SCAF Workshop

"The Use of Parametrics for Cost and Schedule Estimating—are we making best use of it?"

Tuesday 8th February 2011

Conference Room 4, The BAWA Centre, Filton, Bristol

Parametric estimating - have we got the pre-requistes in place?

We are always confronted with a lack of data but do we really understand what is required and what is available. The presentation will focus on the information we require and how it can be best used.

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The Context for this Session

- Example cost estimate classification matrix for the process industries
- From: AACE International Recommended Practice, No. 18R-97
- AACE = “Association for the Advancement of Cost Engineering”
- Many organisations here would agree parametrics can achieve Class 5 / 4 expected accuracy range
- Have seen parametrics achieve Class 2 accuracy in the right circumstances

	Primary Characteristic	*Secondary Characteristic*			
ESTIMATE CLASS	**LEVEL OF PROJECT DEFINITION** Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical variation in low and high ranges [a]	**PREPARATION EFFORT** Typical degree of effort relative to least cost index of 1 [b]
Class 5	0% to 2%	Concept Screening	Capacity Factored, Parametric Models, Judgment, or Analogy	L: -20% to -50% H: +30% to +100%	1
Class 4	1% to 15%	Study or Feasibility	Equipment Factored or Parametric Models	L: -15% to -30% H: +20% to +50%	2 to 4
Class 3	10% to 40%	Budget, Authorization, or Control	Semi-Detailed Unit Costs with Assembly Level Line Items	L: -10% to -20% H: +10% to +30%	3 to 10
Class 2	30% to 70%	Control or Bid/ Tender	Detailed Unit Cost with Forced Detailed Take-Off	L: -5% to -15% H: +5% to +20%	4 to 20
Class 1	50% to 100%	Check Estimate or Bid/Tender	Detailed Unit Cost with Detailed Take-Off	L: -3% to -10% H: +3% to +15%	5 to 100

[a] The state of process technology and availability of applicable reference cost data affect the range markedly; the +/- value represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50% level of confidence) for given scope

[b] If the range index value of “1” represents 0.005% of project costs, then an index value of 100 represents 0.5%; estimate preparation effort is highly dependent upon the size of the project and the quality of estimating data and tools

Pre-Requisites Covered

Policies, Process and Systems

Locate and Capture Cost Data

Standard Cost Breakdown Structure

Collect Data on a Through-Life Basis

Policies, Process and Systems

Embed parametrics thinking in the operational framework of the organisation

- Examples of mandating policies :-
  - All projects shall conduct a formal project closure review at the time of contract completion to ensure an orderly and managed run down of the current project and maximise the opportunity for good outcomes on future projects by capturing baseline costs and cost outcomes for non recurring engineering, unit production costs, costs associated with service delivery, and costs of equipment disposal.
  - In preparation for the above, and whilst the project is still in progress, the interim cost data shall be held in a Project Library; this may take many forms ranging from a structured network drive on a small project to a sophisticated configuration management system on a large one
- Example of mandating a process :-
  - In order that baseline costs and cost outcomes can be used to inform future estimates the contextual information such as the requirements baseline, design information, assumptions list, etc shall also be saved in the Project Library
- Example of mandating a system :-
  - The Project Manager shall assume the responsibility for the system(s) and location(s) used for data storage, the accessibility and distribution of data, and the means of ensuring data integrity (e.g. access controls and backup arrangements)

Locate and Capture Cost Data - 1

Locate and capture cost data both internally and from third-parties

Class 5

- 0-2% definition
- L: -20% to -50%; H: +30% to +100%

Class 4

- 1-15% definition
- L: -15% to -30%; H: +20% to +50%

Class 3

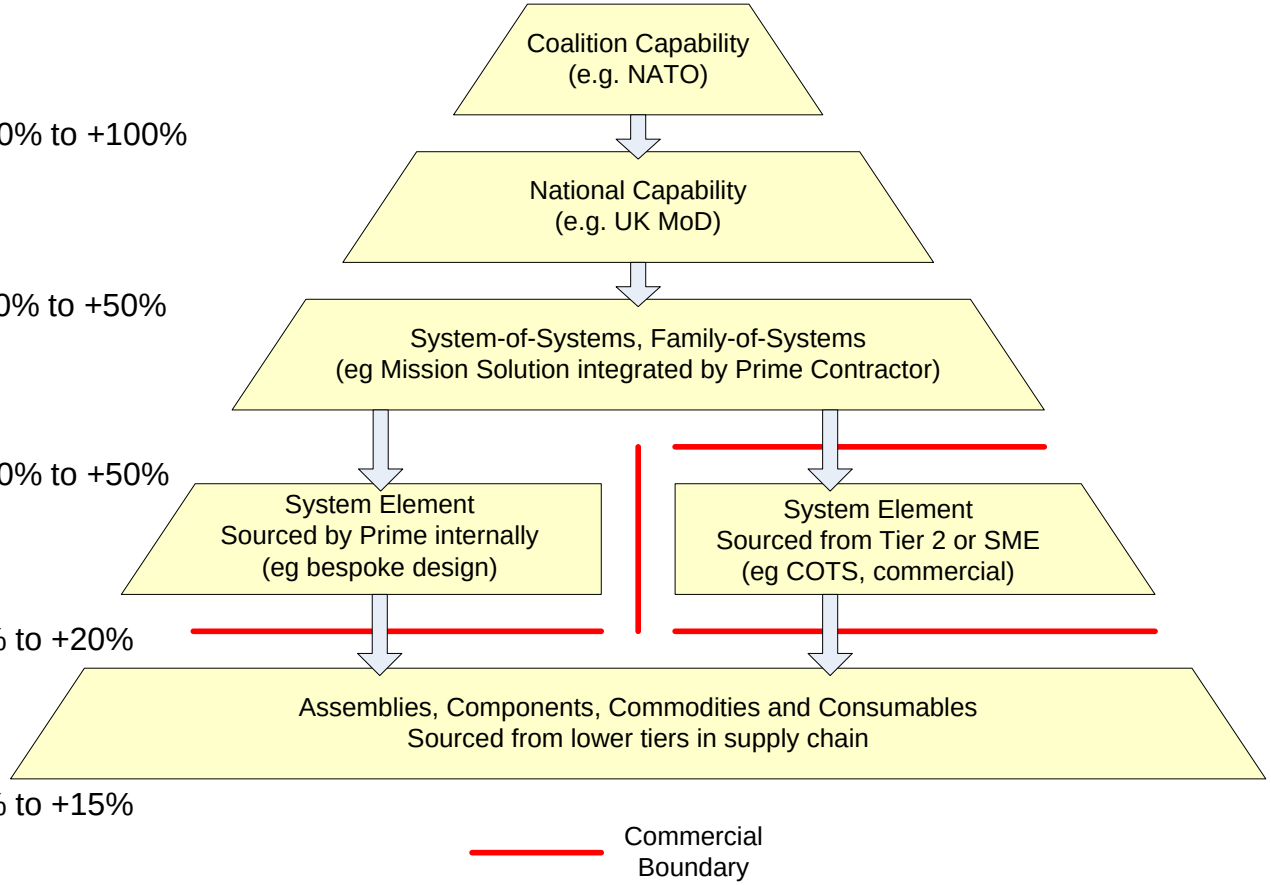
- 10–40% definition
- L: -15% to -30%; H: +20% to +50%

Class 2

- 30–70% definition
- L: -5% to -15%; H: +5% to +20%

Class 1

- 50–100% definition
- L: -3% to -10%; H: +3% to +15%

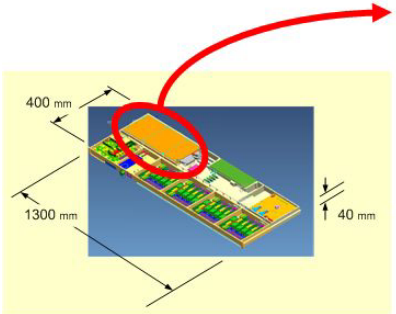


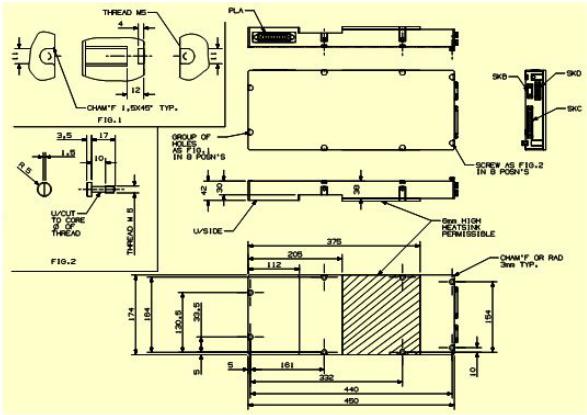
What data will be needed to produce estimates in each class, and where can it be sourced from?

Locate and Capture Cost Data - 2

Locate and capture cost data both internally and from third-parties

- We need to collect, archive, retrieve and analyse the cost outcomes of previous projects in order to calibrate cost estimating relationships (CERs) in both home-grown and third-party parametric models and tools
- The calibration needs to be good enough to ensure that we deliver the expected accuracy range (e.g. as per the expectations set by the AACE example above); failure to do this makes it difficult to sustain support for investment for parametric methods
- We note in passing that the same data informs estimates made using other methods such as ‘expert opinion’ or ‘detailed estimating’ that also rely on experience of historical cost outcomes
- If the level of project definition is high (e.g. 10%-40% for Class 3, 30%-70% for Class 2, or 50-100% for Class 1) third-party models and tools will often be available with calibrated CERs that can produce accurate estimates at the detailed level





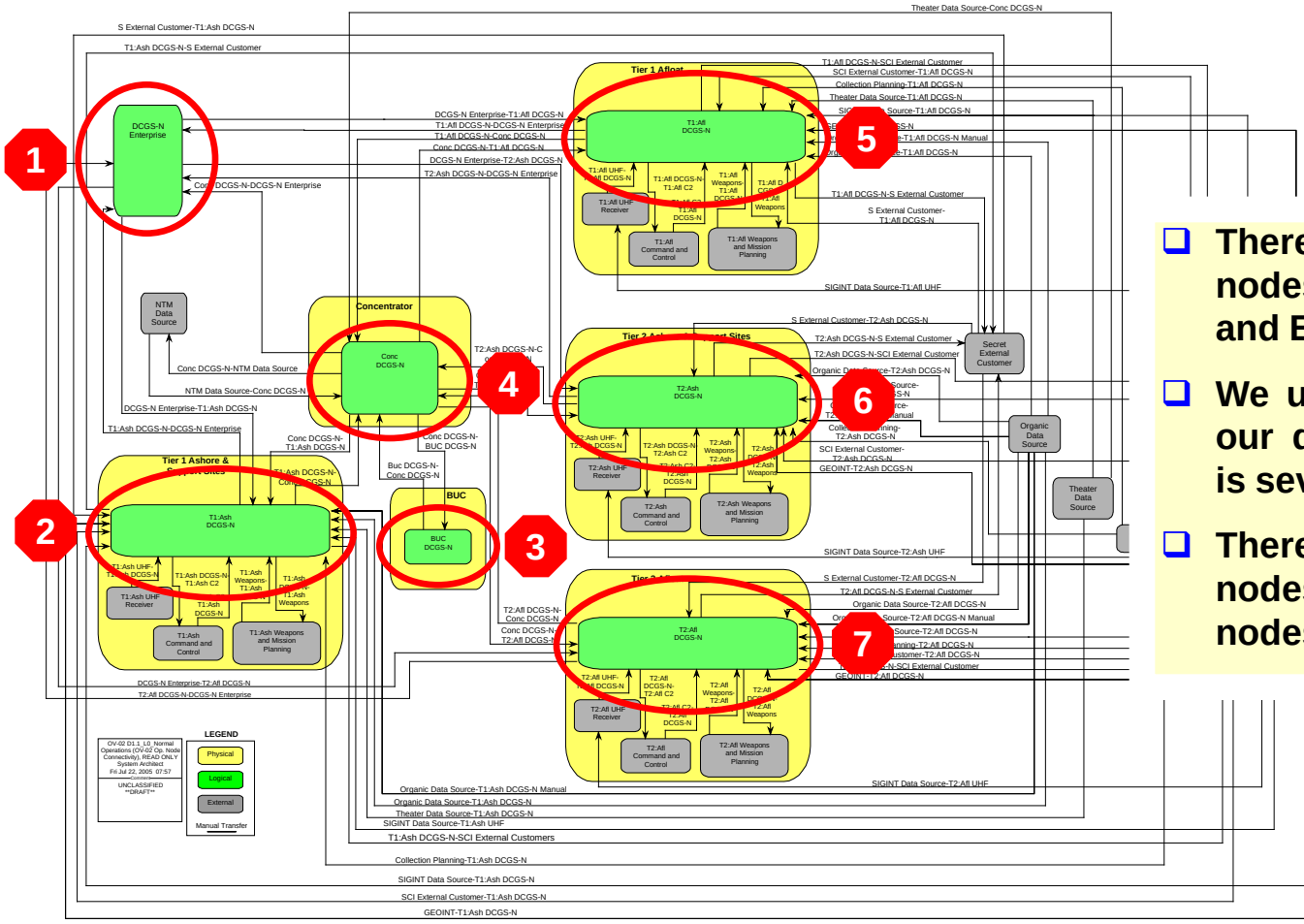
Locate and Capture Cost Data - 3

Locate and capture cost data both internally and from third-parties

- If the level of project definition is low (e.g. 0%-2% for Class 5, or 1% to 15% for Class 4) this will probably be because the design is still at the concept stage; in this situation the Design Authority needs to identify the likely cost drivers so that data can be collected from similar projects in order to construct home-grown CERs
- Architecture based cost drivers based on DoDAF / MoDAF views have been identified as “big movers” for whole life cost; the proposition is that these can be used to make Class 5 or Class 4 parametric estimates
- The next two slides show examples based on a typical DoDAF model
  - Counting the number of operational nodes; an operational node is an organisational structure that may represent an operational role, an organisation, or an organisational type; typically, it consists of human operators and the systems that they operate on
  - Counting the number of information exchange boundaries; the base measure is a count of pairs of producing and consuming nodes; if the information flow is bi-directional then the boundary count is two

Locate and Capture Cost Data - 4

Locate and capture cost data both internally and from third-parties

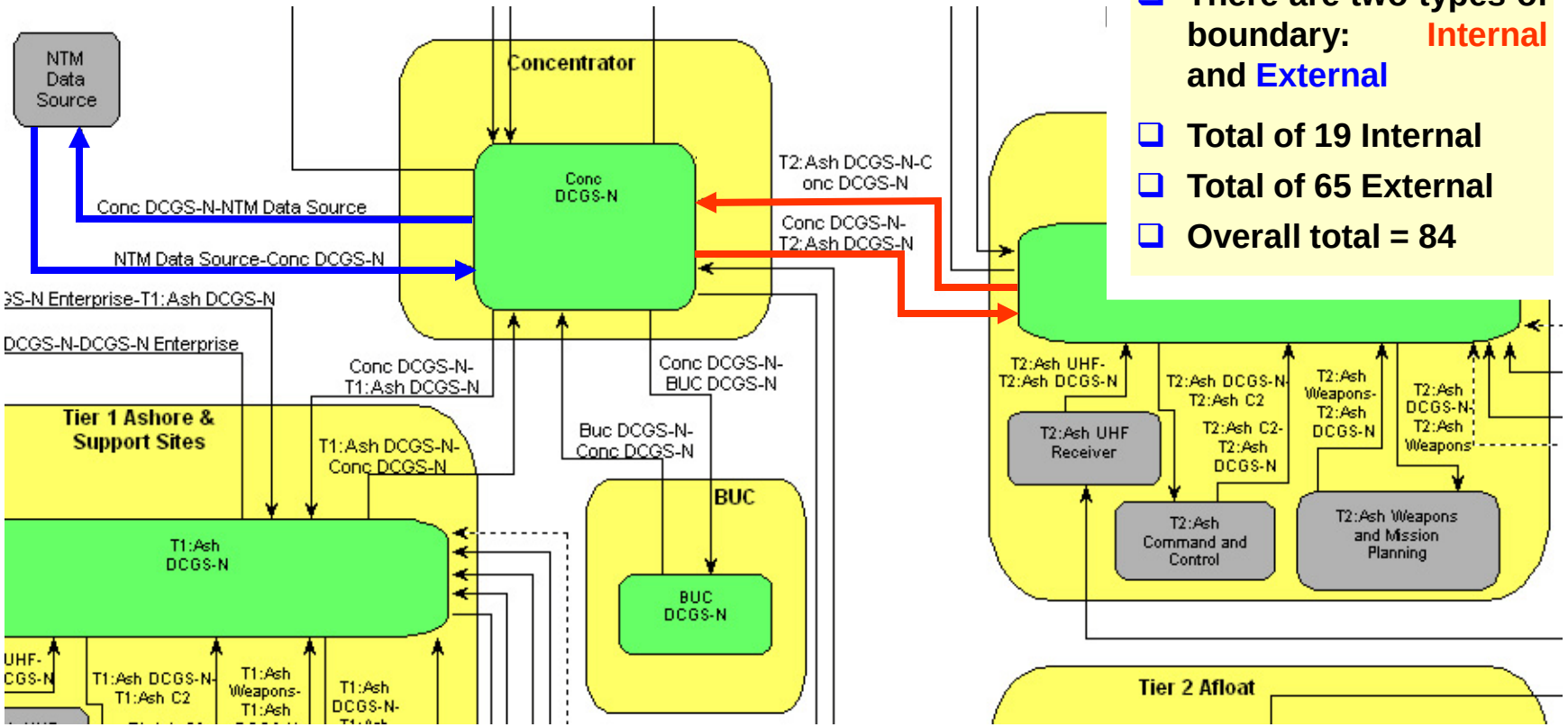


- There are three types of nodes: Logical, Physical, and External
- We use Logical Nodes for our driver quantity – total is seven
- There are also six physical nodes and eight external nodes

Source: US Navy

Locate and Capture Cost Data - 5

Locate and capture cost data both internally and from third-parties



- There are two types of boundary: Internal and External
- Total of 19 Internal
- Total of 65 External
- Overall total = 84

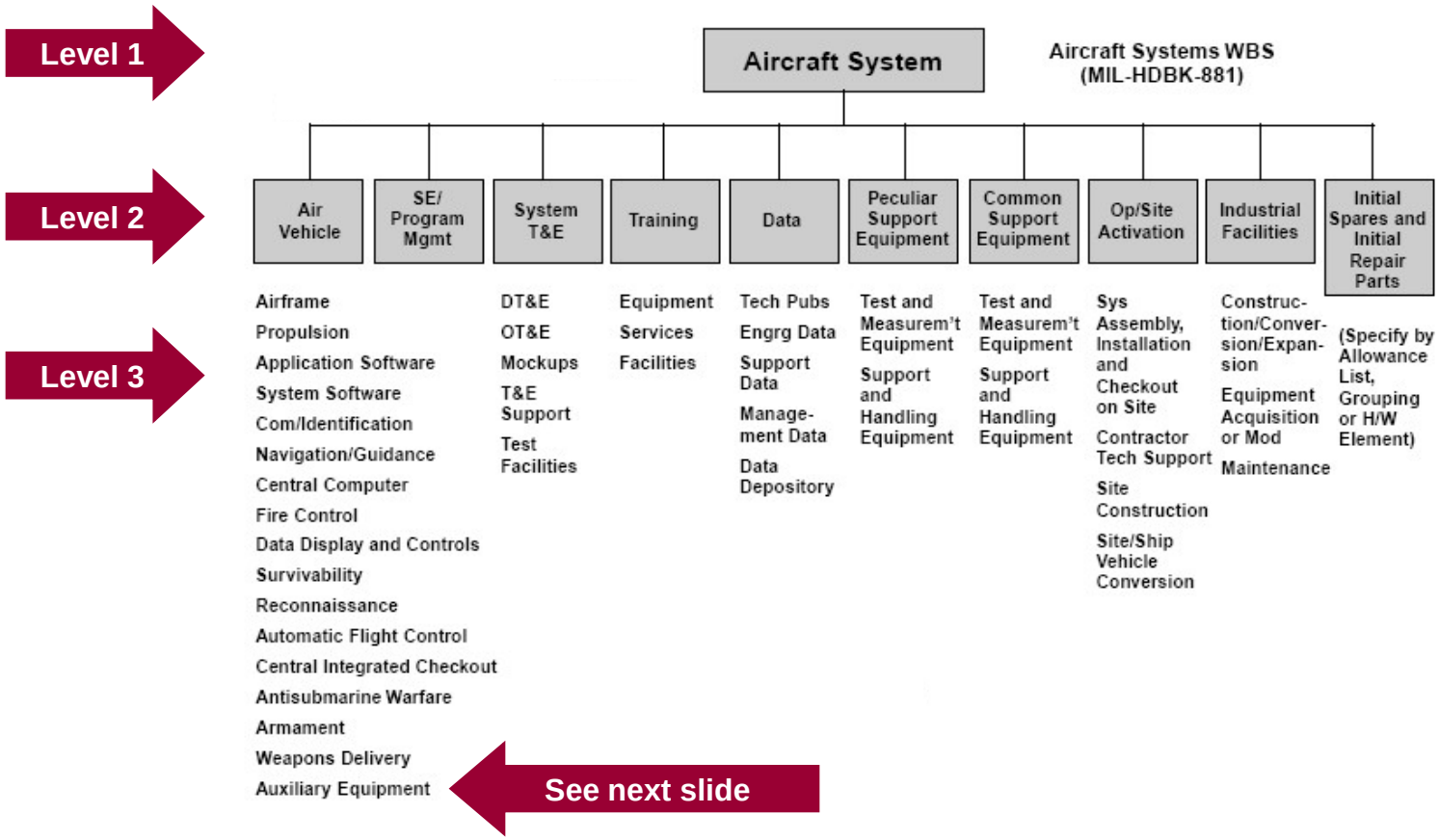
External Boundaries

Source: US Navy

“Standard” Cost Breakdown Structure -1

Adopt a “standard” cost breakdown structure as the repository for the data, recognising that at the lower levels the structure may be need to be tailored for each class of project

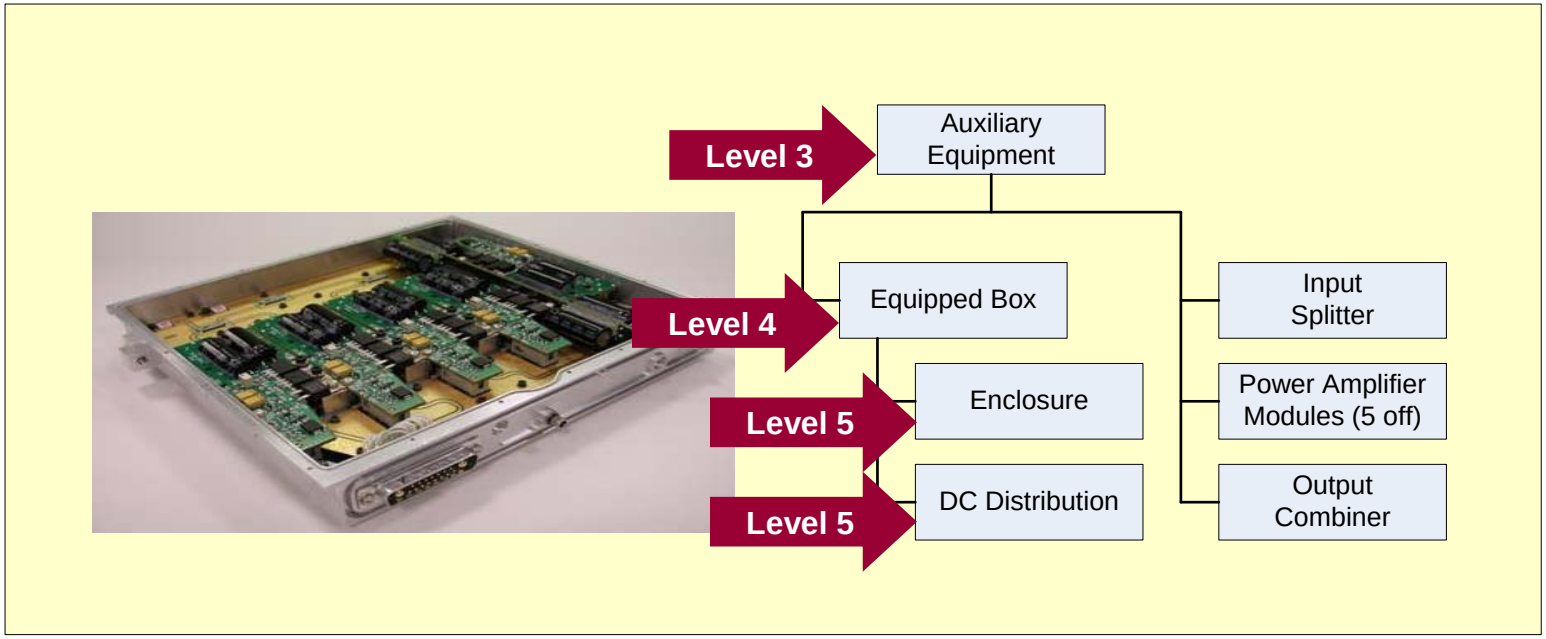
- The US DoD standard *MIL-HDBK-881 Work Breakdown Structure* defines the top three levels of a standard cost structure; organisations need to develop an approach to tailoring at the lower levels



“Standard” Cost Breakdown Structure - 2

Adopt a “standard” cost breakdown structure as the repository for the data, recognising that at the lower levels the structure may be need to be tailored for each class of project

- The Level 3 cost element Auxiliary Equipment is tailored at Levels 4 and 5 as in the example below



“Standard” Cost Breakdown Structure -3

Adopt a “standard” cost breakdown structure as the repository for the data, recognising that at the lower levels the structure may be need to be tailored for each class of project

- The UK equivalent to MIL-HDBK-881 is the *UK MoD Cost and Resource Breakdown Structure (CRBS)* developed for use by the MoD’s project teams, support staff, their scrutiny community (i.e. those evaluating bids from industry), and their cost forecasting staff (i.e. those making independent estimates); this is accessible via the Acquisition Operating Framework at http://www.aof.mod.uk
- The CRBS similarly anticipates that the lower levels of the cost structure will be tailored to the domain; it also explicitly spans the CADMID cycle by defining the following headings at Level 1

    1. Concept
    2. Assessment
    3. Demonstration
    4. Manufacture
    5. In-Service
    6. Disposal

Collect Data on a Through-life Basis - 1

Recognise the need to collect data on a through-life basis to support estimating for availability or capability contracts that include the provision of services as well as products

- In order to get value-for-money in any major project procurement it is essential to examine trade-offs between capability, timescale, and cost; for example the UK MoD mandates this through smart acquisition principles embodied in the Acquisition Operating Framework
- The UK MoD has a large asset base relative to manpower (hence a high capital-to-labour ratio), so a through life cost (TLC) approach to management of these assets is particularly helpful for budgetary control
- In recognition of this it is mandatory for a through life management plan to be submitted for each major defence equipment project seeking approval and TLC forecasts are essential inputs to this plan; this helps to ensure that
  - Project budgets are realistic from the outset, so avoiding nugatory expenditure if the project is cancelled as a result of escalating costs
  - The best trade-offs are achieved during manufacture following award-of-contract
  - The design and optimisation of the in-service and disposal solutions is left shifted, including budgetary and manpower planning for system deployment and operations
- Contractors bidding for MoD contracts must be ready to justify their estimates, particularly for non-competitive bids, and so they need to demonstrate a good understanding of the TLC

Collect Data on a Through-life Basis - 2

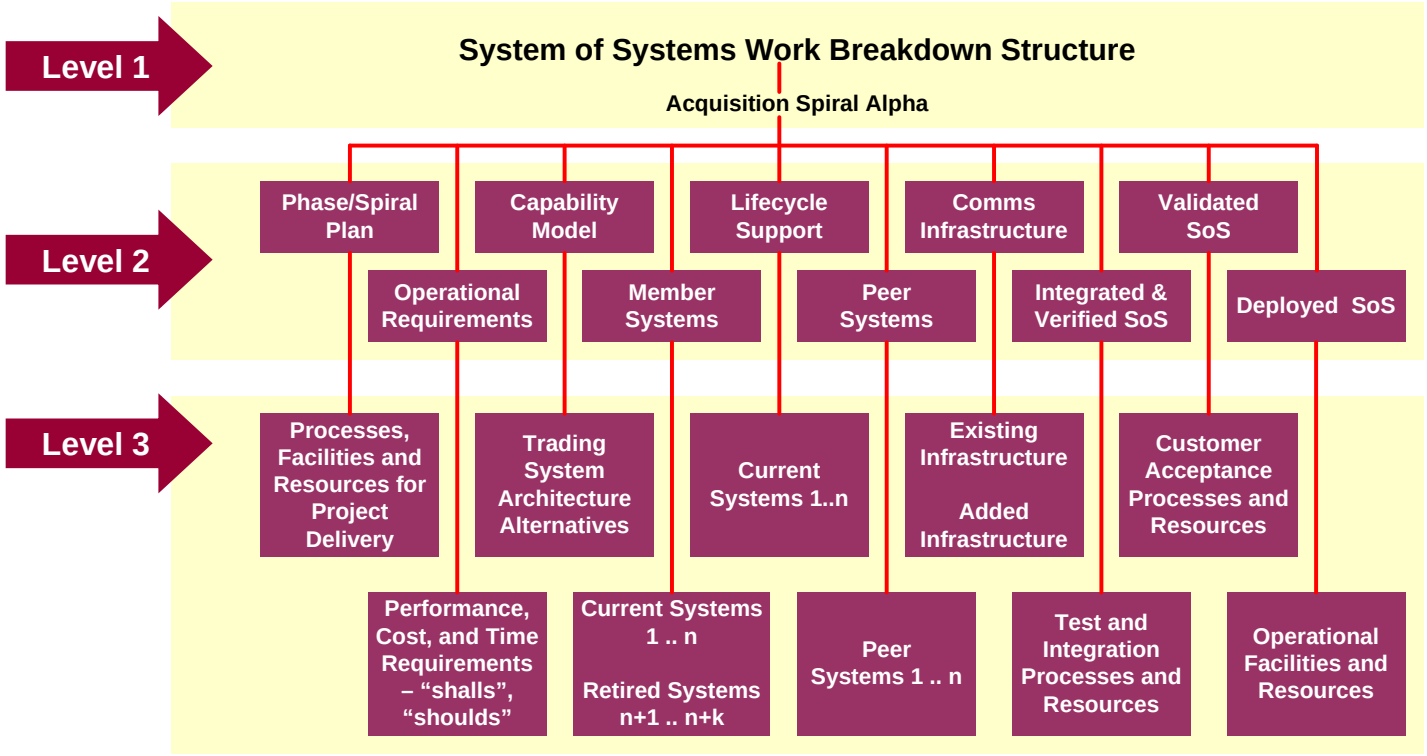
Recognise the need to collect data on a through-life basis to support estimating for availability or capability contracts that include the provision of services as well as products

- One way to demonstrate a good understanding of TLC is to collect historic cost data using a cost breakdown structure that covers the whole lifecycle and all lines of development (e.g. TEPIDOIL) and to apply this to the new project
  - **T**raining
  - **E**quipment
  - **P**ersonnel
  - **I**nfrastructure
  - **D**octrine
  - **O**rganisation
  - **I**nformation
  - **L**ogistics
- With the possible exception of Doctrine all the TEPIDOIL lines of development should be represented in the cost breakdown structure for an availability or capability project
  - what combination of products and services delivers each line of development?
  - are these products and services represented in the cost breakdown structure?
  - do we have metrics in-place to collect cost data for each product and service?
  - is the scope of each product and service defined, e.g. using a data dictionary?

Collect Data on a Through-life Basis - 3

Recognise the need to collect data on a through-life basis to support estimating for availability or capability contracts that include the provision of services as well as products

- This cost breakdown example takes a holistic view of TLC on a systems-of-systems project. It assumes that over the lifetime of the projects there will be a number of acquisition cycles (e.g. for technology insertion or obsolescence resolution), and that these will follow a spiral development model rather than a conventional V model.



Summary

- Put enduring policies, process, and systems in-place so that, over time, the organisation can grow a knowledge base containing cost outcomes of “like for like” elements from prior projects
- “Enduring” means that the policies, process and systems must outlive organisational churn, upgrades in information systems, etc; the first step towards this is to embed parametrics thinking in the operational framework of the organisation
- Recognise that, as well as collecting data internally, the organisation needs to locate and capture cost data from third-parties including customers, suppliers, consultants, tools vendors, and by means of competitive intelligence done on ethical principles
- Adopt a “standard” cost breakdown structure as the repository for the data, recognising that at the lower levels the structure may be need to be tailored for each class of project
- Recognise the need to collect data on a through-life basis to support estimating for availability or capability contracts that include the provision of services as well as products

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