  - Gate 0
  - Gate 1
  - Gate 2
  - Prime Contract Effective Date
  - Initial Operating Capability (IOC)
  - Final Operating Capability (FOC)
- Capability Manager, Program Sponsor, Program Manager, Project Sponsor, User Representatives, Delivery Group.

Source: IPMP Template

Section 2. IPMP Authority

- Identify authority of PES ie when PES approved, relevant Gate etc.
- Confirm traceability of IPMP to the strategies identified in the PES and the need to maintain control over this relationship including approval and management arrangement of deviation.
- Identify FIC providers and key responsibilities.
- Identify consultation in development of this plan.

Source: IPMP Template
Section 3. IPMP Maintenance

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

Source: IPMP Template

Section 4. PES Summary

- **Scope**
- **FIC** summarise the FIC elements, capability baselines and broad responsibilities to be coordinated to realise the capability.
- **Major Factors** factors influencing the PES and the PM approach:
  - Acquisition Strategy.
  - Sustainment Strategy.
  - Transition to Sustainment.
  - Acceptance into Service.
  - Closure.

Source: IPMP Template
Section 5. Project Management Approach

5.1 Governance
5.2 Assurance
5.3 Major Activities
5.4 Budget
5.5 Coordination and Control
5.6 Stakeholders
5.7 Engineering Approach
5.8 Sustainment Approach
5.9 Commercial Approach
5.10 Project Office Management

Source: IPMP Template

Annex A: PM Planning Guidance

A.1 Project Governance
A.2 Project Assurance
A.3 Stage / Detailed Planning
A.4 Project Work Breakdown Structure
A.5 Integrated Master Schedule
A.6 Integrated Project Team
A.7 Battle Rhythm
A.8 Risk and Contingency Management
A.9 Issue Management
A.10 Stakeholder Management
A.11 Transition to Sustainment
A.12 Acceptance into Operational Service
A.13 Project Closure

Source: IPMP Template
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

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
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

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
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

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
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

• 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

- 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

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
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

Capability Definition Documents (CDD)
Needs and Requirements Artefacts

<table>
<thead>
<tr>
<th>What and Why</th>
<th>How</th>
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<tbody>
<tr>
<td>Defence White Paper</td>
<td>PGPA Act</td>
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<tr>
<td>Strategic Guidance</td>
<td>CPRs</td>
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<td>Force Design</td>
<td>DIP</td>
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</table>

Program:
- Raised within Force Design as Program level direction
- Issued by JCA to the CM

Product:
- Proposal = Sponsor’s Paper + JCNS + PES

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**

- Defence Strategic and Operational Guidance
  - DWP, DPG, AMS, AJOC, FJOC
- Joint Capability Narrative (JCN)
- Capability Program Narrative (CPN)

**Program 1**
- Program Strategy
- Program Integrating Operational Concept (PIOC)

**Project 1**
- JCNS 1
- IPMP
- OCD
- FPS
- TEMP

**Project 2**
- JCNS 2
- IPMP
- OCD
- FPS
- TEMP

**Product 3**
- JCNS 3
- IPMP
- OCD
- FPS
- TEMP

**Program Level Supports Sufficiency Goal**

- Defence Strategic and Operational Guidance
  - DWP, DPG, AMS, AJOC, FJOC
- Joint Capability Narrative (JCN)
- Capability Program Narrative (CPN)

**Program 1**
- Program Strategy
  - Program Integrating Operational Concept (PIOC)

**Project 1**
- JCNS 1
- IPMP
- OCD
- FPS
- TEMP

**Project 2**
- JCNS 2
- IPMP
- OCD
- FPS
- TEMP

**Product 3**
- JCNS 3
- IPMP
- OCD
- FPS
- TEMP

Requirements development practices using Program-level needs and requirements information supports FPR and CLC expectations of sufficiency through use of common references and re-use.
Needs and Requirements Re-use

Program Integrating Operational Concept (PIOC)

Sections 1-4
Sections 5-6

Re-use
Re-use
Re-use

OCD
FPS
TEMP

Needs and Requirements Re-use
Needs and Requirements developed specifically for Project

Transformation of Operational Needs

Warfighter Domain
Well Understood by Warfighters

Operational Needs
Transformation

Specifications
Implementation Domain
Well Understood by Acquirers & Developers

OCD Understood by all parties
Transformation documented in OCD
Specification documented in FPS
T&E expectations documented in TCD

UNSW CANBERRA
- 580 -
OCD, FPS, TEMP Relationship

Needs Hierarchy

- Mission
- Level 1
- Level 2
- Level 3
- Level 4
- Level n

OCD

Level 1
- 1
- 1.1
- 1.1.1

FPS

Level 2
- 1.2
- 1.1.2

Level 3
- 1.n
- 1.1.n

Level 4
- ...

Level n

Measures Hierarchy

- CI
- COI
- MOE
- MOP
- TPM

OCD, FPS, TEMP Relationship

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Measures Hierarchy

- CI
- COI
- MOE
- MOP
- TPM

Augmented/prepared by Acquirer (CASG)
OCD, FPS, TEMP Relationship

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.

Prepared by Contractor/Sub-contractors

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.
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• 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
4. EXISTING SYSTEM
  4.1 Existing System Overview
  4.2 Existing System Operational Capability Comparison
  4.3 Existing System Internal Shortcomings
  4.4 Existing System Planned or Active Upgrades
  4.5 Existing System Internal User classes
  4.6 Existing System Internal Functionality
  4.7 Summary of Existing System Internal Scenarios
5. SYSTEM SOLUTION-CLASS DESCRIPTION
  5.1 Materiel System Description
  5.2 Mission System Architecture
  5.3 Materiel System Interfaces
  5.4 Materiel System Internal User classes
  5.5 Materiel System Functionality and Performance
  5.6 Materiel System Support Concepts and Requirements
  5.7 Materiel System Constraints
  5.8 Materiel System Evolution and Technology Forecast
  5.9 Summary of Materiel System Internal Scenarios
  5.9.1 Internal Scenario 1 - ‘A Typical Day’s Operation’
  5.9.1.1 Summary of Situation
  5.9.1.2 Summary of Process Flows and Interactions
  5.9.1.3 Summary of Materiel System Requirements
  5.9.2 Internal Scenario 2 - Scenario Title
  5.9.3 Internal Scenario N - Scenario Title
OCD Template

6. CONSOLIDATED FUNDAMENTAL INPUTS TO CAPABILITY (FIC) REQUIREMENTS
6.1 FIC Related Guidance
6.2 Major Systems FIC Element Requirements
6.3 Facilities and Training Areas FIC Element Requirements
6.4 Support FIC Element Requirements
6.5 Supplies FIC Element Requirements
6.6 Organisation FIC Element Requirements
6.7 Command and Management FIC Element Requirements
6.8 Personnel FIC Element Requirements
6.9 Collective Training FIC Element Requirements
6.10 Industry FIC Elements Requirements
6.11 FIC Impacts on Supporting Capabilities
6.12 Summary of Overall FIC Responsibilities
6.13 FIC Development Forecast

A. ANNEX A - EXTERNAL SCENARIOS
A.1 Capability System Operational Scenarios
A.1.1 Common Scenario Attributes
A.1.2 Scenario 1 - Scenario Title
A.1.2.1 Scenario 1 - Situation Requiring ADF Action
A.1.2.2 Scenario 1 - Military Response
A.1.2.3 Scenario 1 - Operational Needs
A.1.3 Operational Scenario 2 - Scenario Title
A.1.4 Operational Scenario N - Scenario Title
A.2 Consolidated Operational Needs

B. ANNEX B - EXISTING SYSTEM INTERNAL SCENARIOS
B.1 Internal Scenario 1 - 'A Typical Day's Operation'
B.1.1 Internal Scenario 1 - Situation
B.1.2 Internal Scenario 1 - Details of Process Flows and Interactions
B.1.3 Internal Scenario 1 - Identified Shortcomings
B.2 Internal Scenario 2 - Scenario Title
B.3 Internal Scenario N - Scenario Title

C. ANNEX C - MATERIEL SYSTEM INTERNAL SCENARIOS
C.1 Internal Scenario 1 - 'A Typical Day's Operation'
C.1.1 Internal Scenario 1 - Situation
C.1.2 Internal Scenario 1 - Details of Process Flows and Interactions
C.1.3 Internal Scenario 1 - Materiel System Requirements
C.2 Internal Scenario 2 - Scenario Title
C.3 Internal Scenario N - Scenario Title
C.4 Consolidated Materiel System Functionality and Performance
Capability Life Cycle (CLC) Management
Dr Mike Ryan & Dr Shari Soutberg

**FPS**

- Specifies formal requirements for the Materiel System.
- Provides the basis for design and qualification testing of the system.
- Provides the vehicle for the capture of formal, verifiable and unambiguous requirements, ‘distilled’ from the OCD.
- Is intentionally written using formal language, with all requirements in the FPS traceable to needs in the OCD.
- Addresses the total Materiel System, but will later be developed into a Mission System specification and a Support System specification, usually by a prime contractor or prime system integrator.
- FPS requirements may also need to be decomposed and/or allocated for the purposes of individual acquisition contracts.

**FPS Template**

<table>
<thead>
<tr>
<th>Section 1 – Scope</th>
<th>3.14 – Environmental Impact Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 – Identification</td>
<td>3.15 – Useability and Human Factors</td>
</tr>
<tr>
<td>1.2 – System Overview</td>
<td>3.16 – Security and Privacy</td>
</tr>
<tr>
<td>1.3 – Document Overview</td>
<td>3.17 – Adaptation Requirements</td>
</tr>
<tr>
<td><strong>Section 2 – Applicable Documents</strong></td>
<td>3.18 – Design and Implementation Constraints</td>
</tr>
<tr>
<td><strong>Section 3 – Requirements</strong></td>
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<tr>
<td>3.1 – Missions</td>
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<tr>
<td>3.2 – System Boundaries and Context</td>
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<td>3.3 – Required States and Modes</td>
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<td>3.4 – System Capability Requirements</td>
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<td>3.5 – Availability</td>
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<td>3.6 – Reliability</td>
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<td>3.8 – Deployability</td>
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<td>3.9 – Transportability</td>
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<td>3.10 – Environmental Conditions</td>
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<td>3.11 – Electromagnetic Radiation</td>
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<td>3.12 – Architecture, Growth and Expansion</td>
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<td>3.13 – Safety</td>
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<td><strong>Section 4 – Precedence and Criticality of Requirements</strong></td>
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<td><strong>Section 5 – Verification</strong></td>
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<td><strong>Section 6 – Requirements Traceability</strong></td>
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<tr>
<td><strong>Section 7 – Notes</strong></td>
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</tbody>
</table>
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 DT&E

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

CDD Guide v2.2
Develop OCD, FPS, and TEMP

1. Define Capability System context and background
2. Define Capability System needs (Independent of Solution Class)
3. Describe relevant Existing System capability
4. Define Material System & FIC requirements (dependent on Solution Class)
5. Maintain OCD, FPS & TEMP over life of Capability System

CDD Guide v2.0
OCD Section

Develop OCD, FPS, and TEMP

OCD Section 1 to 3 4 5/6

1. Define Capability System context and background
2. Define Capability System needs (Independent of Solution Class)
3. Describe relevant Existing System capability
4. Define Material System & FIC requirements (dependent on Solution Class)
5. Maintain OCD, FPS & TEMP over life of Capability System

What do we need? What do we have? What can we do? Is everything still OK?
Define CS Context and Background

1. Define Capability
2. Define Stakeholders
3. Define Capability Rationale
4. Define Capability System Boundaries
5. Identify Key Timeframes for Capability System
6. Primary and Secondary Mission Objectives
7. Define Operational Policies and Doctrine

Define Capability System Needs

1. Identify All End-user Classes
2. Select Minimal Set of Operational Scenarios
3. Describe Future Situation
4. Extract Operational Needs for Each Business Process Step
5. Consolidate Operational Needs
6. Define Capability System Constraints
7. Prioritize Capability System Needs for Each Operational Scenario and End-user Class

For each Operational Scenario and End-user class:

- Describe Future Situation
- Extract Operational Needs for Each Business Process Step
- Consolidate Needs
- Define Capability System Constraints
- Prioritize Capability System Needs
Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

Describe Existing System Capability

Define Materiel System Requirements
Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg

Selected Important Activities

1.2 Identify Stakeholders
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.

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

Context Diagrams

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

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

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

System Under Consideration

Context Diagram

- Police
- Neighbours
- Environment
- Resident
- Monitoring Agent
- Monitoring system
- PSTN
- Alarm System
- Power point
- Power Distribution Subsystem
- Power entry panel
- Intruder
- Power Grid

- Police
- Neighbours
- Environment
- Resident
- Monitoring Agent
- Monitoring system
- PSTN
- House System
Consider External Interfaces

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

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

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

Consider External Interfaces

- The definition of an interface requires considerably more detail than simply identifying and naming the interface. Broadly there are three main steps in interface definition:

  - **Interface Description.** The interface is given a name, short title and identifier. The nature of the interface is described in terms of *who, what, when, where, why, how*.

  - **Interface Impact Analysis.** The interface is analysed in terms of its impact on the system. In particular, any constraints imposed by the system are identified. A risk analysis is conducted to determine the impact of the interface on the operation and design of the system.

  - **Interface Control Analysis.** Each external interface must be analysed to determine the extent to which it can be controlled so that designers and operators of the system are not at the mercy of its external interfaces.
Consider External Interfaces

- Once it has been defined, each interface has to be documented and managed. Interface management is very important because systems (and the projects that deliver them, for that matter) often live or die by their interfaces. This is even more evident in modern systems where the sheer number of interfaces and their complexity are a significant source of risk in system development.

- The definition of a system’s external interfaces assists in defining the system’s scope—interface management is therefore an important part of the scope management activities undertaken by the project manager. It is highly likely that the scope of a system would be affected should there be a change to any aspect of a system’s external interfaces throughout its development.
Identify Mission (and Operational Needs)

- Because the user has most probably stated the mission for the system in a fairly general way, every project should begin with a concise statement of the mission, elaborated by statements of the system-level needs.
- The mission statement is then expanded and qualified by short declarative statements of the system operational needs (best expressed in a functional hierarchy).
- Level 1 Operational Needs are normally relatively broad, each of which spawns a number of more-specific Level 2 Operational Needs, each of which spawns a number of more-specific Level 3 Operational Needs, and so on.
- Level 3 or 4 is sufficient for the OCD—lower level needs spawn system requirements in the FPS (and subsequently in the SS and then the SSS).
Secondary Missions

• Secondary mission objectives can be considered on the assumption that the Capability System will eventually be in place. These secondary objectives take advantage of the existence of this Capability System, given that, without it, they would have to be satisfied in another way.

• For example, an air-to-air refueller platform may have a secondary mission objective as a communications relay. If the refuelling role did not exist, the communications-relay capability may be achieved by some other means, such as a suitably equipped unmanned aerial vehicle.

1.7 Identify Policies and Doctrine

1.1 (1.1) Identify Capability
1.2 (1.2) Identify Stakeholders
1.3 (1.3) Identify Capability rationale
1.4 (1.4) Identify Capability System boundaries (solution-class-independent)
1.5 (1.5) Identify key timeframes for Capability System
1.6 (3.1) Identify primary and secondary mission objectives
1.7 (3.2) Identify operational policies and doctrine
1.8 (2.1/2.2) Establish and maintain Glossary and list of Referenced Documents
1.7 Identify Policies and Doctrine

- Identify operational and policies such as:
  - international treaties;
  - agreements regarding operation in international waters or airspace;
  - compliance with environmental, heritage, and land rights legislation;
  - compliance with spectrum management regulations;
  - doctrine relating to the primary and secondary missions; and
  - interoperability requirements, which may be considered here, but are usually considered as part of the derivation of the operational needs and solution-class requirements.

- We discuss these in more detail later as enterprise constraints.

18 Glossary and Referenced Documents
1.8 Glossary and Referenced Documents

- The aim of this step is to initially create and then maintain a glossary of defined terms and acronyms, and a list of referenced documents. The set of terms used in each of the OCD, FPS and TEMP may not always overlap, but wherever common terms and documents are referenced, the terminology and references should be the same.

- A project-wide integrated dictionary should be established, consisting of both a glossary of terms and acronyms and a list of referenced documents. A filtered set of this dictionary should be incorporated into the OCD and other CDD, as applicable.
2.1 Identify all End-user Classes

- The aim of this step is to identify all the End-user classes (End-users that have a common set of needs) in conjunction with establishing the scenarios for the Capability System.

- This step is typically iterative because the identification of an End-user class may require additional operational scenarios (next step) in which they appear, and vice-versa.

- The set of End-user classes should identify the people who are external to the 'black box' Capability System and who are the End-users of the system products or capabilities.

- The roles and needs of people inside the Capability System (Internal Users), such as operators, maintainers and trainers, is addressed later (in Section 5.4), during preparation of the internal, solution-class-dependent description.
2.2 Select Operational Scenarios

- Once the mission and high-level operational needs have been articulated, the top-down process is continued through an examination of the range of operational scenarios that the stakeholders propose for the system.

- The examination begins with a description of the general operational environment for the system to identify all of the environmental factors that may have an effect on the operation of the system.

- Specific operational scenarios are then described in users’ language to depict the full range of circumstances under which the system is required to operate.

- It is not necessary to describe every possible scenario, but all types of operation must be represented. Scenarios also need to represent all stakeholder perspectives.
2.2 Select Operational Scenarios

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

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

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

2.2 Select Operational Scenarios

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

- In our aircraft example, a number of modes may be defined for international and domestic operation including taxi, take-off, cruise, approach, landing, turn-around, and so on. Modes may also be defined for maintenance and for administrative movement of the aircraft.
2.2 Select Operational Scenarios

- Users tend to think in terms of the systems operation to suit their purposes—care has to be taken to define exception conditions.

- For example, a pilot of a combat aircraft will naturally describe a number of modes and states during which adversary aircraft are engaged and destroyed, but will need some prompting to describe what happens when the pilot’s aircraft is hit and the pilot must eject.

- At every stage in each scenario, we must ask the question “What could go wrong here?”
Project and Enterprise Constraints

- Before focusing on the detail of the desired system, it is essential to identify the project and enterprise constraints that are relevant to the system and its acquisition. This analysis provides essential information about the development environment for the system and begins the top-down approach to system development.

- Enterprise constraints include any organizational policies, procedures, standards or guidelines that guide system development and procurement. These constraints can include partnering relationships with other companies, contracting policies and so on.

Project and Enterprise Constraints

- Project constraints include the resource allocations to the project as well as any externally imposed deliverables and acquisition timeframes.

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

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

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

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

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

<table>
<thead>
<tr>
<th>Identify External Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>- <strong>External constraints could include:</strong></td>
</tr>
<tr>
<td>- <strong>Business environment.</strong> 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.</td>
</tr>
<tr>
<td>- <strong>Conformance to laws and regulations.</strong> 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.</td>
</tr>
<tr>
<td>- <strong>Compliance with standards.</strong> 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.</td>
</tr>
</tbody>
</table>
Identify External Constraints

- External constraints could include:
  - ...  
  - Ethical considerations and social responsibility. System developers have a moral and ethical responsibility to the owners and users of the system, as well as to the community.
  - Interoperability and or interfacing requirements. Since it is rare that a system would stand alone, interoperability and interface considerations must be taken into account during development.
  - Operating environment. The system will have to exist within an operational environment that will provide constraints in terms of temperature, humidity, and radiation as well as robustness to shock.

Identify Design Constraints

- Design constraints include those factors that directly affect the way in which the system design can be conducted. Of course, a number of enterprise, project and external constraints (such as budgets, regulations, and standards) will flow down and be inherited as design constraints.
- Typical design constraints include the state-of-the-art of relevant technologies, the skill sets of available engineers and tradespersons, as well as extant methodologies and tools to assist in the design, development, construction, and production of the system.
- Additionally, bounds such as all-up weight may be a design constraint for an aircraft system if it is to land on certain classes of airfield.
... and finally

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.
Capability Life Cycle (CLC) Management

Dr Mike Ryan & Dr Shari Soutberg
MilCIS provides two attendance options:

- **MilCIS Expo** attendees must register for their complimentary access to the MilCIS Exhibition Hall and to the MilCIS Expo presentations in the Royal Theatre.

- **MilCIS Conference** delegates pay the relevant registration fee to gain full access to all conference presentations (five parallel streams including the Expo presentations in the Royal Theatre), daily breakfast and lunch product sessions, the MilCIS Exhibition Hall, daily networking morning/afternoon teas and lunches, and the conference dinner.
Entry to Masters Programs

Selected UNSW Canberra Masters programs are available to Technical Managers without a first degree by virtue of your management training and experience. Eligibility requirements for this Pathway are:

**Pathway 5:** No tertiary qualification, but evidence of other academic qualifications and professional management experience submitted to the Program Authority is acceptable grounds for admission.

**Australian and International military applicants:**
- Officers with four years of experience at O3 level (or higher);
- Senior Non-Commissioned Officers with four years of experience at E8 level (or higher).

**Civilian or ADF military applicants:**
- Completed Advanced Diploma or Associate Degree and have completed at least four years full-time professional management experience; or
- Completed TAFE/VET Diploma and have completed at least five years full-time professional management experience.

You are required to undertake the course ZBUS8210 Critical Analysis in Business as a pre-condition of entry and it will be credited to the program for advanced standing.

Study Modes

All courses are available asynchronously online (Distance) or in intensive delivery mode (IDM). You simply download the information, complete the work and upload your assessments as detailed in the Course Outline. The IDM provides five days of face-to-face lectures, after which you complete the coursework as detailed in the Course Outline.

Tailoring your Program

Sessions normally run March to July for Semester 1 and July to October for Semester 2 with the Graduation Ceremony in December.

You can also mix and match your courses between Distance Mode and IDM based on your personal situation. As a rule of thumb one course (6 UOC) = 160 hours of study over a 15 week semester.

We suggest that you do one course per session until you establish a study pattern that fits your personal circumstances. At that point you may wish to review your courses and mix your modes of study.

You may be eligible for credit if you have completed any tertiary study in the last 10 years.

Available Programs

The following Masters programs are available via Pathway 5:
- Systems Engineering (8567)
- Project Management (8595)
- Capability Management (8399)
- Space Operations (8624)
- Cyber Security Operations (8629)

Further Information

For further information about UNSW Canberra and our masters programs visit:

unsw.adfa.edu.au
Master of Systems Engineering (8567)

The Master of Systems Engineering (MSysEng) is designed for you 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, specialisations are also available.

You must complete four compulsory courses (24 UOC) and four elective courses (24 UOC) from the list below. If you wish to graduate with one of the specialisations, you require the four compulsory courses and 24 UOC from that specialisation. You are required to attain a total of 48 UOC in order to graduate.

**Note:** If you enter via Pathway 5, you are required to successfully complete the course ZBUS8210 Critical Analysis in Business as a pre-condition of entry to the program, which will be credited to the program for advanced standing.

### Compulsory Courses
- ZEIT8226 Systems Engineering Practice
- ZEIT8230 Requirements Practice
- ZEIT8231 Test and Evaluation
- ZEIT8305 Systems Thinking and Modelling

### 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 degree
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

GPS and its Military Application
Expressions of Interest (Canberra)

Introduction to Electronic Warfare
Expressions of Interest (Canberra)

Introduction to Guided Weapons
Expressions of Interest (Canberra)

Introduction to Radar Systems
Expressions of Interest (Canberra)

Modern Military Navigation Systems
Expressions of Interest (Canberra)

Optical Surveillance Systems
Expressions of Interest (Canberra)

Target Detection with Advanced Optical Sensing
Expressions of Interest (Canberra)

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Web:  unsw.adfa.edu.au/profed
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.

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

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.

<table>
<thead>
<tr>
<th>Micro-credential Course (3 UOC)</th>
<th>UNSW Canberra Five-day PEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZEIT8238 Systems Engineering Knowledge</td>
<td>Systems Engineering Practice</td>
</tr>
<tr>
<td>ZEIT8240 Requirements Practice Knowledge</td>
<td>Requirements Practice</td>
</tr>
<tr>
<td>ZEIT8244 Systems Thinking and Modelling Knowledge</td>
<td>Systems Thinking and Modelling Practice</td>
</tr>
<tr>
<td>ZEIT8246 Test and Evaluation Knowledge</td>
<td>Test and Evaluation Practice</td>
</tr>
<tr>
<td>ZEIT8242 Satellite Communication Knowledge</td>
<td>Satellite Communications—Advanced</td>
</tr>
</tbody>
</table>

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.