

Whole Life Costing (WLC) – Principles, Problems and Solutions

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Structure of presentation

- Introduction – what are WLC?
- Forecasting of WLC
- Presentation, WLC and COO
- Bounding a WLC
- Trade offs
- Management of WLC
- Finale

Whole life costs are not rocket science

- WLC are the total costs associated with a project, decision or investment. $WLC = TLC = LCC$.
- COO is different, and is explained later.
- Individuals and companies instinctively use WLC to assess alternative investments.
- Governments use WLC for roads, hospitals etc.
- MoD has a relatively-large asset base (hence a high capital/labour ratio) and hence a through-life approach using WLC is particularly necessary.
- In practice, everybody's decisions are constrained by limits on current expenditure.

What are the WLC of defence projects?

- WLC include all costs directly associated with a project through the CADMID process, including
 - Concept studies and applied research
 - Assessment
 - Demonstration and trials
 - Manufacturing and tooling
 - In-service - operations, support and logistics
 - Disposal
- WLC may also include
 - Overhead costs of shared facilities and infrastructure
 - Depreciation and cost of capital employed (in RAB not in IA)
 - Sunk as well as future costs
 - Planned incremental enhancements, or mid-life upgrades

Why are WLC needed?

- In MoD
 - To develop cost-effective force structures
 - To generate realistic project budgets, and so avoid nugatory expenditure when projects are cancelled
 - To select, from alternative proposals, a project with best VFM
 - To guide tradeoffs in project design and management
 - To identify optimal support arrangements, via ILS
 - To support overall budgetary planning
- In industry
 - To develop a corporate plan
 - To support any bid for PFI/PPP

The long march towards WLC

- Since 1974 MoD has been trying to use WLC.
 - Exhorted by HCDC 1988, Treasury 1991, NAO 1992
- Following Buckley report in 1991, the COEIA procedure demanded investment appraisal of all project costs, in accordance with Treasury rules.
- Smart Acquisition in 1998 called for a 'Through Life Approach'.
- No WLC appear in the NAO MPR 2004.
 - Some IPT have had difficulty in applying the approved MoD 'Cost of Ownership' methodology using WLC. Data presented so far is immature, and unable to support decision-making.
- A senior DPA official said WLC are 'too difficult'.

WLC are difficult

- Long project lives, during which technology, requirements, operational and support plans, etc. all may change
- WLC demand integration of the plans of several alienated groups.

Two common delusions

- The 'iceberg' delusion – “In all cases in-service costs far exceed the cost of procurement”. Actually the procurement/in-service ratio varies widely.
 - Aircraft v. missiles
- The 'early freeze' delusion – “Total WLC is largely determined in the early phases of the project”. Actually it can be changed vastly by later decisions.
 - In service or out of service dates
 - Fleet size or mode of operations
 - Success of reliability growth programme
 - Mid-life upgrades
 - Cancellation

An illustrative case study

- The cost of a rifle for storage is £500
- To be useable the rifle must have ammunition and cleaning materials.
- To be used the rifle must be issued to a soldier, who needs pay, uniform, accommodation and rations.
- To be effective in combat the soldier must be part of a military unit, supported by
 - Command and administration,
 - Personnel carriers, logistics, communications, reconnaissance.
 - Army workshops and infrastructure
- Total cost with share of overheads is about £1.2M

Forecasting



Forecasting WLC

- The components of a WLC must be forecast separately because they are associated with different project phases, depend on different factors, and may be funded from different budgets.
 - Concept + assessment – number of options
 - Demonstration – complexity, innovation
 - Production- scale, process, sophistication
 - Operations – crew levels, training, fuel consumption
 - Support – reliability & maintainability, logistics
 - Disposal – materials, laws, public opinion, market demand
- Forecasts became more accurate as the project proceeds and more information becomes available.

How to forecast a component of WLC?

- Finger in the wind?
- Same as predecessor project?
- Accept contractors quotation?
- Modelling
 - Formulate Master Data and Assumption List of relevant info.
 - Collect historic and current cost data
 - Identify cost drivers for the relevant component
 - Develop cost estimating relationships linking costs to drivers
 - Use CER to predict cost component for new project
 - Adjust for any unique features
 - Use risk analysis to derive confidence limits

Challenges to the forecasting process

- Lack of stakeholder commitment early in project
- Bounding a WLC forecast to include relevant items
- Data sources are scarce, polluted or inaccessible
- Project database non-homogeneous
- Blinkered risk management
- Mistrust between stakeholder groups

High risk projects

- New scientific principles, materials or manufacturing methods.
- Inexperienced contractors
- Diffused authority
- Dependence on other concurrent projects



Why past WLC forecasts were wrong

- Changes to the requirement, or to the project programme
 - Performance, schedule or budget
- Technical or managerial difficulties
 - e.g. with new technology or organisation
- Poor systems engineering of interfaces
 - Integration slow and costly
- Over-simplified or obsolete cost models
- Random events
- *Gross over-optimism*
- *Unjustified assumptions and omissions*

Why future WLC forecasts might be worse, or perhaps better?

- Advancing technology but less-frequent projects
- Less-homogeneous cost database, from more-varied strategies in procurement and support
- Restructuring of supplier industries
- Adversarial relationships between stakeholders

- *IT facilitates data gathering and analysis*
- *Integrated Project Teams promote a holistic approach*
- *MoD is (again) committed to a through-life approach*

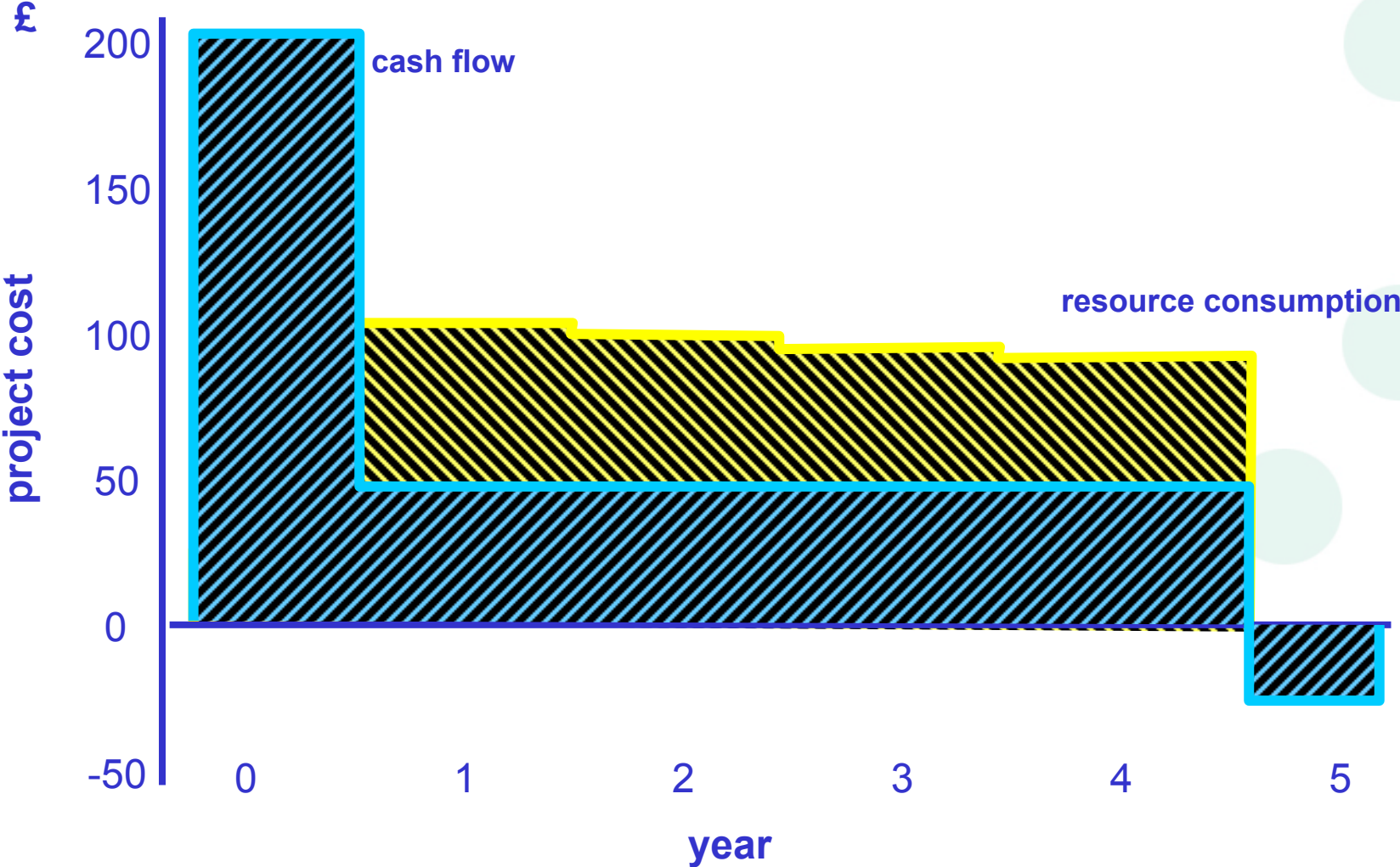
Presentation



Presentation of WLC

- WLC can be presented as a stream of annual cash expenditures, and as their total.
- For investment appraisal, future expenditure is discounted at the Treasury discount rate, and added to get the Net Present Value (NPV) associated with a project.
- In resource accounting and budgeting (RAB) the investment in capital equipment is expressed as depreciation over its planned service life, and MoD must pay a return on capital employed to the Treasury. MoD budget is defined in resource terms.
- Total Cost of Ownership (COO) = WLC + return on capital employed (ROCE)

Time Profiles of WLC and COO



Cash and COO

- The COO time profile is very different from the profile of cash expenditure, and links resource costs to the service delivered.
- Resource accounting and budgeting (RAB)
 - Discourages holdings of assets (land, buildings, spares, ordnance).
 - Favours small forces with high availability
- RAB reduces the ability of the forces to respond to crisis?
- Any WLC may be expressed in terms of cash expenditure or of resource consumption.

Project cash or COO can be divided in various ways, to suit different interests

- Project phase
- Financial year
- Military, civil service and industry
- Location of supply chain
- Area of technology
- Military capabilities to which it contributes
- Sunk, future and total

Bounding a WLC



Bounding a WLC – issues to be resolved

- Equipment itself, integrated and role equipment?
- Ordnance and ancillary equipment?
- Service and government personnel?
- Rates for such personnel?
- Upgrades, pre-planned and likely?
- Administration and infrastructure?
- Logistics to deploy and support in foreign theatre?
- Sunk costs?

Different bounds - appropriate for different purposes.

All users must understand where bound has been set.

Military capability

- In the UK, MoD has adopted a capability-based approach, starting from the effect to be achieved rather than assuming that equipment should be replaced by an improved design in the same class.
- Military capability is delivered not by equipment alone, but by the synchronised integration of 6 lines of development.

6 lines of development of capability

- Equipment
- Personnel
 - Recruit, train and retain sufficient qualified personnel
- Training
 - Manuals, simulators and other facilities
- Concepts & doctrine
 - Procedures and tactics
- Infrastructure
 - Estates, facilities and non-operational systems
- Sustainability
 - Personnel, transport and stocks needed to sustain in peace and in a remote theatre

WLC of capability, not equipment

- Most of the costs of the 6 lines of development should always have been included in WLC (but sometimes were not).
- The new focus on capability makes the non-equipment lines more explicit, and demands inclusion of the associated costs.
- Project WLC needs to include all 6 lines of development.

Guideline on WLC components

Equipment - production, tooling, test & evaluation (zero under RAB)

+ Procurement programme – doctrine, assessment, design, demonstration, database and publications, training and support equipment, initial spares, integrated logistic support, ROCE

+ Upgrades and their integration – capability upgrade, role change, life extension, ROCE.....

Guideline on WLC components (2)

- + In-service costs – personnel and materials (for operations, training, maintenance, repair), logistics, attrition, depreciation, ROCE
- + Indirect cost – research, HQ and administration, infrastructure, defence industrial base, government policy initiatives
- + Disposal

= Whole life cost

Trade offs



Capability, timescale and WLC

- Redesign may affect the performance (and hence the unit capability of equipment) and may also affect timescale and WLC.
- Revision of procurement, operating or support policy may affect timescale and WLC of a given design.
- Decisions on alternative options must balance these three effects, trading off one against another.
- BUT forecasting models may not accurately predict the effects of marginal changes.
- Even if the models were accurate, trade offs can be difficult.

Trade offs

- Model predictions appear as changes to the time profiles of cost and/or capability.
- If equipment with the same unit capability is delivered in the same timescale, alternative cost profiles can be compared via investment appraisal.
- If the unit capability is different but the timescale is the same, a new force structure with the same force capability (and the cost of that force) can be derived by operational analysis; the new cost profile can be compared with the original via investment appraisal.
- There is no agreed method of comparing alternative time profiles of capability.

Managing WLC



A credible WLC

- Explicit, consistent and accepted boundaries
- A MDAL accepted by all stakeholders
- Ample data on past projects, well analysed
- Transparent and traceable cost forecasting models
- Comprehensive and unbiased risk analysis

A defective WLC annoys ALL stakeholders,
particularly taxpayers

Minimising WLC

- Careful capture of requirement and force size
- 'SMART' acquisition strategy suited to the project
 - Early investment, partnering etc.
- Collaboration on research and development
- Balance personnel and equipment for peace/war
- Streamline logistics and support
- Exploit new technology in all phases of acquisition
- Use IT to link all stakeholders
- Export to all allies to spread fixed cost

Barriers to WLC management

- Stakeholder emphasis on short-term problems
 - Ministers, Treasury, MoD branches, industry
- Uncertain WLC are unattractive to engineers and accountants, and complicate trade-off studies
- Affordability and timescale constraints affect decisions, so optimal WLC is unattainable.
- Some interest groups prefer WLC hidden.
- Subsystem manager have limited information
 - Delegated authority, commercial-in-confidence

Final recommendations

- WLC is used to manage personal and corporate projects and it should be used in MoD
- Bounding
 - Include all personnel directly involved, at capitation rates
 - Include only costs of planned upgrades
 - Use systems approach to assess WLC of a military capability
- Forecasting
 - Collect and analyse data, improve models, analyse all risks
 - Refine User Requirements, to avoid later changes
- Management
 - Enhance links between stakeholders
 - Brief managers on all costs of their own, and linked, projects
 - Put project **WLC** on all documents