

Whole-life costing and cost management

Achieving Excellence in Construction Procurement Guide



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NAO endorsement

The NAO recognise that proactive client leadership and robust project management are prerequisites for the successful delivery of construction procurement.

They consider that procurement of construction should be an effective use of administrative value for money and endorse the use of the good practice promoted by this set of guides. They may investigate whether this good practice is adopted in practice in any future award of OJ.

Acknowledgements

This guide has been produced after extensive consultation within government and valuable contributions from leading individuals and organisations across the construction industry.

ODG would like to thank all who have contributed.

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The Achieving Excellence Procurement Guides

The *Achieving Excellence* suite of procurement guides replaces the *Construction Procurement Guidance Notes* series.

The new series reflects developments in construction procurement over recent years and builds on government clients' experience of implementing the *Achieving Excellence in Construction* initiative.

High level guides



Core guides



Supporting guides



07 Whole-life costing and cost management

Value for money is the optimum combination of whole-life cost and quality to meet the user's requirement. This means that awarding contracts on the basis of lowest price tendered for construction works is rarely value for money; long-term value over the life of the asset is a much more reliable indicator. It is the relationship between long-term costs and the benefit achieved by clients that represents value for money.

Introduction

Costs and value are not always well managed by clients. A benchmarking study of government construction projects in 1998 showed that three quarters of the projects exceeded their budgets by up to 50%. Some clients are focusing on the wrong goal – lowest tender price rather than best value; but concentrating on the initial capital costs of a construction project does not give value for money. Clients need to think in terms of achieving value by meeting the needs of end-users with a higher quality project at lower whole-life costs.

In addition, a study by Mott MacDonald for HM Treasury in 2002 showed that clients were frequently over-optimistic in their estimates of costs and the time required for delivery. In some cases, actual budgets were twice as much as the estimates. The study concluded that clients need a better understanding of the basis for their estimates.

This guide explains how to manage costs throughout the life of a facility. The focus is on whole-life costs – that is, the cost of design and construction, the long-term operational and maintenance costs and the costs associated with disposal.

The guide outlines the principles of whole-life cost management and describes a process made up of:

- a framework for cost management
- establishing baseline costs – expected operational costs of the asset
- estimating whole-life costs – every cost likely to be incurred from inception of the project to disposal, construction costs and risk allowance
- cost management and reporting.

Principles

Definitions

Whole-life costs

The whole-life costs of a facility (often referred to as through-life costs) are the costs of acquiring it (including consultancy, design and construction costs, and equipment), the costs of operating it and the costs of maintaining it over its whole life through to its disposal – that is, the total ownership costs. These costs include internal resources and departmental overheads, where relevant; they also include risk allowances as required; flexibility (predicted alterations for known change in business requirements, for example), refurbishment costs and the costs relating to sustainability and health and safety aspects.

Cost management

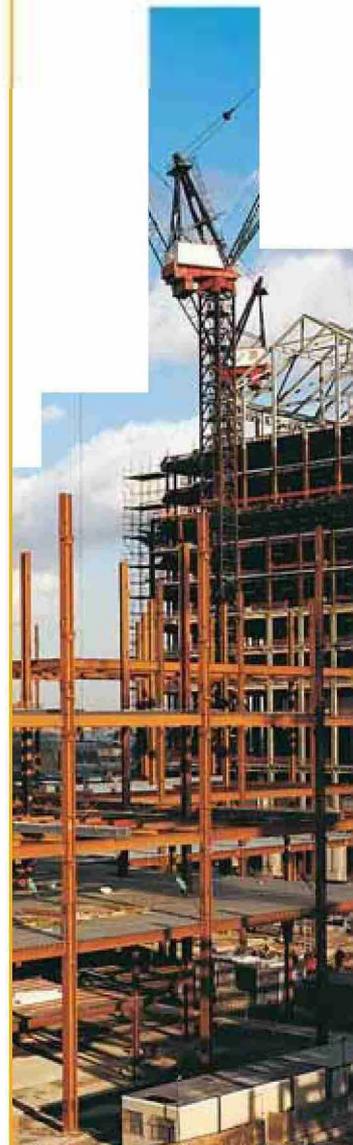
Cost management is the process of planning, estimating, coordination, control and reporting of all cost-related aspects from project initiation to operation and maintenance and ultimately disposal. It involves identifying all the costs associated with the investment, making informed choices about the options that will deliver best value for money and managing those costs throughout the life of the project, including disposal. Techniques such as value management help to improve value and reduce costs (see *AE4: Risk and value management*). Open book accounting, when shared across the whole project team, helps everyone to see the actual costs of the project.

The real costs of an asset

Long-term costs over the life of the asset are more reliable indicators of value for money than the initial construction costs. This is because:

- money spent on a good design can be saved many times over in the construction and maintenance costs. An integrated approach to design, construction, operation and maintenance with input from constructors and their suppliers can improve health and safety, sustainability, design quality; increase buildability; drive out waste; reduce maintenance requirements and subsequently reduce whole-life costs. It is important to take a whole-life approach to the asset, whether or not the same team is responsible for design, construction, operation and maintenance
- investment in a well-built project can, in turn, achieve significant savings in running costs.

This means that the department should be prepared to consider higher costs at the design and construction stages in the interests of achieving significant savings over the life of the facility. It is essential to consider long-term maintenance very early in the design stage; most of the cost of running, maintaining and repairing a facility is fixed through design decisions made during the early part of the design process.



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Promoting excellence in design does not necessarily mean a more costly job if whole-life costs are taken into account. The Royal Academy of Engineering reports that the typical costs of owning an office building for 30 years are in the ratio of 1 (for construction costs): 5 (for maintenance costs): 200 (for costs of the operation being carried out in the building, including staff costs). Consultancy fees account for 10-15% of the construction cost (that is, 0.1-0.15) when compared with 200 operational cost. The focus on whole-life cost should start from the business case by increasing the value in the operational aspect while keeping the maintenance as low as possible. In this way the initial construction cost can be recovered, since this initial cost is the smallest amount and optimising the other two figures will have saved more than the construction costs. The 200 figure is expenditure by the client organisation on operating the facility; it should also reflect the benefit of that facility to the department or the public at large. While a hospital may cost 200 times its construction cost over 20 years to provide a service to patients, a well designed hospital may cost considerably less and a poorly designed one considerably more.

Time and effort spent on the design stage will save significant amounts of money downstream.

A key part of any whole-life cost assessment must be to address the sustainability aspects of the facility. In some areas there are clear links between whole-life costs and sustainability, such as the direct costs of energy usage. Even if the integrated project team does not operate and maintain the facility, it should be designed for convenient, cost-effective and safe operation and maintenance.

Avoiding cost overruns

The main ways for the client to avoid cost overruns are to have:

- objectives that are realistic and not changed during the course of the project
- estimates for project approval that are realistic – that is, not unduly optimistic
- a project brief that is complete, clear and consistent
- a design that meets planning and statutory requirements
- a design that is coordinated and takes account of buildability, maintainability, health and safety and sustainability
- risk allocation that is unambiguous and clear to all parties involved
- clear leadership and appropriate management controls
- simple payment mechanisms that incentivise all parties to achieve a common and agreed goal.

If the client works with the integrated project team at the early stages, more accurate and robust estimates can be prepared, which can be benchmarked against other schemes and client costs to ensure that value for money is achieved.

Who is involved in whole-life costing and cost management?

The investment decision maker is accountable for any decisions relating to the cost of a project or programme. Whole-life costings should provide the information necessary to make the best decisions in terms of procurement route (see *AE6: Procurement and contract strategies*).

The senior responsible owner is responsible for ensuring that budgetary estimates are based on whole-life costs and is assisted by the project sponsor and project manager, as appropriate, together with additional client advice as required, such as value managers and cost consultants.

The integrated project team has an essential part to play in delivering value for money. The team members responsible for design and construction should work together to identify the most cost-effective design solution over the life of the facility. The integrated project team should advise on how the design will affect cost during construction and the operational efficiency of the completed facility; they should also advise on buildability and health and safety aspects in consultation with the planning supervisor.

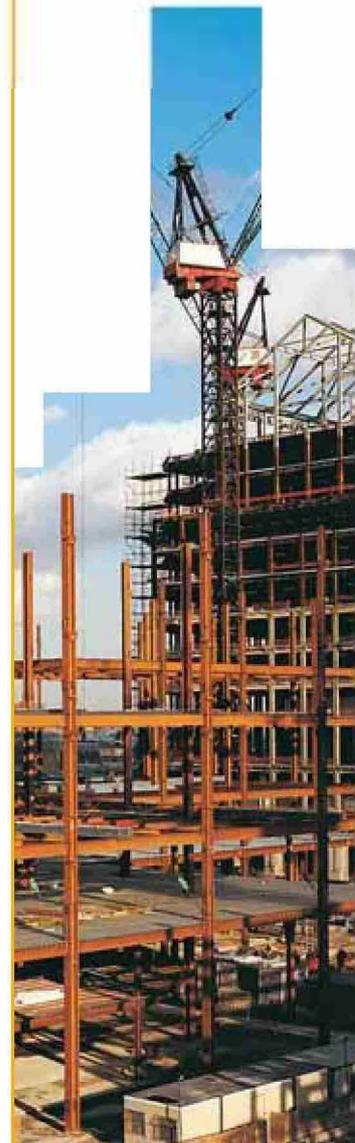
Cost models are described in the next section. The whole-life cost model for a specific project will be developed and subsequently updated by different parties according to the project stage reached and the form of procurement adopted. Integrated project team members work together on updating the model. At project inception, the model might be developed in-house or by an independent client adviser. Tenders will be evaluated on the basis of whole-life costs, and hence at tender stage, the bidder will prepare the model. Where a framework contract is already in place, the framework supplier might be the most appropriate organisation to develop the model.

Whole-life costing

A framework for making decisions on whole-life costs

All parties in the supply chain, including material and component suppliers and specialist suppliers, need to have reliable data on the operational costs of their products, including running and maintenance costs. The main aims of the framework are:

- integrating the design and construction processes, so that the IPT can take responsibility for the cost and quality implications of their design, with input from those who will be responsible for operating and maintaining the facility
- involving the integrated project team early on so that they can advise on how the design will affect cost, health and safety during construction and in use, speed of construction and the operational efficiency of the completed facility



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- taking early account of the needs of the end-users of the facility in order to avoid costly design changes at a later stage
- using opportunities for off-site fabrication and standardisation of building components to improve cost-effectiveness and efficiency on site; integrated teamworking is essential for achieving the required precision in planning and design
- making sustainability of the completed facility a priority, taking full account of its whole-life costs
- materials wastage close to zero compared with industry best practice of 10%
- labour productivity of 65-70% compared with best industry rates of 54%
- a regime where continuous improvement can be demonstrated.

Wherever possible, make the integrated supply team responsible for proving the accuracy of their cost prediction of running costs, whether or not they subsequently maintain the facility. This is a requirement for Prime Contracting.

Establishing baseline costs: overview of the process

Establish the expected operational running costs of the facility. For the whole life of the facility, produce a quantified estimate of running, maintenance and other support costs of operating the proposed building, including the costs of disposal. Compare options based on net present value. HM Treasury's *Green Book* provides advice on how to do this. (http://www.hm-treasury.gov.uk/economic_data_and_tools/greenbook/data_greenbook_index.cfm).

Check how these running costs compare with costs for existing buildings and other comparable facilities. If costs are higher, how are they justified? The Building Cost Information Service (BCIS www.bcis.co.uk) provides a source of such data. However, it is difficult to derive benchmarking costs without knowledge of the way the facility being considered is managed and details of the design, such as additional insulation.

Develop the design

Ensure that:

- the project team is integrated from the outset of the design process, to enable specialist suppliers to contribute to the design
- enough consideration is given to opportunities for optimising the operational efficiency of the facility.

Make 'value' explicit: design to meet a functional requirement for whole-life cost:

- draw up a design brief that is output-based with explicit reference to value; involve the users of the facility and others in its development
- specify at an early stage any constraints on capital costs (note that constraints here may affect ability to deliver best whole-life value for money) or whole-life target costs.

The business case should look beyond the cost of ownership to the value of the facility and the output specification should be clear about how that value could be improved – for example, faster throughput for an operating theatre. The integrated project team can then work with the client stakeholders to explore the best ways of increasing value within the business case framework.

Assess the proposed method of construction

Use techniques such as value management and value engineering to minimise the potential for waste and inefficiency and optimise the use of materials over the lifespan of the facility. Quantify the impact on whole-life costs that will be delivered by the construction process.

Specify the requirements in output terms – that is, what is required to meet the business need; not the detail – for example, numbers of windows and thickness of walls should not normally be specified by the client. This allows the integrated project team to propose ways of meeting these requirements in the most cost-effective way (using value management and engineering techniques) and also to suggest innovative solutions (see *AE4: Risk and value management* and *AE9: Design quality*).

Determine the baseline against which to measure the actual performance achieved

Set the cost baseline:

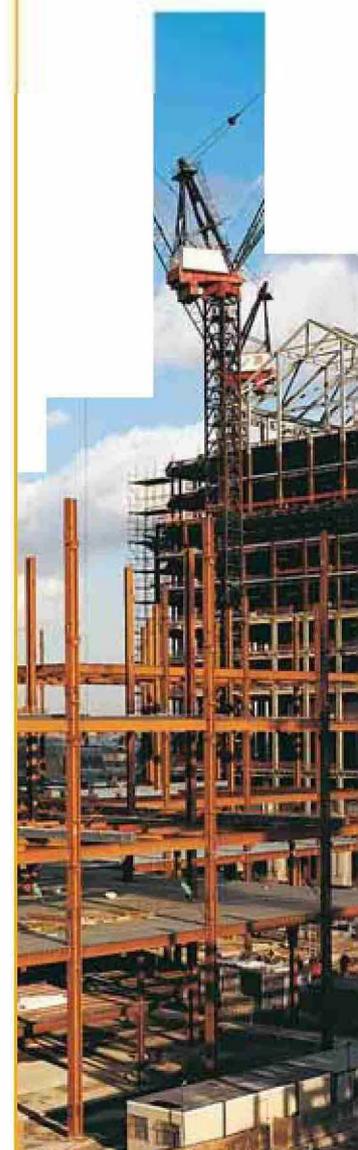
- total investment needed to complete a facility, such as the cost of design, construction cost and land cost
- estimated running cost of the completed facility over its operational life.

Note that the initial budget estimate and all subsequent budget estimates should allow for all costs in connection with the project – in-house costs, consultancy costs, land costs, legal costs, operation and maintenance costs, design and construction costs, concession payments and decommissioning costs. It should also include a risk allowance and provision for VAT.

Benchmark the baseline

Compare capital and predicted whole-life costs with the benchmark cost for a similar facility procured in the same way (such as Design & Build):

- calculate the benchmark costs and record data for future benchmarking. Note that this is often difficult in practice as there may be little available data on actual costs as opposed to prices of materials; there may also be limited reliable information about maintenance and energy costs (see Annex B for notes on historic and predictive costs; see also the Further information section at the end of this guide)



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- aim for the integrated project team to deliver better value rather than lower margins
- seek opportunities to further reduce predicted whole-life costs without reducing quality or value by using value engineering during the design process
- consider the scope for allowing higher capital costs to reduce running costs – for example, investment in more efficient heating systems
- consider the scope for sharing any further savings made during the construction of the facility.

The value engineering process works by enhancing whole-life value, not by squeezing profit margins or initial construction costs.

Integrate project activities:

- manage costs collaboratively, with the integrated project team engaged at the earliest stages wherever possible – using target costing, value management and risk management
- avoid fixing a guaranteed maximum price until the design stage is complete, to ensure quality and functionality for the client; if the price has to be fixed at an earlier stage, agree an incentive scheme for the sharing of benefits
- aim for a clear understanding of actual construction costs, in terms of labour, plant and materials. Separate underlying costs from risk allowances; distinguish between profit and overhead margins.

Estimating whole-life costs

Whole-life costing is aimed at answering the question: 'What is the cost of achieving this objective in this way?'. It is always considered in relation to quality in meeting the business need, in order to determine value for money. Different solutions to meeting the business need could result in significantly different cost profiles and contract duration; appraisal of options needs to be flexible enough to compare very different approaches. Engagement with the integrated project team at the earliest possible stages – even the Strategic Outline Business Case – allows the parties to work together to identify risks/problems and resolve them. Sensitivity analysis is also important, to challenge assumptions about uncertain future events and hence variations in costs. HM Treasury's *Green Book* provides advice on sensitivity analysis.

'Optimism bias' – that is, a tendency towards over-optimism – needs to be assessed with care, because experience has shown that being unrealistic about benefits that can be achieved in relation to risk will have a significant impact on costs. Over-optimism about time and cost estimates in relation to risk would significantly alter the balance of actual cost/benefit/risk and hence the basis for justifying the investment.

Clients are often too optimistic about what their project will cost and how well they can manage risk. A recent report showed that many departments frequently underestimated costs and risks by 50%, often much more.

[Source: Report for HM Treasury 2002 (Mott MacDonald)]

Assess the value to the business operations – can the cost be justified?

The most important aspect when considering the whole life of a facility is how it will enhance the core business operations that will take place in, on or around it. There must be a very clear understanding of what those business operations currently are – and how they might change in the future – before the output performance requirements of the facility can be determined and an estimate of the likely cost made.

Check that the facility will meet the brief developed with the users and is flexible enough for future operational change while remaining affordable.

Note that the business benefits from a facility cannot be achieved until it is complete and put to use, so the time to completion is a crucial factor. The improvements in time savings during the design and construction stages that have been realised through Private Finance Initiative projects demonstrate what can be achieved when the full economic assessment of a project is taken into account over the long term.



It is at the design stage that the greatest value gains can be achieved. Best practice clients take a long-term view of the likely quality of the completed facility and how the design will influence the cost of running the facility over its operational life. They recognise that badly designed facilities have high maintenance costs, could be dangerous and can be both inefficient and costly to construct.

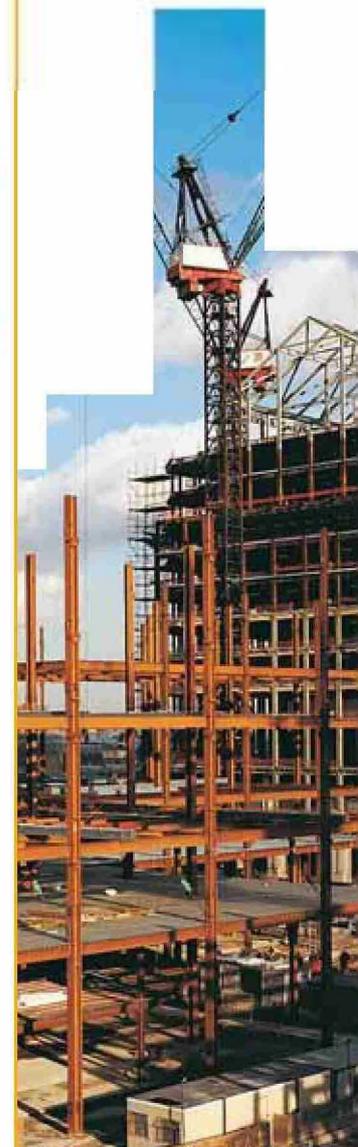
Produce an output-based specification

Specifications should be output-based, setting out the functional requirements; they should not be prescriptive and should avoid setting out the process or details of how the end product is to be achieved. (See *AE9: Design quality*.)

Output-functional specifications help to:

- focus the end-user's mind on what functions the facility is to perform
- allow the supply team the greatest opportunity to innovate and find ways of enhancing the function of the facility while reducing its whole-life costs.

Output specifications should provide sufficient flexibility to allow the different elements of the facility to be upgraded in relation to their respective lifespans. For example, internal layouts of office buildings typically change every 5-7 years.



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Consider the elements that make up whole-life costs

It is important to focus on future trends rather than compare against the costs of the past. Where historical data is available, it may provide misleading information, such as the past mistakes in the industry in focusing on lowest price. Irrespective of whether or not historical cost information is available, it is always preferable to estimate the costs from first principles and only to use historical cost information as a check (see Annex B).

Where the budgets for capital expenditure, maintenance and utilities such as energy are not held by one individual, the holders of the separate budgets will need to work together to arrive at the optimum whole-life cost solution.



Defence Estates' Building Down Barriers initiative includes a framework for making decisions on whole-life costs. All parties in the supply chain have to provide reliable data on the operational costs of the products, including maintenance costs.

The aim is that the whole-life cost model should include every cost likely to be incurred in respect of the facility from inception to disposal. This section identifies some of the elements that need to be included in the model but are often not. It should not be regarded as an exhaustive list.

Each part of a facility has its own physical and economical lifespan. The model will need to reflect the economical lifespan of each part. See HM Treasury's *Green Book* for more information on economic appraisal.

In-house resources

These should include the total costs to the client organisation for all staff time and other resources relating to the project and should include the relevant proportion of all overhead resources.

Planning costs

There will be costs associated with obtaining planning permission for construction of a facility; there may also be a requirement for planning permission for a refurbishment project. Note that there may be additional costs if there is a delay; it is important to allow a realistic time period.

Consultancy fees

The total costs of all consultancy fees incurred for the project at any stage from inception to disposal should be included in the model. Consultancy fees might be incurred through any of the following:

- procurement advice and development of client brief
- legal advice
- fees linked to purchase of site/assets
- cost consultancy

- change management
- financing
- design
- value management and risk management
- project management
- economic appraisal
- planning supervisor role
- advice on technical issues.

Note that if too many advisers are appointed outside the integrated project team, this will tend to increase the cost without a commensurate increase in the value delivered.

With an integrated procurement route, some of the above elements will not appear as separate items but be included as part of an integrated design and construction package.

IT costs

Where not included in design/construction/project management costs, there may be IT costs – for example, for three-dimensional modelling of the proposed facility, planning for prefabrication of construction components and project scheduling.

Construction costs

These are described in detail in the next section.

Health and safety

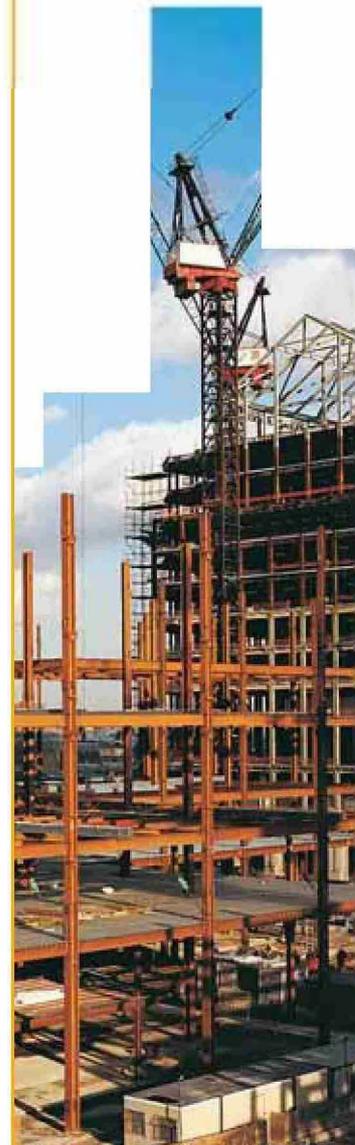
Health and safety issues arising in the construction, occupation, maintenance, alteration and disposal of the facility should be included in the model. Initial failure to address the ease with which the built environment can be safely maintained can lead to unnecessary costs and risks to health and safety at a later date. The Construction (Design and Management) Regulations 1994 place specific duties and responsibilities on clients. For further information, see *AE10: Health and safety*.

Security

The cost of providing a full security service at each point of entry and exit to a facility is considerable and is often overlooked during the early development stages. There may also be other security issues as design considerations.

Operations

The aim is to identify the total resources necessary to operate the facility. There is often an overlap between this element and the resources necessary to carry out the core business operations of the organisation, including staff costs and IT infrastructure costs. The important aspect is to consider how the performance of the facility can be improved to optimise the resources used for both elements. There should be a risk allowance to cover risks that materialise during the operational life of the facility.



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Cleaning

The sustainability of a facility can be attributed in part to maintaining it in its original state and that requires a structured, effective cleaning regime. Cleaning of the facility, both internally and externally, needs to be addressed at the outset. The design can have a significant impact on the ease of cleaning and even on the frequency at which cleaning is required.

Maintenance

The maintenance strategy needs to be developed during the early stages of the project. Allowance needs to be made for the total resources for normal routine maintenance, regular inspections and, where appropriate, testing as well as for replacement of elements through normal wear and tear. The costs of providing accommodation and other facilities for maintenance activities, such as access, need to be addressed. The costs of disruption to business operations and/or the resources incurred in decanting staff while maintenance operations are carried out should be included.

Utilities

The total costs for different forms of utility supply, such as heating, cooling, power, lighting, water and waste, should be allowed for.

Alterations

There needs to be consideration of the likelihood for future changes to the facility that may be required as a result of changes in the way that the core business operations are carried out. Any allowance considered necessary should include the total costs of making the alterations, including those incurred when moving staff. Ideally, adequate flexibility needs to be included in the parts of the facility where changes may occur, while remaining affordable.

Disposal

Consideration needs to be made of how the facility will be disposed of and whether it will have any residual value at that time. This may include demolition or sale.

Carry out a risk analysis

There will need to be a comprehensive risk analysis, listing all significant risks that might occur over the life of the facility. For further information on risk analysis, see *AE4: Risk and value management*.

There are several areas where costs might increase at a rate higher than inflation for a variety of reasons. These might include maintenance activities, use of labour for site activities and green taxes. These can be addressed in the same way as any other risks. For each risk, the probability of occurrence and the likely impact can be established and a risk allowance made.

Estimating construction costs

This section provides advice on the preparation of budget estimates for the construction component of the project and the calculation of risk allowances. Budget estimates should, for each element, consist of a base estimate and a risk allowance. The risk allowance should be calculated for identified risks and not be

just guessed at as a percentage of the total (the term 'contingency' should not be used). The risk allowance may well exceed the base estimate during the early project stages and will gradually reduce as the project develops. Expenditure of risk allowance should be for identified risks only. Project change control procedures should be invoked where unidentified risks occur (see *AE3:Project procurement lifecycle* for more details).

The most important aspect of estimating the construction costs is to predict the outturn capital cost of the project at the earliest project stages. An estimate that fails to predict the outturn cost with some degree of certainty is of little value.

It is essential to produce an estimate that allows properly for the cost consequences of risks and that ultimately predicts the outturn costs, rather than generate a very detailed costing of every single item but fail to allow for risks and hence fail to predict the outturn cost accurately. However, it is recognised that cost-estimating accuracy should increase as the project progresses, risks either materialise or not, and requirements are tied down.

Construction cost elements

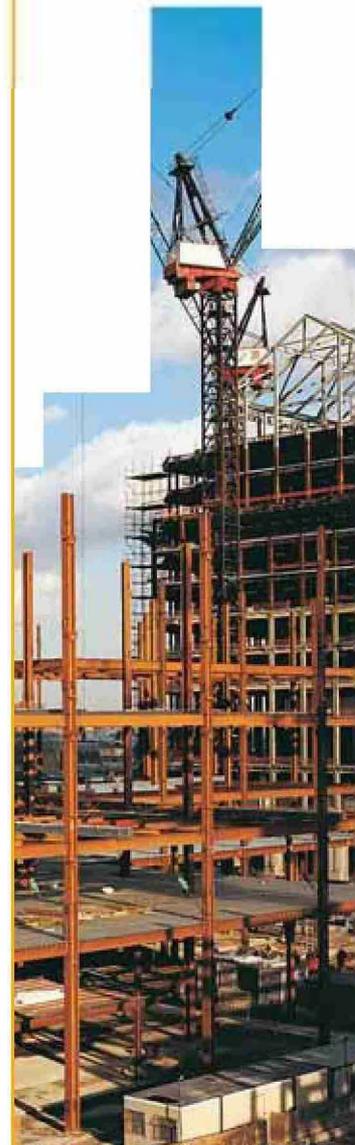
The construction cost of a project is made up of many elements, which include:

- in-house costs and expenses (including all central support services, administration, overheads, etc)
- consultancy fees and expenses (such as financial, technical, legal advice)
- land costs
- wayleaves and compensation
- demolition and diversion of existing facilities
- new construction or refurbishment costs
- insurances.

The cost estimate for the construction components of a project should address each element to arrive at the total cost estimate for the project. Focusing on any individual element of the total project cost in isolation might result in a distorted picture because a reduction in one element could result in an increase in cost for another element. (See Annex C for examples of elements.)

During the early project stages, the cost estimates for each element necessarily will be based on the limited outline information available. However, estimates still can be prepared, although it may be necessary to make a number of assumptions. Any assumptions should be set down clearly so that they can be verified if necessary and referred to at a later stage.

Estimates will need to be prepared for a number of options, some of which may include Private Finance Initiative projects. Advice should be sought from the departmental Private Finance Unit or HM Treasury's Private Finance Unit.



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All such comparisons should be calculated as net present value for a realistic Private Finance Initiative contract duration in line with the guidance in *Treasury Taskforce Technical Note No 4: How to construct a public sector comparator*.

As the project progresses and becomes more clearly defined, the construction cost estimates need to be revisited and more finely tuned to reflect better, more detailed information as it becomes available.

Risk allowance

Each element of a cost estimate comprises two components: the base estimate and the risk allowance. The base estimate is the estimated cost of the element without any risk allowance included. The risk allowance is that sum calculated as part of a formal risk analysis to allow for identified risks (see *AE4: Risk and value management*).

Standards and sources of information for whole-life costing

Whole-life costing is covered by a British and International Standard – BS ISO 15686: Service life planning of buildings and constructed assets. Annex A sets out the structure of this standard; Annex B describes historic costs and predictable costs. In addition, the Further information section at the end of this guide provides details of data sources.

Cost management

Cost management and reporting: overview

Management of the overall cost of the project is the responsibility of the project manager, reporting to the project sponsor. Delegations and limits of authority for these two roles should be agreed at the start of the project, so that everyone knows exactly what they are empowered to do in managing project costs.

The main tasks are:

- to manage the base estimate and risk allowance
- to operate change control procedures
- to produce cost reports, estimates and forecasts. The project manager is directly responsible for understanding and reporting the cost consequences of any decisions and for initiating corrective actions if necessary
- to maintain an up-to-date estimated outturn cost and cashflow
- to manage expenditure of the risk allowance
- to initiate action to avoid overspend
- to issue a monthly financial status report.

The objectives of cost management during construction include:

- delivering the project at the appropriate capital cost (having considered the implications of quality, programme and whole-life objectives, using the value criteria established at the start of the project)
- ensuring that, throughout the project, full and proper accounts are monitored of all transactions, payments and changes.

The principal areas of cost management are:

- scope – defining what is to be included in the project and limiting expenditure accordingly
- programme – defining the project programme from inception to completion. Estimates and cash flow should be consistent with the programme
- design – ensuring that designs meet the scope and budget; delivering quality that is appropriate and conforms to the brief
- commitments – ensuring that orders are properly authorised
- contracts and materials – ensuring that the contracts provide full and proper control and that all costs are incurred as authorised; ensuring that materials are properly specified (in output terms) so as to meet the scope and design and that they can be procured effectively
- risk allowance – ensuring all expenditure relating to risks is appropriately allocated from the risk allowance and properly authorised; and monitoring use of risk allowance to assess impact on overall outturn cost
- cashflow – planning and controlling both commitments and expenditure within budgets so that unexpected cost over/under runs do not result; ensuring that all transactions are properly recorded and authorised and, where appropriate, decisions are justified.

Financial reviews at key decision points

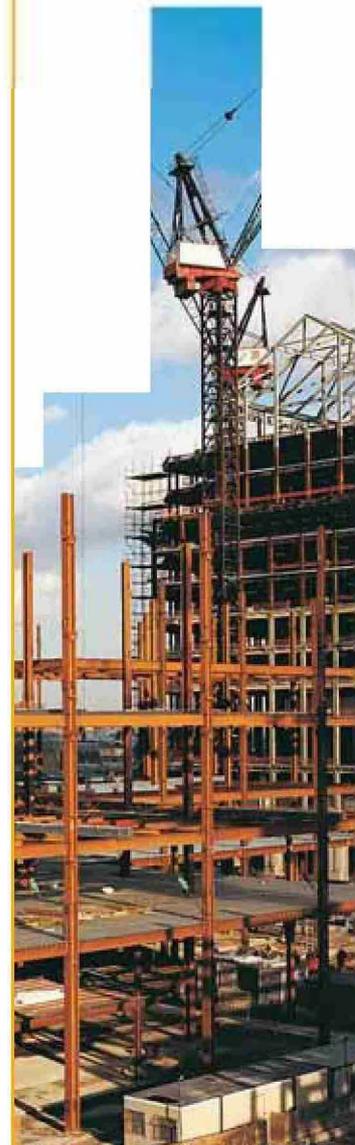
There should be a financial review at each Gate and other major decision points. The Gateway process is summarised in the companion document *Achieving Excellence in Construction: A Manager's Checklist*.

Each financial review should ensure that:

- the latest estimate is compared with the previously approved budget and does not exceed it without fully reasoned justification
- the latest estimate of cost is made up of the base estimate for whole-life costs and the risk allowance
- the risk allowance is for identified risks only (not an assumed contingency provision)
- the project is still affordable
- funds are available for planned expenditure.

Management of the risk allowance

The project sponsor should manage the risk allowance, with support and advice from the project manager. Essentially, management of the risk allowance consists of a procedure to move costs out of the risk allowance into the base estimate for the project work as risks materialise or actions are taken to manage the risks. There must be formal procedures for controlling quality, cost, time and changes. Risk allowances should only be expended when the identified risks to which they relate occur. When risks occur that have not previously been identified, they should be treated as changes to the project. Similarly, risks that materialise but have insufficient risk allowance made for them will also need to be treated as changes.



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Risks and the risk allowance should be reviewed on a regular basis, particularly when formal estimates are prepared, but also throughout the design, construction and equipping stages. As more firm commitments are entered into and the work is carried out, so the risks in future commitments and work are reduced. The estimate for the risk allowance should reflect this. (See also *AE4: Risk and value management*.)

Change management

The client must make every effort to avoid introducing changes after the briefing and outline design stages are complete. Changes can be minimised by ensuring that the project brief is as comprehensive as possible early on and the stakeholders have approved it, which might involve:

- early discussions with planning authorities to anticipate their requirements
- undertaking adequate site investigations, or condition surveys if existing buildings are to be renovated
- ensuring that designs are adequately developed and coordinated before construction begins
- imposing discipline on users to finalise and sign off their requirements in strict accordance with the project programme.

Elemental cost planning

In an elemental cost plan the estimate is broken down into a series of elements that can then be compared with later estimates, or with actual costs as the project progresses. For building projects, the most widely used breakdown of elements is that produced by the Building Cost Information Service (BCIS). Typically, each element is treated as a cost centre, but money may be transferred between elements, provided a reasonable balance between elements is maintained and the overall target budget is not exceeded. The initial cost plan is likely to be based on approximate figures, which provide a fair basis for determining the validity of future estimates. Control by the project manager is achieved by an ongoing review of estimates for each cost centre against its target budget. As design develops and is costed, any variance in cost from the cost plan is identified. Decisions are then taken on whether that element can be permitted to increase in cost, which would require a corresponding reduction elsewhere, or whether the element must be re-designed in order to keep within the budget.

Annex C provides a sample set of cost elements.

Continuous and stage estimates

The project manager is responsible for ongoing reviews of designs as they develop and providing advice on costs to the integrated project team. This continuous costing is of great benefit in assessing individual decisions and is particularly important on large and complex schemes. There also needs to be a periodic formal assessment of the whole scheme, as budgetary estimates, at each project stage.

Cost control during design development

The project sponsor has overall responsibility for the project, including the estimated cost, and will need to be satisfied that appropriate systems for controlling cost are in place and operating. Where significant costs are attached to a design, these must be properly reviewed against the budget decision and properly authorised. The project sponsor may delegate a level of financial authority for design development decisions to the integrated project team, appropriate to the project. For complex projects there might be delegated levels for each cost centre. Value management and value engineering have an important part to play in influencing costs – see *AE4: Risk and value management*.

Cost management during construction

During construction, instructions issued to the integrated project team, whether for change via a formal change control procedure, or for clarification of detail, have a much more immediate impact on cost. The project sponsor needs to establish procedures for instructions and information that ensure:

- instructions are issued within delegated authority
- instructions are costed and their impact assessed before issue
- the instruction is justified in terms of value for money and overall impact on the project
- the cost of all instructions is monitored on a continuous basis
- specific approval is sought and given where costs are forecast to be outside delegated authority.

Payment

The client, as the contracting party, is responsible for paying the integrated supply team the interim and final payments to which they are entitled. In most construction contracts there will be milestone/stage payments due during the course of the work. The project sponsor, on the advice of the project manager, should keep the client organisation's finance division aware of future payment requirements by means of the updated cashflow forecast.

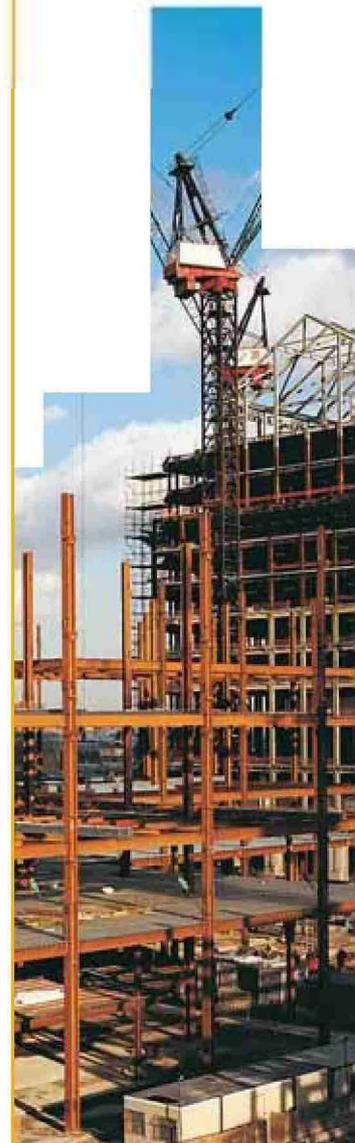
Note that for PFI projects, payments do not start until the service becomes available.

The terms of the contract may allow integrated supply teams to claim additional payments in certain circumstances defined in the contract conditions. These are generally due to:

- risks occurring that are client risks under the contract
- ordering of additional/varied work
- failure by the client to comply with its obligations under the contract – often expressed as disruption to the integrated project team's work programme due to changes or late information.

Final accounts

The payment process should be managed as effectively as the design/construction process. All payments should be made on time and payments for variations, provisional sums, etc should be discharged as the work is carried out.



07 Whole-life costing and cost management

Annex A: BS ISO 15686 – service life planning of buildings and constructed assets

Whole-life costing is covered by a British and International Standard: BS ISO 15686 – service life planning of buildings and constructed assets. Service life planning addresses the design of a structure or a building with a view to its operation through its whole life. It means looking at long-term performance and overall operating costs at the design stage and earlier, enabling the design to be tailored to meet clients' long-term needs.

Part 1: General principles

This provides a methodology for whole-life costing of buildings and other structures. It is based on prediction rather than on past performance, where that is not available. Published as a full BS ISO in 2000, it was tested in the UK by the MoD on the Building Down Barriers project.

Part 2: Service life prediction principles

This describes a procedure for service life predictions of individual building components. It is a prediction method, not based on past performance; primarily applicable for test and approvals laboratories. Published as a BS ISO in 2001.

Part 3: Performance audits and reviews

This is concerned with ensuring the effective implementation of service life planning. It gives a basis for internal reviews or for formal third-party audits. Published as a BS ISO in 2002.

Parts 4 and 5: Life cycle costing (in preparation)

Part 4 is for use in conjunction with other parts of BS ISO 15686 when lifecycle costing is to be included in service life planning.

Part 5 will deal with guidance on assessment of the lifecycle costs and maintenance planning of a building.

Annex B: Historic and predictive costing

Historic costs

These are based on analysis of similar facilities in use, such as:

- £/m²/year
- £/occupant/year
- £wlc (whole-life cost) as percentage of capital cost.

They are useful in providing quick, broad estimates, but:

- cost build-up is not always explicit
- they can lack robustness
- they are unlikely to be suitable as a cost-optimisation tool.

Predictive costs

For each building element/component/location:

- what maintenance/replacement will be needed?
- when and how often?
- how much of it?
- at what cost?

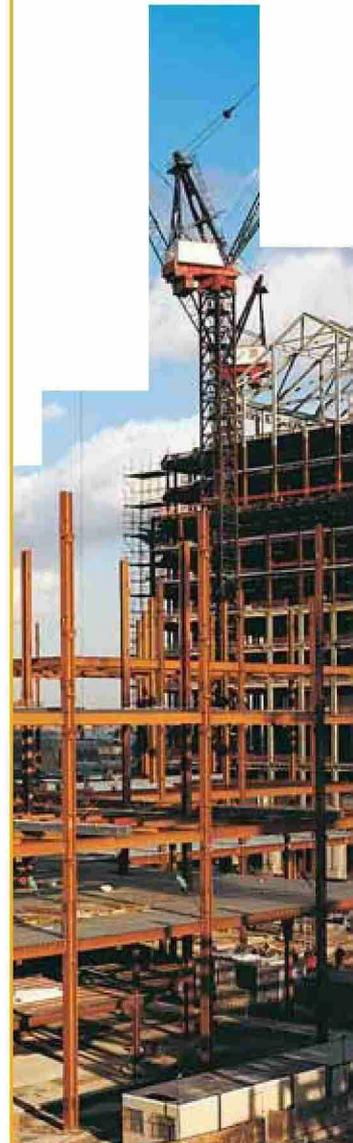
Note that it is always preferable to estimate the costs from first principles and only to use historical cost information as a check.

A further advantage of the predictive approach is its greater capability to spread cost by carrying out minor repairs or postponing repairs in certain areas in order to smooth peaks and troughs in expenditure profiles.

Computer applications can help by computing whole-life cost by plotting design and durability data, as well as predicting cost based on what-if scenarios and comparing installation expenditure with operating cost (for example, heating installation with energy efficiency).

A recommended approach is to use standard software such as Excel and adapt it to perform the required tasks, building in a facility for key variables. Specialist software does exist but most versions are not as adaptable and cannot process variable data as efficiently.

[Source: CIRIA]



07 Whole-life costing and cost management

Annex C: Sample set of cost elements

As an example of elemental cost planning, BAA groups its elements as follows:

- enabling works within building
- substructure
- structure
- envelope
- interiors
- fixtures, fittings and equipment
- services
- specialist services
- services within tunnels
- site works
- below ground structures
- above ground structures
- external works including pavings, roads and railtrack
- airfields
- landscaping
- external services
- external specialist services
- preliminaries/general items
- risk allowances.

Within each group there are a number of elements. The table below shows the elements that make up the first three groups. [Source: BAA]

Group	Elements
Enabling works within building	Demolishing parts of buildings Alterations Other enabling works within building
Substructure	Strip foundations Pad foundations Piled foundations Raft foundations Basements Structure within basements Specialist foundations Other foundations
Structure	Frame Upper floors Stairs and ramps Roof structure Pits Other structure

Further information

HM Treasury's *Green Book, Economic Appraisal in Central Government*, is the overarching document and starting point for all investment decisions (available from HM Treasury website at www.hm-treasury.gov.uk and in the OGC Successful Delivery Toolkit). Advice on government procurement policy in the United Kingdom is provided in Procurement Policy Guidelines available in the OGC Toolkit.

The following documents and information sources are also relevant to whole-life costs:

- *Whole Life Costing, A client's guide* – Confederation of Construction Clients (this is a key document that should be read in conjunction with this guide – see www.clientsuccess.org.uk)
- *Building Down Barriers: Handbook of supply chain management*, CIRIA (www.ciria.org.uk)
- *Achieving Sustainability in Construction Procurement: Sustainability Action Plan*, OGC
- *Whole Life Costing*, BRE Report 367 (www.bre.co.uk)
- *Service Life Planning: Part 1, ISO 15686-1* (www.bsi-global.com)
- *Whole Life Costing and lifecycle assessment for sustainable building design*, BRE Digest 452
- *Waste minimisation and recycling in construction: design manual*, SP134 CIRIA 1998
- *HAPM Budgeting for Sustainability* - key sources of whole life value data can be found at www.bre.co.uk/sustainableprocurement/print.jsp?id=10
- *BS 7543 Guide to durability of buildings and building elements, products and components* (AMD 9854)
- Building Maintenance Information Ltd (BMI produce publications of regularly updated indices on building maintenance costs for different types of buildings – see www.bcis.co.uk/order/bmipub.html)
- Energy Efficiency Best Practice Programme, provides impartial, authoritative information on energy efficiency techniques and technologies in industry and buildings (www.carbontrust.co.uk/energy)
- *RICS Surveyors' Construction Handbook Part 2: Section 2 Life Cycle Costing* (www.rics.org/RICServices/BCIS/)
- *HM Treasury Report*, Mott MacDonald, 2002.



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