Whole Life Appraisal for Construction

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with
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Preface

In the old economy, the pressure was to minimise initial capital cost and, although ‘lip service’ was paid to the operating and maintenance costs, in effect, they were ignored. In the new economy, everybody is interested in value for money, whether they are the user, investor, developer, design team, construction team, or member of the supply chain. Over a 25-year period an office building will cost about three times its initial capital cost to operate and maintain, yet far more attention is paid to the initial capital outlay than to the significant running costs. It is far too short-sighted to consider just the initial costs when substantial cost and environmental savings can be made over time.

Whole life appraisal is a valuable tool that considers both cost and performance over the whole life of a facility and involves balancing the capital costs against the future operating and maintenance costs whether it is a school, a road, an airport or a power plant. The privatisation of infrastructure and buildings around the world has led to an increase in the number of build-operate-transfer/public private partnerships/concession schemes where a concession is granted to design, finance, build and operate a facility over a defined time horizon of 20–30 years. Balancing whole life cost and performance against the capital costs is crucial to the concession team for the economic viability of the investment.

The whole life concept is neither new nor complicated and there is a general acceptance that it will lead to better decisions on design, refurbishment, and facilities and asset management, and provide whole life economies. However, there remain challenges in the application of whole life techniques due to a number of reasons including the ‘data problem’, with the paucity of standardised information about cost and performance of
facilities in use, the uncertainty of predicting future costs, and performance over a time horizon. The book addresses these challenges and attempts to clarify the techniques and explain the jargon that shrouds the whole life appraisal concept.

Whole life appraisal, when properly understood and used, is a useful and powerful tool. It is a practical tool that enhances, rather than replaces, professional skills. It blends knowledge, judgement, and data to make better, more informed decisions about the future and value for money. The book discusses the benefits and the challenges of using a whole life approach for the appraisal of assets from design through construction and into the operating phase. It explains the principles, techniques and use of whole life appraisal in a straightforward, practical and comprehensible way that will appeal to both students and professionals in the sector.
Whole life appraisal – an introduction

1.1 Objective

The objective of this book is to present a discussion on the benefits of using a whole life approach for the appraisal of assets from design through construction and into the operating phase and to present in a straightforward and comprehensible way the principles, techniques and use of whole life appraisal. The intention is:

- To identify the benefits of a whole life approach to the design team, owners and users of buildings.
- To explain and illustrate the techniques used in whole life appraisal.
- To understand the data required for whole life appraisal.
- To present a set of standardised procedures whereby the whole life approach can be implemented in the construction sector.

1.2 What is whole life appraisal (WLA)?

Whole life appraisal is the systematic consideration of all relevant costs, revenues and performance associated with the acquisition and ownership of an asset over its physical/economic/functional/service/design life. It minimises total expenditure through proper appraisal of costs that will be incurred through the life of the facility.
1.3 Why bother with whole life appraisal?

All clients expect the construction sector to deliver value for money. This means cost-effective solutions, efficient performance and fitness for purpose over the whole life of a facility. The aim for most clients is to ensure the most advantageous combination of capital, maintenance, and operational costs is achieved over the life of the facility.

WLA can be used to:

- Compare outline and scheme designs.
- Refine the design detailing in the choice of systems and components.
- Help management to plan and manage the facility through its planned service life.
- Promote realistic budgeting and programming of operation and maintenance activities.

1.4 Is whole life appraisal different to whole life costing (WLC)?

Over time the terminology has changed. Initially, the term was ‘costs in use’, then ‘life cycle costing’, which then became ‘whole life costing’. Now, the term used globally is ‘whole life appraisal’ where both costs and performance are considered; it embodies through-life costs. This makes sense as costs are influenced by the performance characteristics of plant and facilities, by the standards of maintenance, and by the periods of occupancy.

1.5 Who uses WLA and WLC?

Everybody involved in owning, developing, or managing a facility should care about balancing initial capital cost with whole life costs. Being realistic, there is always a capital cost restraint – if you have not got the cash today it is pointless saying that, by spending 20% more today, 60% would be saved over the service life of 30 years. But WLA is not about spending more; it is about making the right decision at the outset or even
during the operating phase. By spending 20% less, you may still be able to save 60% over the whole life by making informed decisions that analyse all the options.

Property developers who leased property on a full-repairing lease used to focus on capital costs, not running costs, because the tenant took responsibility for the cleaning, maintenance, energy costs, etc. Times have changed – tenants want efficient, reliable and low running costs in facilities that are flexible and easy to adapt. They will balance the rental charge with the whole life costs before signing the lease agreement.

Manufacturers, developers, architects, engineers, contractors, specialist contractors, construction equipment manufacturers and owners all need to think about WLA and WLC.

1.6 When should WLA be undertaken?

Whole life appraisal should be integrated into the design process from concept through to occupancy. As the design process moves through each iteration, ideas are developed and assessed. WLA needs to be embedded in the design process to ensure the best value for money. WLA is a tool, a technique to help make better decisions where options are being considered. It also involves planning to identify which aspects of a facility need to meet performance and maintenance requirements.

Throughout the whole WLA process, communication is essential to ensure that all parties are aware of the assumptions made about the in-use environment, the maintenance requirements and the cost limits.

Start the WLA process early on new build projects. Refurbishment and maintenance of existing facilities require a different approach; start with an estimate of the stock condition.

1.7 What is the link between best value and best price?

Best value should drive every decision. Best price may be attractive in the short run, but it will not necessarily deliver the best facility. Any system that gives an increased service life for lower whole life cost should be welcomed. A higher initial investment may provide greater long-term benefits with reduced maintenance and operating costs.
1.8 Nobody can accurately forecast the future, so how reliable are the results of a whole life appraisal exercise?

Whole life appraisal does not guarantee accurate forecasting. All methods of calculating future costs involve estimates and best guesses; WLA is no different. Be clear about the term ‘accurate’: accuracy relates to the data available and the ability to measure costs, revenues and performance. Reliability is a better term; it reflects some level of confidence placed on a forecast/estimate. Some information is better than no information about the future; as John Maynard Keynes said ‘it is better to be almost right than precisely wrong’.

1.9 How can money spent at different times over the life of a facility be incorporated into WLA?

The discount rate is the main tool for taking tomorrow’s money into account. Money in the future is not the same as money today; it has a time value. All future money is discounted (reduced in value) by applying a discount rate selected specifically for the appraisal. Discounted present value or present costs should not be confused with real money.

1.10 What discount rate should be used?

The discount rate has two important functions. First, it enables future costs over a time horizon to be brought to a present value (PV) using standard accounting techniques; in effect it is an exchange rate that converts tomorrow’s cost and revenues back to today. Second, by converting costs that occur at both regular and irregular intervals to today, it is possible to compare different options on a comparable basis. Not everybody uses the same discount rate; it varies between organisations. The discount rate is crucial, because if a very high rate is chosen it will swamp all other decisions. The higher the discount rate, the lower the impact of future expenditure. Methodologies for discounting future costs, such as Internal Rate of Return (IRR) and Annual Equivalent Cost (AEC) are discussed later in the book.
1.11 How is inflation taken into account in the calculations?

If future costs in the analysis are expected to rise during the whole life, it is important to include the effects of inflation or escalation in the whole life cost appraisal (see Chapter 5), and to differentiate between a ‘nominal’ and a ‘real’ discount rate.

‘Nominal’ is the discount rate set by the organisation; it may be the bank overdraft rate, the bank interest rate for borrowing, or the weighted average cost of capital. The ‘real’ rate takes general inflation into account by adjusting the discount rate (this is discussed later).

A number of approaches are possible:

- General inflation may be considered in setting the discount rate, thus producing a ‘real’ rate that takes into account both inflation and discounting of future costs.
- If a ‘real’ discount rate is not used, each of the costs over the life in the analysis should be escalated as necessary before the discount rate is applied to them.
- Even where a ‘real’ discount rate is used, it may be necessary to apply differential cost escalation factors to costs that are rising (or falling) faster than the general inflation rate. A common example is the costs of energy – even if say a 4% discount rate is chosen to account for the general effects of inflation, it may be necessary to think of energy costs as escalating 3%, or 5%, or 10% faster than the general inflation rate.

However it is done, it is important to make careful assumptions about inflation and rising costs. If a real rate is used (say, inflation of 3% per year) then its effect becomes greatly magnified if the analysis covers a number of years. Since future inflation and escalation rates are, by definition, estimates, it is important to carry out some ‘sensitivity’ testing to make sure that assumptions about inflation are not skewing the results of the analysis.

1.12 Why isn’t WLA used more widely?

There are a number of reasons for WLA not being used widely, namely:
- Availability of reliable data on costs and performance, that is relevant, reliable, up to date, cost effective, and can be tested.
- Lack of awareness of the importance of future costs/values.
- Concern over the uncertainty surrounding forecasting future events over the life of a facility and its components.
- The tradition of separating construction and maintenance costs.
- The complex and theoretical relationship between money now and money spent or received in the future.
- The diverse nature of the industry’s clients, with very different motivation.
- The long time lag between the design process and data becoming available on the running costs of the project in use, with the data structured in a useful format.
- The natural concentration by construction consultants on services for which they are paid and, therefore, those in demand.

### 1.13 So why bother now with WLA?

In the UK, the Private Finance Initiative (PFI) means that some projects are procured on a design, build, finance, and operate basis over a concession period of, say, 25 years. The company formed to build and operate the facility is responsible for the

The aim of PFI is to secure private sector funding for major building projects, such as schools, hospitals and roads, which would traditionally have been funded by the public sector, either through tax and other state revenue and/or public borrowing. Under PFI, a private sector consortium – normally made up of a construction company, a bank or financier, a facilities management contractor and consultants – finances the capital costs, carries out the construction of the project, provides for its long-term maintenance and manages the support services, in return for a stream of income over a number of years related to the use made of the project. In order for the scheme to be attractive to the private sector, a satisfactory level of profit is guaranteed. In the case of a school being built by PFI, the government pays the consortium a regular fee for the use of the school, which covers the construction costs, the rent of the building, the costs of support services and a profit element to offset the risks transferred to the private sector.
operating costs over the concession period. Therefore, whole life costs and performance are crucial.

Similarly, the various forms of build, operate and transfer (BOT) schemes throughout the world also give the responsibility of operating a facility to the team that designed, financed and built it. Whole life considerations have become crucial, not only in economic terms, but also because of environmental issues and the concepts of sustainability.

1.14 Has the computer made a difference to the calculation of WLA?

Computers have transformed the management and manipulation of data. Databases, statistical packages, search engines, spreadsheets and simulation have all made a difference to WLA. The internet and web portals mean that data can be moved in real time. Manufacturers’ data on performance can be downloaded electronically on to a computer and used in an appraisal. The cost, speed, and availability of computing power enhances the use of WLA.

1.15 What has happened overseas?

- Sweden has extensively used WLA for public sector projects; it has a whole life culture.
- Japan has a WLA policy for public sector expenditure.
- Australia requires public sector projects to have a whole life appraisal.
- Where the USA has influence, whole life is on the agenda. Some South American countries are looking into whole life issues.
- Developing countries are so short of cash that whole life considerations are not part of the equation. However, on internationally funded projects such countries are forced to justify the project on a whole life basis. The World Bank requires all investment appraisals to include a WLA before the project is financed.
- There has been a move to provide guarantees on projects, beyond the defects liability period. Selling guarantees is
becoming good business, but it requires an understanding of whole life issues.

- Facilities and asset management is a growing industry with a much better view on whole life costs and performance.
- BOT is growing in use to procure many types of projects, hence WLA is an important part of balancing the initial capital cost with the whole life cost.

1.16 The whole process seems to be surrounded by jargon; how can WLA be made simpler to understand?

Common sense must prevail. Discounting can be confusing; however, the underlying concept is very straightforward: money has a time value. Take the approach on a step-by-step basis. Running costs is the term used to describe all the operating and maintenance costs of an asset over its life.

1.17 Where does sustainability fit with WLA?

Business and projects must be sustainable. Twenty years ago there was little awareness of the importance of sustainability; now it is high on everyone’s agenda. Sustainability means thinking about how a project affects the environment, now and in the future. There needs to be an increased use of materials that can be reused and recycled, a reduction in waste and emissions and more use of renewable energy alongside energy efficiency measures. The effect of sustainability on the whole life of a project means that it is best integrated into the design process. However, this does not preclude making decisions based on sustainability in the repair, maintenance and refurbishment processes.

1.18 Have the Construction Design and Management Regulations (CDM) 1994 changed the way whole life issues are considered?

The CDM Regulations (HMSO, 1994) in the UK place a duty on clients, designers and construction personnel to consider health and safety hazards during construction and maintenance. Regu-