TOOL C.4

COLLECTING AND DOCUMENTING THROUGH-LIFE COST DATA

1. INTRODUCTION

The objective of the Building Down Barriers pilots was that they should be procured on the basis of minimal through life cost, not just lowest capital cost. In this tool, we describe how design decisions were made on the basis of their affect on the through life cost of the building rather than the capital cost of that design decision.

This exercise is undertaken through the use of a discounted cash flow model and in this Tool we describe how the exercise was undertaken on the Building Down Barriers pilots. This tool should be read in conjunction with ToolA.3 which describes how the client can calculate a through life cost baseline using the same principles and the same discounted cash flow modelling process for investment justification and for the Prime Contractor's price guide.

The BDB Pilot Projects used an electronic spreadsheet-based cost model for building up a meaningful picture of the through life costs of a project, based on a particular set of design options. At each stage of development of the Scheme Design, and indeed during subsequent Detailed Design, options for components and materials will be under consideration. To make decisions on the value offered by different design options, and associated components and materials, their through-life cost implications need to be entered into the model and compared. Before looking at how data can be obtained to feed into the model, we first of all look at the model itself and how to use it.

2. USING THE BDB COST MODEL

The following paragraphs should be read with reference to the BDB Through Life Cost model in spreadsheet form which is shown in Figure 1: Summary sheet of the cost model). The spreadsheet model is available in both Excel and Lotus format. The model is three-dimensional with a summary page at the front followed by the following pages;

Capital - Base Estimate - Functional
Capital - Base Estimate - Elemental
Capital - Base Estimate - Segmental
Capital - Base Estimate - Clustered
Capital - Risk Estimate
Maintenance Summary
Occupancy Summary

The following refer to the spreadsheet model which is enclosed on a page by page basis, with comments related to individual lines and columns within pages.

The model is conceptually robust and consistent with the latest approaches to both aggregate and dis-aggregate elements of value.

Figure 1: Summary sheet of the cost model

SUMMARY	Total Nominal	Year Zero	Year 1	Year 2	Year 3	Year ...20	Year ...34	Year 35	Years 6 to 10	Years 11 to 15	Years 16 to 20	Years 21 to 25	Year 26 to 30	Year 31 to 35	check total 1	check total 2	Difference s/b zero
£000																	
Reference Cost																	
Capital Costs - Base Estimate	2,601	2,601							0	0	0	0	0	0			
Capital Costs - Risk Allowance	457	457							0	0	0	0	0	0			
Exceptional Costs	0								0	0	0	0	0	0			
Capital Costs - Replacement	3,460				106	175		26	388	865	281	239	1,423	132			
Maintenance Costs Summary	1,525		43	43	43	46	43	46	218	218	218	218	218	218			
Occupancy Costs Summary	2,991		85	85	85	85	85	85	427	427	427	427	427	427			
Residual Costs	0								0	0	0	0	0	0			
Total Costs by Year	11,033	3,057	128	129	235	307	129	157	1,033	1,510	927	884	2,068	777	7,199	7,199	0
Present value factor @ 6%		1.000	0.943	0.890	0.840	0.312	0.138	0.130	0.629	0.470	0.352	0.263	0.196	0.147			
Present Value By Year (PV)	6,066	3,057	121	114	197	96	18	20	642	673	319	233	378	113			
Latest Target Cost																	
Capital Costs - Base Estimate	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Capital Costs - Risk Allowance	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Exceptional Costs	0								0	0	0	0	0	0			
Capital Costs - Replacement	0								0	0	0	0	0	0			
Maintenance Costs Summary	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Occupancy Costs Summary	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Residual Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Total Costs by Year	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Present value factor @ 6%		1.000	0.943	0.890	0.840	0.312	0.138	0.130	0.629	0.470	0.352	0.263	0.196	0.147			
Present Value By Year (PV)	0	0	0	0	0	0	0	0	0	0	0	0	0	0			

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Summary

The summary sheet is designed to show on one A4 page an overview of the whole project. The first line identifies the reference cost which, once agreed, will not ordinarily be changed during the projects life. Below, the reference cost is a summary of the various elements of the latest target cost calculation. It is assumed that the model will be updated regularly and the target cost calculation updated. Line items which have their own pages are discussed below. However, this leaves three lines: (1) Exceptional Costs; (2) Capital Costs Replacement; (3) Residual Costs; and (4) Area Meters Squared.

Exceptional Costs is a special category designed to capture possible one-off restructuring costs that the users want to segregate from normal capital and operating costs. Capital Costs Replacement is designed to capture major items of refurbishment during the life of the project. Residual costs would typically include an estimate for terminal site clearance costs and possibly a negative amount for disposal proceeds. It is recognised that in the public sector these are normally conservatively forecast to be zero. There is a box on the summary sheet for entering the estimated square meters.

The summary sheet shows an aggregation of all types of costs over the whole life of the project. These are also expressed as cost per square meter.

The objective of the whole life model is to help to manage the estimated whole life costs over the life of the project. Future costs are translated to a net present value equivalent using a discount rate which is agreed by the Client and his Advisors (6% is recommended by the Treasury for public sector financial evaluation.)

Summary Functional

Summary Functional is very similar to the Summary sheet discussed above except that instead of using square meters as a denominator for calculation of ratios, another yardstick is used. In the example, average use headcount is used for illustration purposes. It is expected that the functional cost perspective will be most useful in the early stages of the project when detailed estimates are not available.

Capital - Base Estimate (BE) - Elemental

Capital - Base Estimate (BE) - Elemental is the traditional bottom-up perspective of costs by recognised building elements. It is important to understand that the Base Estimate (BE) excludes risk which is recognised elsewhere in the model. The top of the page summarises group elements and these are segmented into elements and sub-elements consistent with the BCIS guidelines for elements for design and build contracts. It is recognised that in the early stages of the project it is difficult to estimate the costs "bottom-up". Typically a mixture of top-down and bottom-up would be applied based upon previous experience of comparable projects. Whilst there are difficulties with an elemental basis for estimating and controlling future costs, the many years of industry-wide data provides a useful reference point for benchmarking.

Capital - Base Estimate - Segmental

Capital - Base Estimate - Segmental takes the same aggregate costs as highlighted by the elemental analysis but attempts to break these into major segments of cost. In line with industry practice the segments include: materials; labour; equipment; and sub-contract costs. However, the model also allows for overhead costs and profit. Whilst the latter categories have not been traditionally shared within the industry, it is envisioned that this practice will change leading to increasing adoption of "open book" costing. It is expected that the segment of overhead cost will increasingly be challenged as in other industries. A further refinement will be to introduce the widely deployed principles of activity-based costing (ABC). ABC would attempt to estimate the overhead costs spilt by major business process.

Capital - Base Estimate - Clustered

Capital - Base Estimate - Clustered is a fourth fundamental perspective, i.e. functional, elemental; segmental; and clustered. In essence the costs would be both aggregated by major work Clusters. The spreadsheet model shows how these clusters may be derived top-down by high-level mapping to the BICS format. However, for purposes of management of the effectiveness of the clusters, it is likely that the clusters will also need to aggregate their costs bottom-up. The clusters are likely to be interested in further segmentation by element and by segment as described above.

Capital - Risk Estimate

Capital - Risk Estimate is the financial representation of project risk. Only risk summary is shown but in practice, it is likely that this would be segmented into risk in the capital project and risk in the effective life. The Capital - Risk Estimate would be updated periodically as the risks are systematically reduced.

Maintenance Summary

Maintenance Summary identifies the best estimate maintenance costs during the life of the project. These are projected at a high level, typically split into : decorations; fabric maintenance; and service. It is likely that these costs would be expressed by meter or by some other appropriate denominator. It is important to understand that the model is an iterative tool that should be used to optimise capital expenditure vs. maintenance costs.

Occupancy Summary

Occupancy summary is similar to maintenance costs, identifying the best estimate of costs during the life of the project. These would typically split into: cleaning; utilities; administrative costs; and overheads. Again the model would be used iteratively to optimise capital expenditure vs. maintenance costs.

3. OBTAINING DATA FOR THE TLC MODEL

The BDB approach has been put together in full recognition that current levels of availability of reliable through-life cost data for many building components and materials is poor. The key to assessing the through-life costs associated with a component or material contained in a design option is to first estimate its service or design life.

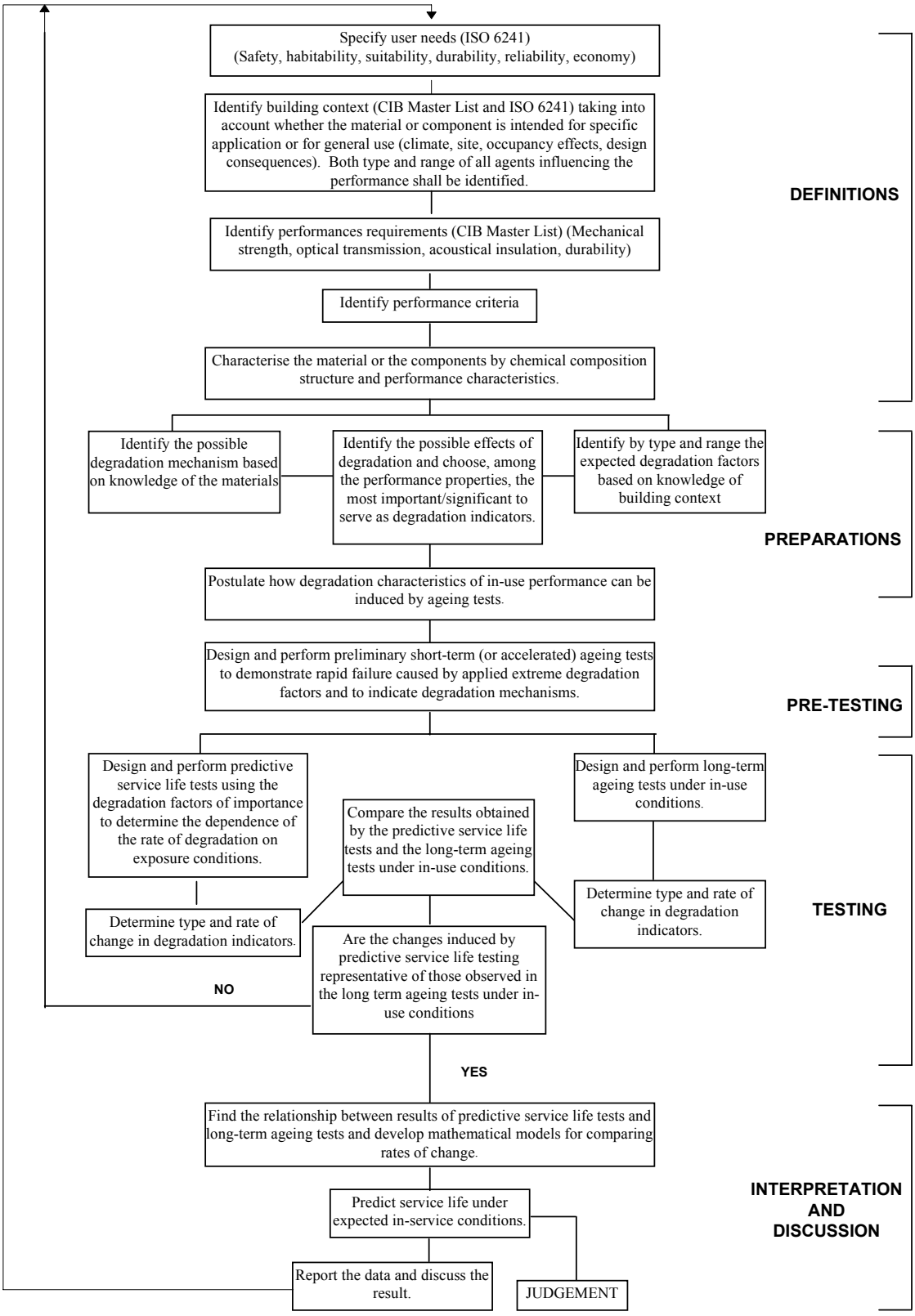
Data on the design lives of components and assemblies is available from:

- Manufacturers Data
- HAPM, Component Life Manual, published by Spons.
- Degradation Tests

Reference should be made to the draft ISO on Service Life Planning obtainable from the British Standards Institution.

The process is summarised in Figure 2: Decision tree procedure for service life prediction.

Figure 2: ***Decision tree procedure for service life prediction***



Data about lives of components need to be recorded on appropriate forms an used during the value Engineering activities. A model of "TLC form" used in the BDB Pilot Projects is provided in Figure 3: TLC Form.

Figure 3: ***TLC Form***

TLC FORM			
Project: Component: Data Source:		Operation Period (in years) Base rate (%): Inflation rate (%):	
Alternatives	**1**	**2**	**3**
	BASE COST		
Initial capital			
Cleaning Actual cost per annum			
Maintenance Actual cost per annum			
Running Actual cost per annum			
Replacement Frequency of replacement			
Actual cost			
	NET PRESENT VALUE		
Initial capital			
Cleaning Total costs			
Maintenance Total costs			
Running Total costs			
Replacement Total costs			
THROUGH LIFE COSTS			
Comments			

4. THE THROUGH-LIFE COST MODEL AS A COMPLIANCE INDICATOR

As the design develops, it will be necessary for the Prime Contractor to extend the data held in the cost model, to show precisely how the overall TLC build-up has been made up. As we shall see in Tool D2, the through-life cost model must provide the basis for producing a Compliance Plan. According to this, actual operating costs will be compared with predictions during the Proving Period. Whatever the level of detail to which the design has been

developed, it is important to be clear what the figures for operating costs, e.g. for energy consumption, maintenance and cleaning, are taken to include and/or exclude, to prevent excuses at a later date on the basis that the budget figure did not take account, for example, of an access tower required to clean soffits.

It will therefore be necessary for each item costed in the model to have a description stating what is included. Where the audit of the through life cost identifies areas of cost which are critical in that a change in assumption will create a large variation in the through life cost, these may need to be examined by the Client or an appointed technical advisor in some detail in order to test the validity of the assumptions made, and whether they include all that they should and at appropriate costs.

The additional level of detail can be achieved by either adding more sheets to the 3D spreadsheet, or by creating a linked database which feeds the information to the relevant cells. The example below provides some guidance on the approach which will be required from a Prime Contractor, in order to provide sufficient information to enable the Client to assess the probability of the building meeting the predicted life cycle cost. The spreadsheet shows a possible approach to providing the data for the roof coverings - in this case a metal deck roof with insulation and high performance felt covering.

As the design develops, so the information under each of the headings will increase and become more specific, to the extent that the material would be fully specified, the area accurate and broken down into sub-areas, the cost would become the actual expenditure and so on. The maintenance requirements and period would then be written into the operating manual, and the work to be carried out defined e.g. clean gutters twice a year.

The figures within this spread sheet need to be carried forward to the main through-life cost model - for example cell E10 on this sheet would be linked to C:D89 in the main model, and H5, H6, H7 and H9 to C:X89.

I	A	B	C	D	E	F	G	H	I	J
1	Roof Coverings build-up	material	area/no	cost/m2	total cost	life	replace	replace cost	maint.	period
2										
3	deck	steel profiled	20,000	2	40,000	35	0	0	0	0
4	fixings	self drill	10	0.4	800	35	0	0	0	0
5	insulation	polyurethane	20,000	0.5	10,000	20	1	12,000	0	0
6	vapour barrier	polythene	20,000	0.1	2,000	20	1	2,000	0	0
7	waterproof layer	hp felt	20,000	3	60,000	20	1	72,000	0	0
8	solar reflective	paint	20,000	0.15	3,000	10	3	9,000	0	0
9	gutters	upvc	200	2	400	20	1	400	200	2
10	total capital cost				116,200					

An alternative approach would be for the Prime Contractor to use a data base linked to the through-life cost model to provide the detailed breakdown of the various materials and their associated costs. As more information is gathered, and other projects are approached in the TLC manner, so the ready access to durability, cleaning and maintenance costs for a range of materials will become more valuable.

We are aware of software currently under developed or at the trial stage which attributes information from a database to be assigned to objects drawn in a CAD drawing. This would allow a check to be made that all the items shown on a drawing had been given appropriate lives and that maintenance requirements had been stated.

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Contact Don Ward (Chief Executive):
(E) don.ward@beonline.co.uk (W) www.beonline.co.uk
PO Box 2874, London Road, Reading RG1 5UQ. (T) 0870 922 0034

Collaborative Working Centre – www.collaborativeworking.co.uk
The Collaborative Working Centre of Be is a not-for-profit organisation set up from members of the team that facilitated *Building Down Barriers* to provide consultancy, training and other continuous improvement services to support the development and implementation of collaborative working.

Contact Neil Jarrett or Vassos Chrysostomou (Directors):
(E) neil.jarrett@collaborativeworking.co.uk or vassos@collaborativeworking.co.uk
c/o PO Box 2874, London Road, Reading RG1 5UQ. (T) 0870 922 0034