Project Controls Expo - 31st Oct 2012
Twickenham Stadium, London

Producing a Quality Cost Estimate;
Hints, Tips and Best Practice

Carl Dalton
Director
Polaris Consulting Ltd

Speaker Profile - Carl Dalton

- Carl is a Fellow of the Association of Cost Engineering and has over 30 years of experience in providing management and technical consultancy to governments and industry. Carl has worked for a variety of government organisations and leading contractors in Europe, North America, the Far East and Australia.
- He specialises in Cost Analysis and Project Risk Management; generally on large complex programmes. These include large aircraft and ship programmes, military and commercial vehicles, complex weapons, other transportation systems, software intensive programmes, personnel and commodities.
- He is experienced in utilising commercial available cost and risk management products and tools as well as developing bespoke solutions.

Index

- What is an Estimate
- What to include in an Estimate
- The Estimating Process
- Types of Estimating
- Developing a Cost Estimating Tool/Model
- Data Collection
- Cost Engineering
- Risk
- Verification and Validation

What is an Estimate?

*"An assessment of the likely **quantitative** result. Usually applied to project costs and durations."*

PMI-Guide to the PMBOK 4th Edition

*"An **approximation** of project time and cost targets that is refined throughout the project life cycle."*

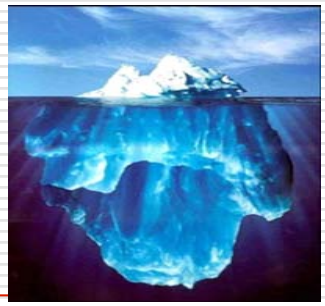
APM Body of Knowledge 5th Edition

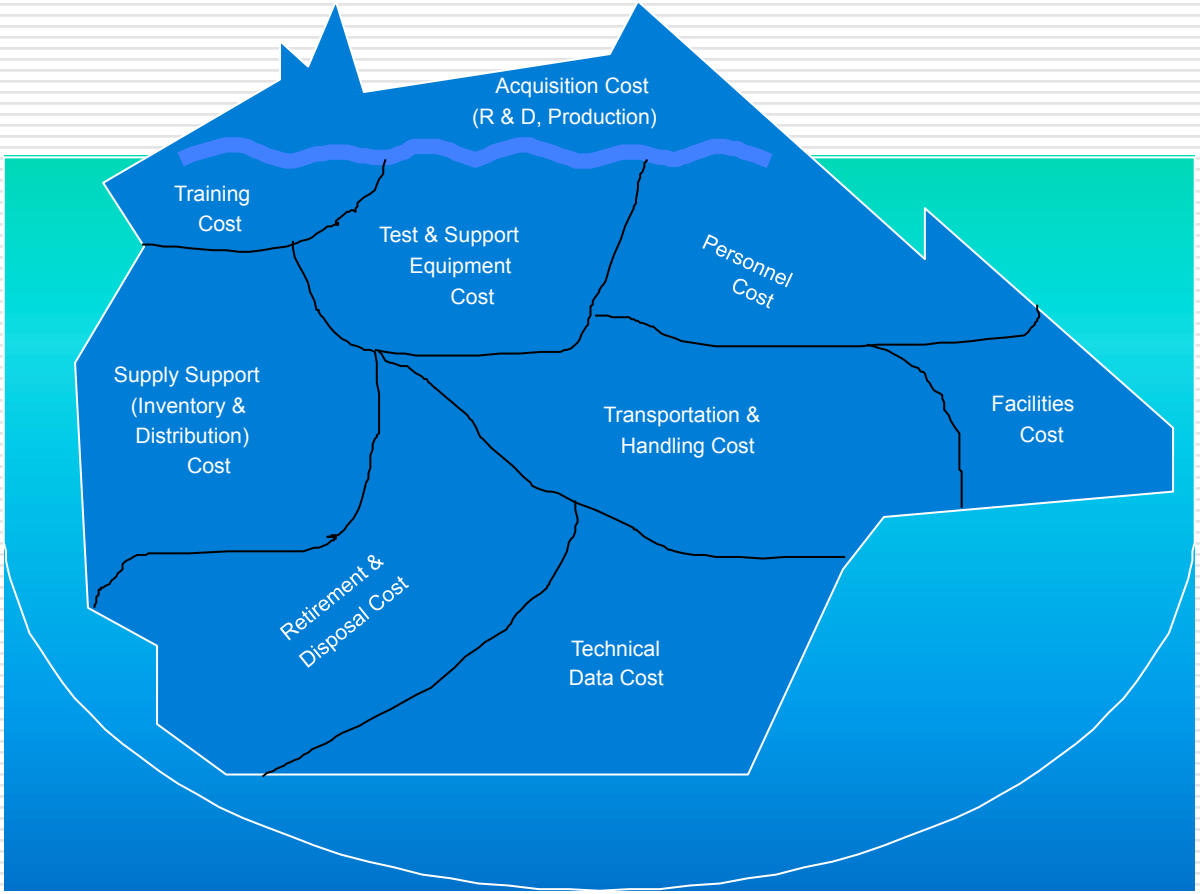
Project Controls EXPO

Estimating

- Estimating is about helping management make decisions
  - Establish what tasks/activities are required to be completed
  - Estimate each activity in terms of required resources, duration and cost
  - Apply known facts, using relevant historical data where available, and make assumptions for unknown factors.
  - Apply to all activities (work packages)
  - Define accuracy/confidence
  - Document to provide an audit trail to supporting **EVIDENCE**
- Accuracy increases as project progresses

The Tip of the Iceberg





Project Controls EXPO

Define Cost Elements and Boundary

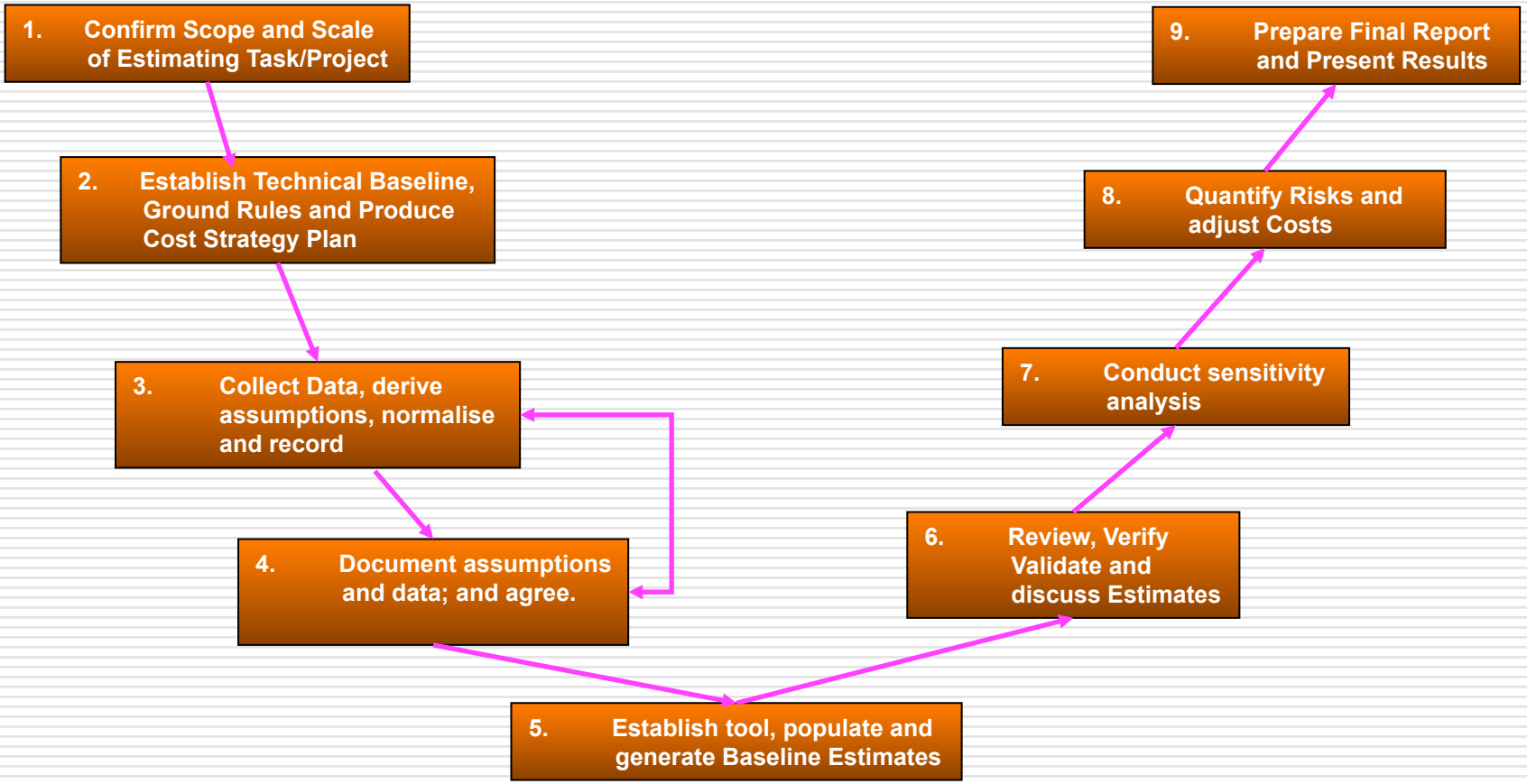
Cost Elements

- Development
- Production
- Bringing into Operation/Service
- Operating
- Supporting
- Disposal

Estimate Boundary

- Physical – Equipment Breakdown e.g. Space System
  - Ground station
  - Launcher
  - Satellite
  - Interfaces
- Programme
  - Quantity
  - Phases
  - Life
  - Whole Life? Or Partial Life
- Economic
  - Economic conditions
  - Currency

Whole Life Cost Assessment
Consistent Processes = Reliable Estimates



Project Controls EXPO

Estimating Start-up

- Complete Estimate Registration Form
  - Why?
  - Details of project
  - Estimating requirements
- Establish Start-Up meeting:
  - Review project brief; agree project scope/deliverables
  - Establish the estimating strategy
  - Review current data and make assumption
  - Agree framework for the WBS
  - Define responsibility & authority; lines of communication
- Attendance: Key stakeholders (client/sponsor-PM-core team)

Types of Estimating Techniques

- Cost estimating requires arithmetic operations; many of which must be performed in a specified sequence
- Parametric
- Analogy
- Scaling
- Detailed
- There is usually no single predictive technique/tool/model that covers
  - the whole of the life cycle and
  - all of the cost elements required

When to employ different techniques

	Analogy	Parametric	Engineering Build-Up	Actuals
Concept	Assessment	Demonstration	Production	Support

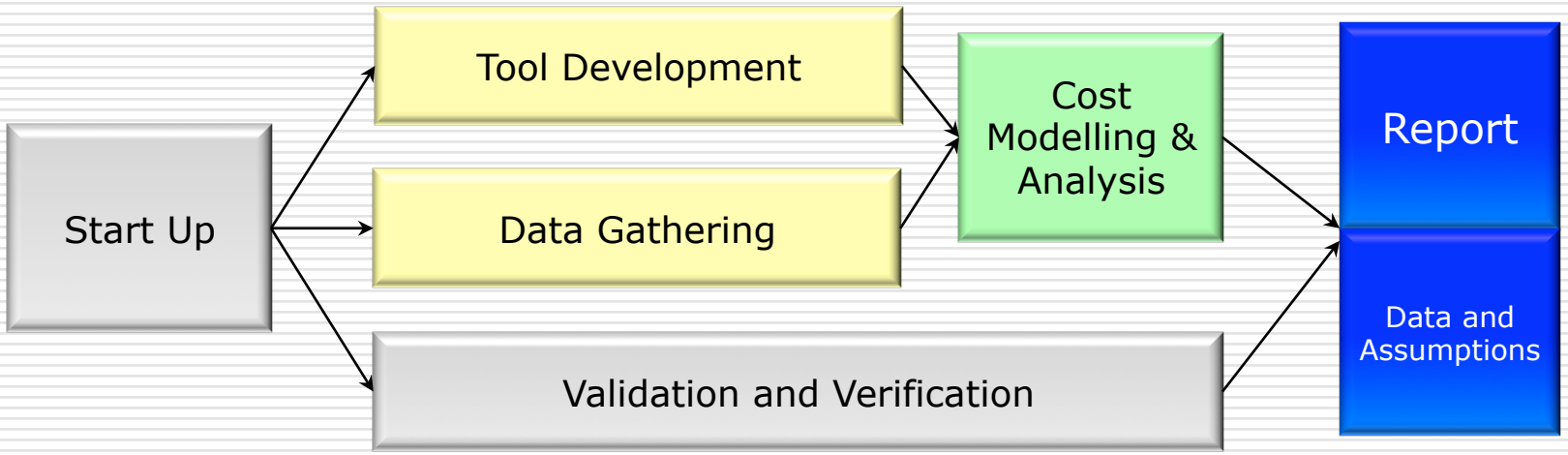
- Estimating often requires a combination of the above
- Use multiple methods as a sanity/cross check

Building a Cost Estimating Model

The 6 distinct phases of a 'bespoke' cost estimating model development are:

1. **Scope** – assess the requirements and agree with customer;
2. **Specify** – define the logic with simple formulae, no embedded constants and ensure input is only made once. No cost estimating relationships are to be developed in programming language; clear and open;
3. **Design** – produce the most effective structure and logical layout i.e. top to bottom and left to right, for the model. Ensure there are separate worksheets for control, inputs, calculations (costing engine) and outputs and use freeze panes. Use agreed colour coding e.g. grey for information, yellow for inputs, green for calculations and blue for outputs;
4. **Develop** – construction of the tool/model takes place with appropriate documentation i.e. design, verification & validation log book together with user and future developer instructions;
5. **Test** – do basic checks prior to independent Verification and Validation;
6. **Use** – populate model and produce Cost estimates.

Colour Coding Different Estimating Activities



Key:

Information

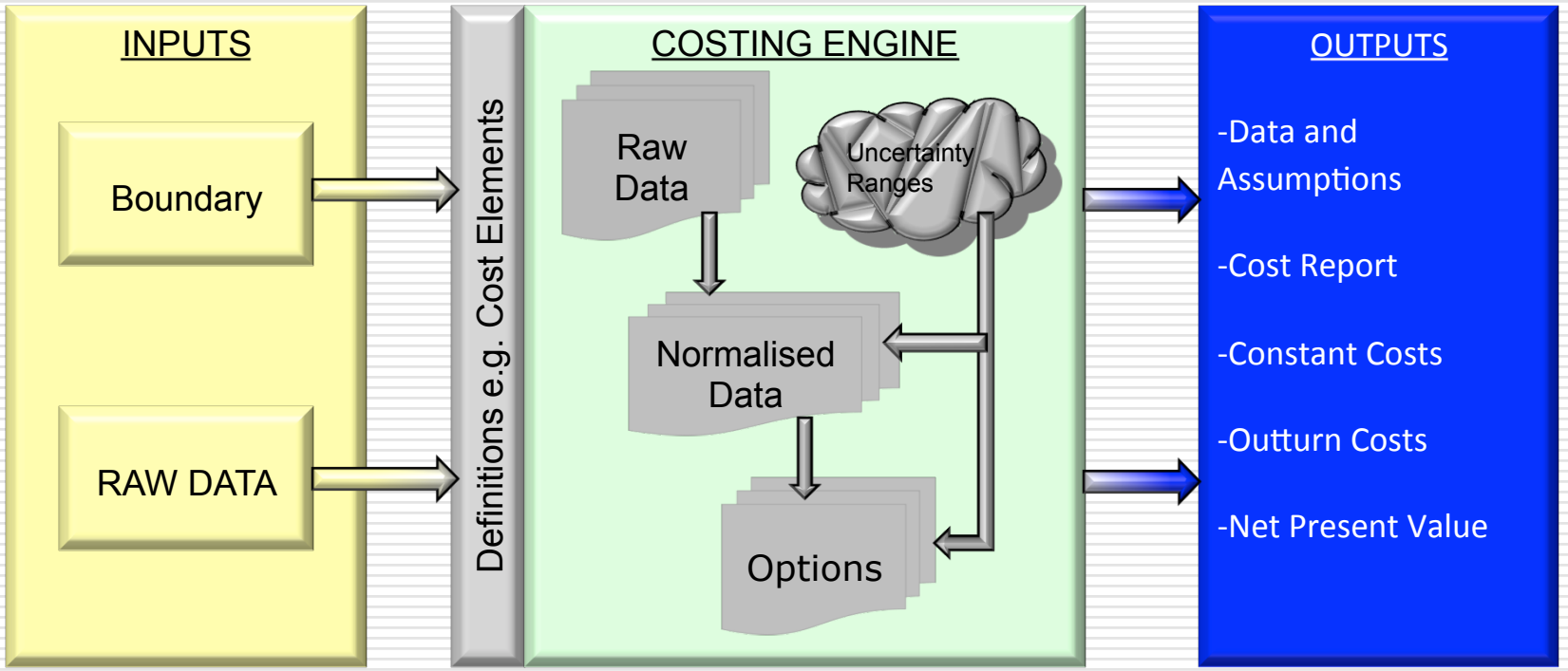
Calculations

Inputs

Outputs

Project Controls EXPO

A Cost Estimating Model

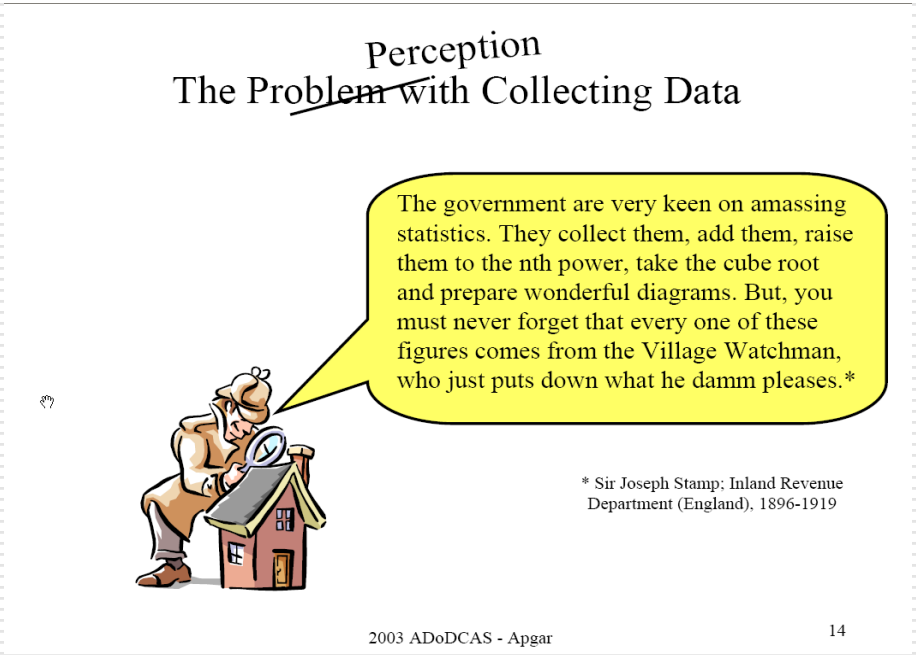


Key: Information, Calculations, Inputs, Outputs

Project Controls EXPO

Data Collection

- Gathering and Normalisation
- Data Requirements
- Data Sources
- Recording Data and Assumptions



Gathering and Normalisation

- Major phase of any cost study; Most time/effort consuming phase of the assessment…iterative…more data becomes available becomes available
- Establish a structured approach
- Need for quality data
- Need for relevant data
- Historical cost data needs to be normalised to a common base
  - Common economic conditions
  - Common currency
  - Common allowances e.g. Profit, Tax etc.
- Data needs to be sanity checked
- Where data is suspect; or not available assumptions need to be made
- These need to be clear, unambiguous and agreed where-ever possible
- Provides background 'EVIDENCE'

Data Requirements

- Historical/Actuals
  - Essential to assist in the future prediction of cost and schedule estimates
  - Analogy
  - Model development
  - Model calibration
- Candidate Solution
  - Technical
  - Physical
  - Programme
  - Economical
- Alternative Options
- Cost
- Effort
- Schedule
- Phase
- Labour rates
- Base Rates
- Supporting technical/physical data
  - Option description
  - Physical characteristics; weight, size, material
  - Use Case
  - Reliability/Defects

Data Sources

- Contractors
  - Across all disciplines; Engineering, Production Support….
- Conceptual Designs/Engineering Drawings
- Bills of Materials
- Process/Routing Sheets
- Master production Schedules
- Accounting/Finance/Historical Records/Standard Time data
- Supplier/Catalogue information
- Labour rates
- Use cases
- Repair and Maintenance Schedules
- Enterprise Resource Planning Systems
- Actual hardware
- Company experts; interviews/questionnaires/input sheets
- Lessons learned reports
- …and don't forget your colleagues!

Data Readiness Levels

DRL	Definition e.g.	Sources and Indicators
DRL 1	Early Indication	Individual Opinion
DRL 2	Consensus	SME Consensus
DRL 3	Minimum level of data	Limited data but not reliable source
DRL 4	Minimum data	CERs; reliable source but un-validated estimate
DRL 5	More detailed data	Parametric modelling and sound methodology
DRL 6	Data for Business Case	Calibrated parametric or bottom up estimate
DRL 7	Pre-contract	Pre-negotiation bid
DRL 8	Mature costs	Detailed bottom up
DRL 9	All data fully mature	Validated 'actuals'

Uncertainty/Variability in Estimating

- In source data
- In assumptions
- In modeling approach
- …

- Important to produce a cost estimate based on a single currency..but;
  - Often costs/prices are provided from suppliers etc. in different currencies
  - Use exchange rates at a common base point
  - Document values used in an Cost Data Assumptions List
  - Conduct sensitivity analysis to test how much the exchange rates need to move to significantly change the costs.

Document Data and Assumptions

- General
- Option Specific
- Exclusions
- Known Data
- Cost Data Assumptions List

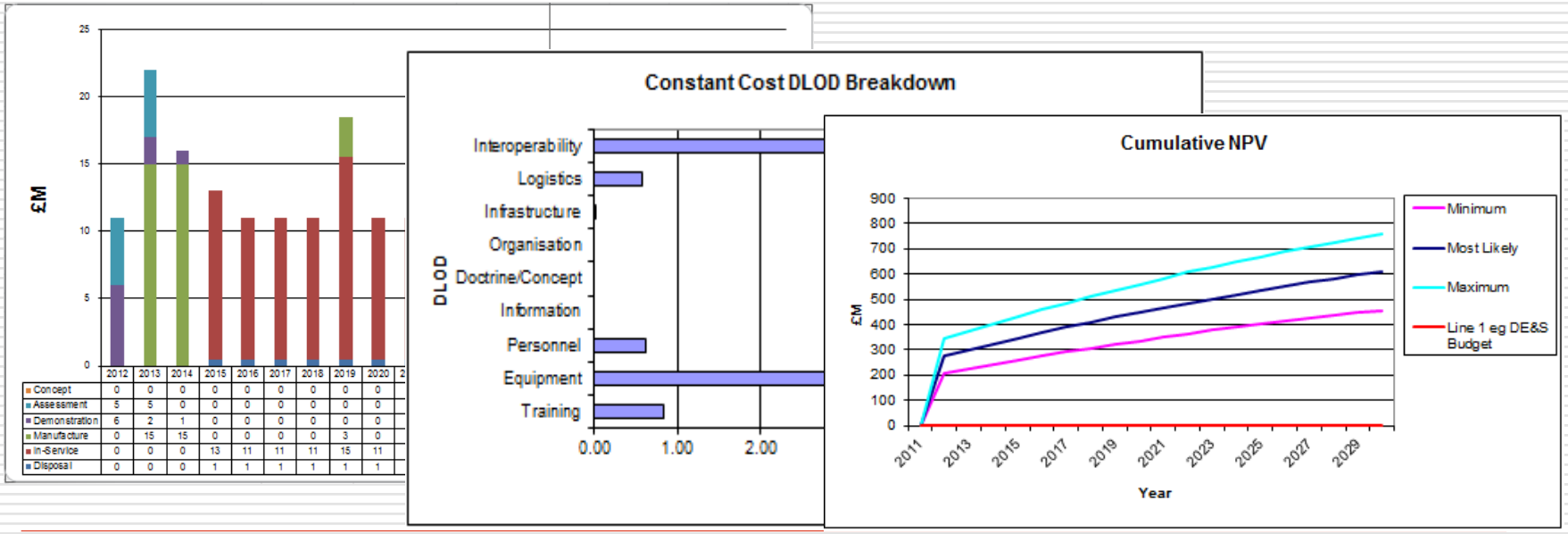
- Get it agreed before detailed cost estimating

Cost Engineering

- Outturn; inflated to then year costs
- Constant; baseline economic condition
- Discounted; allows comparison
- Normalised Outputs
  - Equivalent Annualised Costs
  - Rate of Return
- Cost Drivers
- Cost Benefit Analysis
- Cost Effectiveness
- Design to cost
- Value Analysis
- Budgets
- Benchmarking
- Cost Control
  - Objectives
  - Approaches
  - Cost Variances
  - Earned value

Output requirements

- Outputs should be adjusted to reflect the customer's requirements, however more often than not you can build 'generic' outputs to be produced within your cost model for all projects.
- Outputs can be shown in cumulative constant costs, net present value and inflated as well as costs by budget holder, phase of project and activity.



Project Controls EXPO

Factors affecting Accuracy

- Estimating is not an exact science. Some of the factors that affect the quality of estimates are:
  - the scope, approach and the estimating technique employed
  - accurate historical data
  - understanding the problem/requirement
  - the availability of reliable design/technical information for the candidate system/project
  - the type and size of the project
  - the extent to which feedback is used
  - the teams/estimators optimism and desire to protect own position
  - the estimators skill and knowledge; or lack of it; and ability to use appropriate judgement.

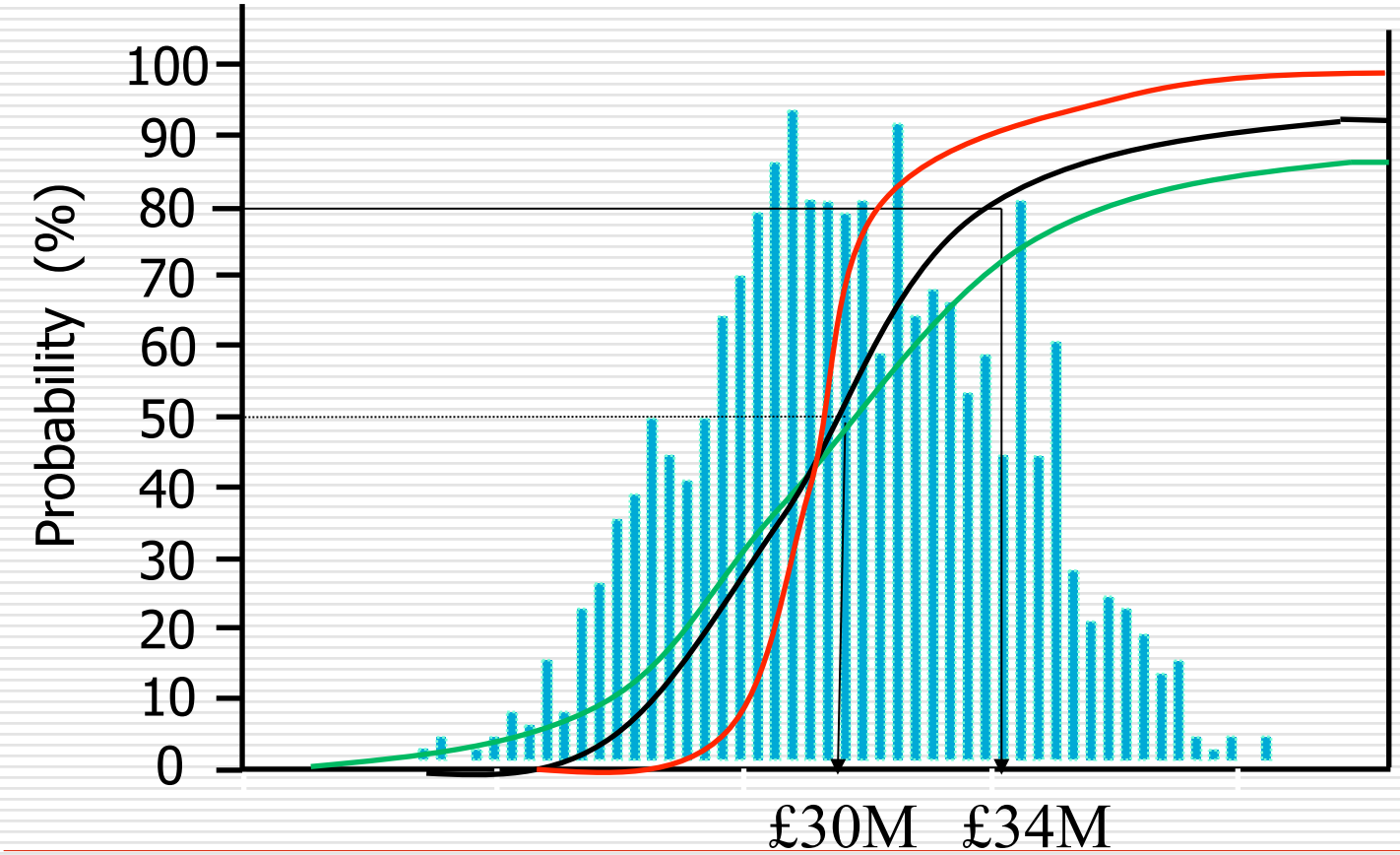
The Effects of Risks on Estimates

- A Point Estimate is never correct!
- There is always potential variability in inputs.
- Costs of managing the Risks that we decide to manage:
  - Budget for Managed Risks
- Costs of the impacts of Risks that we decide to accept (Known-Unknowns):
  - Contingency Reserve
- Costs of the impacts of Risks that we were unaware of (Unknown-Unknowns):
  - Management Reserve

Risk Quantification

- **Aim**: Quantify the effects of risk
- **Input**: Qualitative risk assessment
- **Techniques**:
  - Monte-Carlo simulations
  - Path convergence
  - Decision trees
- **Results**:
  - Defines range of outcomes + most likely
  - May create false impression of precision and reliability

Risk Assessment - Quantitative



Project Controls EXPO

Independent Verification and Validation

- Model should be fit-for-purpose and working correctly
- Cost model needs to be verified to confirm it meets its specification
- Model and data must be documented to allow evidence for an audit trail
- In-built relationships e.g. CER should be checked
- VBA is frowned upon unless to help functionality i.e. adding lines
- Data entry and manipulation of data needs to be confirmed and validated
- Check for double counting…missed items
- Can the Business Case costs be traced back to the cost model; have costs changed since the previous iteration
- Need to ensure the model can conduct:
  - Sensitivity analysis
  - Risk Analysis
- Peer and Management Reviews

Seven Tests of a Quality Cost Estimate

- Objectivity
  - Is the estimate based on objective data; grounded in facts and related historical data. Firm foundation
- Honesty
  - Genuinely building on above data; representative of the true position of the bid.
- Relevance
  - Are the data and analysis relevant and pertinent to what is being estimated
- Logic
  - Does the estimate make sense. Are the math's correct. Are there any gaps or overlaps?
- Accuracy
  - Are you estimating processes producing accurate estimates. Have you tested past estimates/outturns and made adjustments where necessary. Does an independent estimate verify the main estimate?
- Holism
  - Is it complete? Integrated?
- Communicability
  - Is the estimate clear and easy to understand. How well is the cost estimate being communicated internally, to peers and reviewers, and externally. Is it well documented with assumptions etc. How is the estimate being perceived.

Know the Jargon – Acronyms - Interpretation

A key necessity for a cost engineer is to know your Jargon-Acronyms-Interpretation

- WLC – Whole Life Costs
- CDEL – Cost Departmental Expenditure List
- RDEL – Resource Departmental Expenditure List
- CRBS – Cost Resource Breakdown Structure
- CDAL – Cost Data Assumptions List
- NPV – Net Present Value

Questions

Carl Dalton
Director
Polaris Consulting Ltd
07764 685332
carldalton@polarisconsulting.co.uk