Life Cycles
- Application to Project Planning

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APM Planning SIG

Knowledgeshare 2011
Introduction

- The speaker:
  - Career in aerospace & defence, starting in system engineering
  - Currently Project Support Manager for ITT Defence Limited
  - Providing planning and control services to project managers
  - Generally on small and medium sized system engineering projects
  - Planning SIG member

- The Planning SIG:
  - Has published introductions to Project Planning and Project Control
  - Is publishing a Scheduling Maturity Model
  - Is working on a Guide to Project Planning
  - Is working towards project planning qualifications (single subject examinations)
Presentation Overview

- Objectives:
  - Introduce life cycles other than the project life cycle
  - Outline their application to project planning
  - Obtain feedback on the ideas presented

- Content:
  - Principles
  - Different life cycles
  - Life cycle interactions
  - Application to project planning
  - Summary & conclusions
  - Questions, discussion, feedback

- Status:
  - Personal views
  - Under consideration by Planning SIG
Principles
What is Project Planning?

- Answers key questions about projects: why, what, how, where, when, who, how much, risks, returns
- Defines all aspects of projects: objectives, methodology, scope, quality/time/cost, risks, financial returns
- Uses multiple processes: objective setting, scoping, scheduling, resourcing, cost estimating, risk assessment, investment appraisal
- Generates multiple outputs – captured in project management plans
- Outputs support business cases and contract proposals
- Extendable to programmes ("big projects")
- Different from portfolio planning (which optimises the mix of projects, programmes and business as usual activities)
Definitions - From Outputs to Benefits

- Projects create outputs (products or services):
  - **Products** are tangible outputs (hardware and software)
  - **Services** are acts of help or assistance (e.g. user training, equipment installation)
- Generally, outputs are deliverables (handed over to sponsor/client/users)
- **Systems**:
  - Are integrated sets of elements (interrelated, interdependent, interacting)
  - The elements are deliverables from projects
  - Systems provide **capabilities**
- **Capabilities**:
  - Are functions fulfilling user needs
  - Are provided by systems operated within an organisation’s infrastructure by trained personnel using appropriate procedures
- **Benefits** are improvements arising from new capabilities
“System” Versus “Product”

- A “system” can be almost anything, e.g. power station; communication system; IT system; office building
- A system can be represented using a product breakdown structure (PBS)
- A PBS is a hierarchical decomposition of a system’s elements, from top level down to the lowest level required, e.g.:
  - Level 1: System
  - Level 2: Subsystems
  - Level 3: Units
  - Level 4: Components
- Note the unresolved mismatch in terminology:
  - **Product** breakdown structure; but
  - **System**, **system life cycle** and **system readiness levels**
- Potential resolution: adopt “system breakdown structure” (SBS)
What is a Life Cycle?

- A representation of the life story of an entity in terms of phases
- The “entity” can be an animal, a system, a project etc.
- The phases are the same from one generation to the next
- Each phase is distinctly different from the others
- Phases may be sub-divided into stages
- A distinct level of maturity is achieved at the end of each phase (and stage)
- For example – the life cycle of a butterfly
The Life Cycle of a Butterfly

Phases: Egg → Caterpillar → Chrysalis → Butterfly

Maturity: Laid → Hatched → Pupated → Emerged → Died

Phases repeated in next generation
The Project Life Cycle – and Others

- Projects are transient and unique but their phases are generally the same (hence the project life cycle)
- The project life cycle is a helpful structure for project management in general and project planning in particular
- But the project life cycle is not the only life cycle relevant to project management
- Using *only* the project life cycle omits useful aids to project planning and control
- Life cycles vary between business sectors and between organisations (types and phases)
- Organisations should choose life cycles to suit their needs – but common principles apply
Different Life Cycles
Capability Acquisition

- An organisation requires the benefits of a new capability
- The capability will be provided by a new system
- The system must be designed, developed, produced and handed over to users
- To acquire the system, the organisation initiates a programme
- Elements of the system will be delivered by third parties (contractors)
- The organisation therefore needs to let contracts (probably via competitive tendering)
- Each contractor will implement a project to deliver its system elements
- System elements may embody new technologies which must be matured for operational use
The capability acquisition involves five life cycles:

- **Acquisition**: representing how an organisation acquires a new capability
- **Technology**: representing how technology matures from ideas to operationally-proven applications
- **System (or Product)**: representing how a system (or product) matures from definition of user requirements to fully operational
- **Contract**: representing how a client organisation lets and a contractor organisation undertakes contracts
- **Project**: representing how an organisation undertakes a project

Six life cycles, including the organisation’s **programme** life cycle
Five Life Cycles - Phases

Acquisition Life Cycle
- Concept
- Assessment
- Demonstration
- Manufacture
- In Service
- Disposal

Technology Life Cycle
- Basic Research
- Feasibility Proving
- Technology Development
- Technology Demonstration
- Application Demonstration
- Application Operation

System Life Cycle
- Requirements
- Design
- Build
- Integration & Testing
- Verification & Validation
- Production
- Handover
- Operation
- Disposal

Contract Life Cycle (Client's & Contractor's perspectives)
- Requirement
- Assessment
- Request for Proposals
- Selection
- Oversight
- Completion
- Identification
- Investigation
- Pursuit
- Proposal
- Execution
- Completion

Project Life Cycle
- Initiation
- Concept
- Definition
- Mobilisation
- Implementation
- Closure
## Acquisition Life Cycle Phases

<table>
<thead>
<tr>
<th>Phase</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Concept</strong></td>
<td>User requirements defined. Technology and procurement options identified. Planning for subsequent phases. Outline business case prepared.</td>
</tr>
<tr>
<td><strong>Assessment</strong></td>
<td>System requirements defined. Optimum technology and acquisition options selected. Planning for subsequent phases. Business case refined.</td>
</tr>
<tr>
<td><strong>Demonstration</strong></td>
<td>System designed, built, integrated and tested, verified, validated - demonstrating that it provides the required capability. System accepted.</td>
</tr>
<tr>
<td><strong>Manufacture</strong></td>
<td>System produced in quantities required by the users and handed over to them.</td>
</tr>
<tr>
<td><strong>In Service</strong></td>
<td>System used operationally to provide required capability and deliver required benefits. System supported and may be improved/upgraded.</td>
</tr>
<tr>
<td><strong>Disposal</strong></td>
<td>System decommissioned, withdrawn from service and disposed of.</td>
</tr>
</tbody>
</table>

**Reviews:** gate reviews at ends of phases
# Technology Life Cycle Phases

<table>
<thead>
<tr>
<th>Phase</th>
<th>Description</th>
<th>TRL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Research</td>
<td>New technology identified</td>
<td>1</td>
</tr>
<tr>
<td>Fasibility Proving</td>
<td>Feasibility confirmed through analysis &amp; experimentation</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Technology Development</td>
<td>Technology matured through analysis and experimentation</td>
<td>4</td>
</tr>
<tr>
<td>Technology Demonstration</td>
<td>Suitability for eventual operational use demonstrated using models and simulators</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Application Demonstration</td>
<td>Technology applied in prototypes of operational system which are tested and demonstrated</td>
<td>7</td>
</tr>
<tr>
<td>Application Operation</td>
<td>Technology applied in production examples of operational system and qualified through successful mission operations</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>

**Reviews:** gate reviews at ends of phases
## Technology Readiness Levels

<table>
<thead>
<tr>
<th>Level</th>
<th>Technology Readiness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Basic principles observed and reported</td>
</tr>
<tr>
<td>2</td>
<td>Concept and/or application formulated</td>
</tr>
<tr>
<td>3</td>
<td>Analytical and experimental critical function/characteristic proof of concept</td>
</tr>
<tr>
<td>4</td>
<td>Basic validation in a laboratory environment</td>
</tr>
<tr>
<td>5</td>
<td>Basic validation in a relevant environment</td>
</tr>
<tr>
<td>6</td>
<td>Technology model or technology prototype demonstrated in a relevant environment</td>
</tr>
<tr>
<td>7</td>
<td>Technology prototype demonstrated in an operational environment</td>
</tr>
<tr>
<td>8</td>
<td>Actual technology completed and qualified through test and demonstration</td>
</tr>
<tr>
<td>9</td>
<td>Actual technology qualified through successful operational missions</td>
</tr>
</tbody>
</table>
# System Life Cycle Phases

<table>
<thead>
<tr>
<th>Phase</th>
<th>Description</th>
<th>SRL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirements</td>
<td>User requirements captured. System requirements defined. Verification, validation and acceptance criteria defined</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Design</td>
<td>System options explored. Chosen system option defined down to component level. Integration &amp; test plans prepared.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Build</td>
<td>Prototype components are manufactured; software is coded.</td>
<td></td>
</tr>
<tr>
<td>Integration &amp; Testing</td>
<td>System is progressively integrated from its components and tested, in accordance with integration &amp; test plans</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Verification &amp; Validation</td>
<td>Prototype system undergoes tests and trials in representative operational environments to gather evidence for verification, validation and acceptance</td>
<td>7</td>
</tr>
<tr>
<td>Production</td>
<td>System is manufactured in quantities required by users for operational use</td>
<td>8</td>
</tr>
<tr>
<td>Handover</td>
<td>Production systems handed over to users, who must be trained. Support arrangements must also be in place</td>
<td></td>
</tr>
<tr>
<td>Operation</td>
<td>Production systems used for their intended purpose, providing the capability needed by the users and providing benefits to the users’ organisation</td>
<td>9</td>
</tr>
<tr>
<td>Disposal</td>
<td>Production systems are withdrawn from operation and disposed of, with due consideration of residual value, recycling and environment</td>
<td></td>
</tr>
</tbody>
</table>

**Reviews:** requirements; design; test readiness; validation & verification; production readiness
## System Readiness Levels

<table>
<thead>
<tr>
<th>Level</th>
<th>System Readiness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mature user requirements, capable of validation</td>
</tr>
<tr>
<td>2</td>
<td>Mature system requirements, capable of verification</td>
</tr>
<tr>
<td>3</td>
<td>Mature system (architectural) design</td>
</tr>
<tr>
<td>4</td>
<td>Mature subsystem designs</td>
</tr>
<tr>
<td>5</td>
<td>Individual subsystems verified in simulated system (laboratory) environments</td>
</tr>
<tr>
<td>6</td>
<td>Subsystems integrated with realistic supporting elements and verified in simulated operational (laboratory) environments</td>
</tr>
<tr>
<td>7</td>
<td>Represented prototype system integrated and verified in a high-fidelity simulated operational environment (eg vehicle integration testing)</td>
</tr>
<tr>
<td>8</td>
<td>Final prototype system demonstrated in a representative target platform</td>
</tr>
<tr>
<td>9</td>
<td>Production system in its definitive form operational under mission conditions</td>
</tr>
</tbody>
</table>
System Life Cycle Stages – Design & Development V Model
Design & Development Waterfall Model

- User Requirements
- System Requirements
- System Design
- Unit Design
- Component Design
- Build
- Component Testing
- Unit Integration & Testing
- System Integration & Testing
- Verification
- Validation

Concurrent
Sequential
## Contract Life Cycle Phases

<table>
<thead>
<tr>
<th>Phase (Client)</th>
<th>Description (Client)</th>
<th>Phase (Contractor)</th>
<th>Description (Contractor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirement</td>
<td>Client establishes need for a contract and defines the requirement.</td>
<td>Identification</td>
<td>Contractor identifies that client is likely to be letting a contract and determines whether to investigate the business opportunity.</td>
</tr>
<tr>
<td>Assessment</td>
<td>Client assesses contractors potentially able to execute the contract. May seek qualification information.</td>
<td>Investigation</td>
<td>Contractor investigates opportunity and prepares an outline business case. Responds to any information requests.</td>
</tr>
<tr>
<td>Request for Proposals</td>
<td>Client may issue request for information. Prepares and issues request for proposals.</td>
<td>Pursuit</td>
<td>Contractor responds to any request for information. Seeks to favourably influence the contractor. Refines business case.</td>
</tr>
<tr>
<td>Selection</td>
<td>Client receives and evaluates contractors’ proposals, selects preferred contractor, negotiates and awards contract.</td>
<td>Proposal</td>
<td>Contractor prepares and submits proposal. If selected, negotiates and accepts contract.</td>
</tr>
<tr>
<td>Oversight</td>
<td>Client oversees contractor to ensure that contract requirements are met.</td>
<td>Execution</td>
<td>Contractor executes contract and hands over required deliverables.</td>
</tr>
<tr>
<td>Completion</td>
<td>Client and contractor complete contractual matters, confirming that all deliverables have been provided and payments made.</td>
<td>Completion</td>
<td>Client and contractor complete contractual matters, confirming that all deliverables have been provided and payments made.</td>
</tr>
</tbody>
</table>

**Reviews:**
- gate reviews at ends of phases - approval to issue RFI and RFP, selection etc.
- gate reviews at ends of phases - investigate, pursue, bid, proposal, contract acceptance etc.
## Project Life Cycle Phases

<table>
<thead>
<tr>
<th>Phase</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Initiation</strong></td>
<td>Pre-project phase conducted as part of life cycle management, e.g. at programme level. Project need identified. Project initiation document prepared. Project manager appointed. Concept phase budget allocated.</td>
</tr>
<tr>
<td><strong>Concept</strong></td>
<td>(Project is started.) Project preliminary planning carried out. Outline project management plan and business case prepared. Project need confirmed. Definition phase budget allocated.</td>
</tr>
<tr>
<td><strong>Definition</strong></td>
<td>Project detailed planning carried out. Project control arrangements defined. Project management plan and business case refined. Project need re-confirmed. Mobilisation, implementation &amp; closure phases budget allocated.</td>
</tr>
<tr>
<td><strong>Mobilisation</strong></td>
<td>Full project team assembled; facilities and equipment obtained. Project control arrangements become operational. Plan is baselined. Initial work packages authorised. (Project is launched.)</td>
</tr>
<tr>
<td><strong>Implementation</strong></td>
<td>Core work of project carried out. Project control arrangements are operated. Re-planning and re-baselining as required. (Project is completed.)</td>
</tr>
<tr>
<td><strong>Closure</strong></td>
<td>Final reviews carried out and lessons learned are documented. Project information is archived. Project team is demobilised. (Project is closed.)</td>
</tr>
</tbody>
</table>

**Reviews:** gate reviews at ends of phases
Project Life Cycles Comparison

Project Life Cycle – Planning & Control

<table>
<thead>
<tr>
<th>Initiation</th>
<th>Concept</th>
<th>Definition</th>
<th>Mobilisation</th>
<th>Implementation</th>
<th>Closure</th>
</tr>
</thead>
</table>

Extended Project Life Cycle

- Concept
- Definition
- Implementation (Design & Build)
- Handover & Closeout
- Operations
- Termination

Project Life Cycle – APM Body of Knowledge 5th Edition
Project Life Cycle – Planning & Control

**Initiation**
- LCM Process
  - Initiation Planning

**Concept**
- Project Planning Process
  - Preliminary Planning
  - Detailed Planning
  - Baselining

**Definition**
- Plan Maintenance, Replanning & Rebaselining

**Mobilisation**
- Core Work of Project

**Implementation**
- Operate Control System

**Closure**
- Close Control System

---

**Plan**
- Do
- Review
Life Cycle Management

- All the life cycles require active management
- Life cycle management is an important governance function
- Life cycle management requires:
  - Defined life cycle models
  - Formal gate reviews with agreed maturity criteria (e.g. TRLs, SRLs)
  - Trained and experienced independent reviewers
- It’s preferable not to combine gate reviews for different life cycles
- Gate review outcomes:
  - Pass (continue to next phase)
  - Conditional pass (continue but with corrective actions)
  - Hold (until corrective actions are completed)
  - Fail (terminate the life cycle)
- Project life cycle management:
  - Is a programme, portfolio or business as usual function
  - Terminated projects should proceed to closure phase – learn lessons
Life Cycle Interactions
Interactions Between Life Cycles

- The different life cycles interact
- For planning purposes, the interactions of the different life cycles need to be worked out
- This involves establishing the relationships between the phases of the different life cycles
- Examples of interactions include:
  - Project life cycles within programmes
  - Contract and project life cycles – project planning
  - Acquisition, technology and system life cycles
  - Acquisition, contract and project life cycles
Interactions – Project Life Cycles Within Programmes

Portfolio or Subsidiary Portfolio

Programmes

Projects
Interactions – Contract & Project Life Cycles – Project Planning

Contract Life Cycle (Client’s)

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Assessment</th>
<th>Req for Prop</th>
<th>Selection</th>
<th>Oversight</th>
<th>Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract Requirement</td>
<td>Assessment of Potential Contractors</td>
<td>Preparation of Request For Proposals</td>
<td>Analysis of Proposals; Contractor Selection &amp; Negotiation</td>
<td>Contract Oversight</td>
<td>Contract Completion</td>
</tr>
</tbody>
</table>

Contract Life Cycle (Contractor’s)

<table>
<thead>
<tr>
<th>Identification</th>
<th>Investigation</th>
<th>Pursuit</th>
<th>Proposal</th>
<th>Execution</th>
<th>Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opportunity Identification</td>
<td>Opportunity Investigation</td>
<td>Positioning &amp; Influencing</td>
<td>Proposal Planning &amp; Preparation; Negotiation</td>
<td>Contract Management</td>
<td>Contract Completion</td>
</tr>
</tbody>
</table>

Project Life Cycle
Interactions – Acquisition, Technology & System Life Cycles

### Acquisition Life Cycle

<table>
<thead>
<tr>
<th>Concept</th>
<th>Assessment</th>
<th>Demonstration</th>
<th>Manufacture</th>
<th>In Service</th>
</tr>
</thead>
</table>

### Technology Life Cycle

<table>
<thead>
<tr>
<th>Basic Research</th>
<th>Feasibility Proving</th>
<th>Technology Development</th>
<th>Technology Demonstration</th>
<th>Application Demonstration</th>
<th>Application Operation</th>
</tr>
</thead>
</table>

### System Life Cycle

<table>
<thead>
<tr>
<th>Reqs</th>
<th>Design</th>
<th>I&amp;T</th>
</tr>
</thead>
</table>

Outline requirements; conceptual design; analysis/modelling/simulation

<table>
<thead>
<tr>
<th>Reqs</th>
<th>Design</th>
<th>Build</th>
<th>Integration &amp; Testing</th>
<th>Verification &amp; Validation</th>
<th>Production</th>
<th>Handover</th>
<th>Operation</th>
</tr>
</thead>
</table>

Draft requirements; technology demonstrator design, build, integration & testing

Finalised requirements through to operation
Interactions – Acquisition, Contract & Project Life Cycles (Summarised)

Client’s Acquisition Life Cycle

- Concept
- Assessment
- Demonstration
- Manufacture

Client’s Programme

Concept Phase Project

Assessment Phase Project

Assessment Phase Contracts (One per Contractor)

Demonstration & Manufacture Phases Project

Demonstration & Manufacture Phases Contract

Contractors’ Contracts & Projects

Assessment Phase Contracts (One per Contractor)

Assessment Phase Contracts (One per Contractor)

System Life Cycle (Second Pass)

Contractor’s Contract & Project

Demonstration & Manufacture Phases Contract

Demonstration & Manufacture Phases Project

System Life Cycle (Third Pass)
Interactions – Acquisition, Contract & Project Life Cycles (In Detail)
Application to Project Planning
Life Cycle Uses

- Use of life cycles:
  - Ensures consistency of approach
    - Re-use of planning outputs
    - Basis for comparative estimating
  - Provides a quantitative basis for objective setting, e.g. TRLs & SRLs
  - Helps manage risk:
    - Defined maturity and phase exit criteria
    - Enforced by formal gate reviews
  - Assists project scoping
- Illustration of the latter using an acquisition scenario
Acquisition Scenario

- Client:
  - Needs to acquire a new capability
  - Has completed concept and assessment phases of acquisition life cycle
  - Will award contract for system demonstration and manufacture (D&M)

- “Our” contractor:
  - Was one of several which undertook assessment phase contracts
  - Now has a system solution at SRL 3 (mature system design)
  - Least mature components at TRL 4 (laboratory validation)
  - Is in the investigation phase of the D&M contract life cycle
  - Is in the concept phase of its D&M project
  - Is performing preliminary project planning
Contractor’s Preliminary Planning

- Objectives:
  - To prepare outline project management plan and business case
  - So that contractor can determine whether to pursue the contract opportunity
  - As quickly and cheaply as possible, consistent with minimising uncertainty and risk

- Process:
  - Scoping: system solution, sourcing, implementation method and scope of work (What? How? Where?)
  - Scheduling: outline schedule (When?)
  - Resourcing: preliminary assignments (Who?)
  - Estimating: ROM cost estimate and contract price (How much?)
  - Risk management: assess risks (Risks?)
  - Investment appraisal: assess returns (Returns?)
System Solution – Product Breakdown Structure

<table>
<thead>
<tr>
<th>Product Breakdown Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>System</td>
</tr>
<tr>
<td>Level 1</td>
</tr>
<tr>
<td>System</td>
</tr>
<tr>
<td></td>
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<td></td>
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<tr>
<td></td>
</tr>
</tbody>
</table>
System Solution – Technology Readiness

Product Breakdown Structure

<table>
<thead>
<tr>
<th>System (TRL 4)</th>
<th>Unit 1 (TRL 4)</th>
<th>Component 1.1 (TRL 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 2 (TRL 9)</td>
<td>Component 1.2 (TRL 4)</td>
<td></td>
</tr>
<tr>
<td>Unit 3 (TRL 4)</td>
<td>Component 2.1 (TRL 9)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Component 2.2 (TRL 9)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Component 3.1 (TRL 4)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Component 3.2 (TRL 4)</td>
<td></td>
</tr>
</tbody>
</table>
System Solution – Sourcing

Product Breakdown Structure

<table>
<thead>
<tr>
<th>System</th>
<th>Units</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Level 2</td>
<td>Level 3</td>
</tr>
</tbody>
</table>

- **Made Items**
  - System (TRL 4)
  - Unit 1 (TRL 4)
  - Component 1.1 (TRL 4)
  - Component 1.2 (TRL 4)
  - Unit 2 (TRL 9)
  - Component 2.1 (TRL 9)
  - Component 2.2 (TRL 9)
  - Unit 3 (TRL 4)
  - Component 3.1 (TRL 4)
  - Component 3.2 (TRL 4)

- **Bought Items**
Implementation Method

System
determines Core Work

Acquisition Life Cycle Phases

System Life Cycle Phases

Implementation Method
(defined by Project Team)

through System Life Cycle

How?

Core Work 
of 
Project

Production
Handover
V&V
I&T
Build
Design
Reqs
Manufacture
Demonstration

Product Breakdown Structure

<table>
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<tr>
<td>System (TRL 4)</td>
<td>Unit 1 (TRL 9)</td>
<td>Component 1.1 (TRL 4)</td>
</tr>
<tr>
<td></td>
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<td>Component 1.2 (TRL 4)</td>
</tr>
<tr>
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<td>Component 1.3 (TRL 4)</td>
<td>Component 2.1 (TRL 9)</td>
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<tr>
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<td>Component 2.2 (TRL 9)</td>
<td>Component 3.1 (TRL 4)</td>
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<td>Unit 2 (TRL 4)</td>
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<tr>
<td></td>
<td>Unit 3 (TRL 4)</td>
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</tbody>
</table>

Implementation Method
(defined by Project Team)
Core Work – Demonstration

### Product Breakdown Structure

<table>
<thead>
<tr>
<th>System</th>
<th>Units</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Level 2</td>
<td>Level 3</td>
</tr>
<tr>
<td>System (TRL 4)</td>
<td>Unit 1 (TRL 4)</td>
<td>Component 1.1 (TRL 4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Component 1.2 (TRL 4)</td>
</tr>
<tr>
<td>Unit 2 (TRL 9)</td>
<td>Component 2.1 (TRL 9)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Component 2.2 (TRL 9)</td>
<td></td>
</tr>
<tr>
<td>Unit 3 (TRL 4)</td>
<td>Component 3.1 (TRL 4)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Component 3.2 (TRL 4)</td>
<td></td>
</tr>
</tbody>
</table>

### System Life Cycle Stages

<table>
<thead>
<tr>
<th>Stage</th>
<th>System Design</th>
<th>Component Design</th>
<th>Build</th>
<th>Component Testing</th>
<th>Unit Integ &amp; Testing</th>
<th>System Integ &amp; Testing</th>
<th>Verification</th>
<th>Validation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>User Reqs</td>
<td>System Reqs</td>
<td>System Design</td>
<td>Component 2.1 Build &amp; Testing (Procurement – Supplier B)</td>
<td>Component 2.2 Build &amp; Testing (Procurement – Supplier B)</td>
<td>Unit 3 Integration &amp; Testing</td>
<td>Verification</td>
<td>Validation</td>
</tr>
<tr>
<td>Level 2</td>
<td>Component 3.1 Design</td>
<td>Component 3.2 Design</td>
<td>Component 3.1 Build</td>
<td>Component 3.1 Testing</td>
<td>Component 3.2 Testing</td>
<td>Unit 3 Integration &amp; Testing</td>
<td>Verification</td>
<td>Validation</td>
</tr>
<tr>
<td>Level 3</td>
<td>Component 3.1 Design</td>
<td>Component 3.2 Design</td>
<td>Component 3.1 Build</td>
<td>Component 3.1 Testing</td>
<td>Component 3.2 Testing</td>
<td>Unit 3 Integration &amp; Testing</td>
<td>Verification</td>
<td>Validation</td>
</tr>
</tbody>
</table>

**Unit 1**
Design, Build, Integration & Testing (Subcontract – Subcontractor A)
### Core Work – Manufacture

<table>
<thead>
<tr>
<th>Product Breakdown Structure</th>
<th>System Life Cycle Stages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System</strong></td>
<td><strong>Component Manufacture &amp; Testing</strong></td>
</tr>
<tr>
<td>Level 1</td>
<td><strong>Unit Assembly &amp; Testing</strong></td>
</tr>
<tr>
<td>System (TRL 8)</td>
<td><strong>System Assembly &amp; Testing</strong></td>
</tr>
<tr>
<td>Unit 1 (TRL 8)</td>
<td><strong>Handover</strong></td>
</tr>
<tr>
<td>Comp’n 1.1 (TRL 8)</td>
<td></td>
</tr>
<tr>
<td>Comp’n 1.2 (TRL 8)</td>
<td></td>
</tr>
<tr>
<td>Unit 2 (TRL 9)</td>
<td><strong>Component Manufacture &amp; Testing</strong></td>
</tr>
<tr>
<td>Comp’n 2.1 (TRL 9)</td>
<td><strong>Component Manufacture &amp; Testing</strong></td>
</tr>
<tr>
<td>Comp’n 2.2 (TRL 9)</td>
<td><strong>Component Manufacture &amp; Testing</strong></td>
</tr>
<tr>
<td>Unit 3 (TRL 8)</td>
<td><strong>Component Manufacture &amp; Testing</strong></td>
</tr>
<tr>
<td>Comp’n 3.1 (TRL 8)</td>
<td><strong>Component Manufacture &amp; Testing</strong></td>
</tr>
<tr>
<td>Comp’n 3.2 (TRL 8)</td>
<td><strong>Component Manufacture &amp; Testing</strong></td>
</tr>
</tbody>
</table>

Unit 1 Manufacture, Assembly & Testing (Subcontract – Subcontractor A)

Component 2.1 Manufacture, Assembly & Testing (Procurement – Supplier B)

Component 2.2 Manufacture, Assembly & Testing (Procurement – Supplier B)

Comp. 3.1 Manufacture & Testing

Comp. 3.2 Manufacture & Testing

Unit 3 Assembly & Testing

User Training
Scope of Work

Acquisition Life Cycle Phases
- System Life Cycle Phases
- Project Life Cycle Phases

Mobilisation Closure

Core Work of Project
- Overall Scope of Work

Core Work - Demonstration
Core Work - Manufacture

Requirements Management
Configuration Management
Contractor’s Preliminary Planning – Next Steps

- Remainder of concept phase/preliminary planning:
  - Scheduling, resourcing, cost estimating, risk management, investment appraisal
  - Iterate as necessary
  - Prepare outline PMP and business case

- Gate reviews:
  - Project life cycle: is it a viable project?
  - Contract life cycle: is it a winnable contract?
  - Contract might not be winnable with a viable project!

- If proceeding to definition phase/detailed planning:
  - Prepare detailed plan – capable of implementation
  - Refine PMP and business case
  - Provide information for contract proposal
Summary & Conclusions
Summary

- Definition of “life cycle”:
  - Distinct phases, same from one generation to the next
  - Distinct level of maturity at end of each phase
- Five different life cycles identified:
  - Acquisition
  - Technology
  - System (Product)
  - Contract
  - Project
- Identified life cycle uses
- Illustrated application to scoping core work of project
Conclusions

- There are multiple life cycles
- Organisations should choose life cycles to suit their needs
- Useful aids to project planning
- Limiting to use *only* the project life cycle
- Use of life cycles requires active life cycle management
- Adhere to life cycle principles but apply flexibly – a guide, not a straightjacket
Questions, Discussion, Feedback
Supplemental Material

(for discussion if required)
Project Life Cycles Comparison

Project Life Cycle – Planning & Control

<table>
<thead>
<tr>
<th>Initiation</th>
<th>Concept</th>
<th>Definition</th>
<th>Mobilisation</th>
<th>Implementation</th>
<th>Closure</th>
</tr>
</thead>
</table>

Project Life Cycle

Extended Project Life Cycle

Project Life Cycle – APM Body of Knowledge 5th Edition
## Project Life Cycles Comparison (continued)

<table>
<thead>
<tr>
<th>Item</th>
<th>Body of Knowledge 5th Edition</th>
<th>Planning &amp; Control perspective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same life cycle for all projects?</td>
<td>No</td>
<td>Extended life cycle required</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vary scope of implementation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>phase to suit system life cycle</td>
</tr>
<tr>
<td>Project management scope different in each phase?</td>
<td>???</td>
<td>Implementation, handover &amp;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>closeout, operation &amp;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>termination are similar?</td>
</tr>
<tr>
<td>Representation of what happens before project start?</td>
<td>No</td>
<td>Initiation phase (at</td>
</tr>
<tr>
<td></td>
<td></td>
<td>programme, portfolio or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>business as usual level)</td>
</tr>
<tr>
<td>Mobilisation phase represented</td>
<td>No</td>
<td>Short but significant</td>
</tr>
<tr>
<td>Closure phase always comes at the end?</td>
<td>No</td>
<td>And combined with handover</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Optimum basis for describing planning &amp; control?</td>
<td>No</td>
<td>Implementation, handover and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>operations similar</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Each phase distinctly different</td>
</tr>
<tr>
<td></td>
<td></td>
<td>???</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maybe 7th Edition?</td>
</tr>
</tbody>
</table>
Project Life Cycle – Human Analogy

Project Life Cycle – Planning & Control

| Initiation | Concept | Definition | Mobilisation | Implementation | Closure |

Human Life Cycle

Relationship

Conception

Pregnancy

Labour

Living

Dying