What is the Purpose of this Document?

This guide note reminds design teams of the key considerations affecting the service life of buildings, their associated component assemblies, including engineering services, plant and materials. Together these considerations help provide guidance in determining the design life necessary to meet the business service requirements and set the tone for a building’s life cycle performance.

Key Strategic Objectives

ISO 15686-1:2000 Building and Constructed Assets – Service Life Planning Part 1: General Principles provides technical guidance which states that, ‘Service life planning is a design process, which seeks to ensure, as far as possible, that the service life of a building will equal or exceed its design life, while taking into account (and preferably optimising) the life cycle costs of the building.’ (ISO 15686-1:2000)

From a holistic perspective, the process of deciding an appropriate service life for a building is a complex matter that attempts to integrate a number of key strategic objectives:

• Meet the business service requirements of the organisation / client;
• apply effective asset management principles to optimise performance and forecast the costs of ownership over the building life; and
• meet integrated, sustainable development principles.

Finding a successful balance between these key strategic objectives will depend on the prevailing contextual nuances unique to each situation. Important aspects of these objectives are outlined below:

Business Service Functions

Buildings form part of an organisation’s service delivery strategy along with other resources (e.g. people, finance, information and technology). Buildings must therefore meet current business service functions and as far as practicable, be sufficiently adaptable to accommodate future changes in business service direction.

Changes over the life of a building can also result in various forms of obsolescence borne out of the inability to satisfy changing functional, technological or business factors. As a consequence these changing circumstances may trigger a re-evaluation of the nature and purpose of the building and its service life.

External Market and Community Influences

In addition to an organisation’s internal business drivers, a building’s service life may be impacted by a range of external influences such as the changing market in which it operates, or changes in social and economic conditions.

Consider, for example, the nature of the market within which the building is required to deliver service outcomes. This may be driven by either commercial or public sector imperatives.
Commercial Life Considerations

In the commercial property market financial planning horizons may typically operate over a modest building life span of 40-60 years, governed by shorter term, financial imperatives rather than by longer term, service life considerations.

Public Sector Building Considerations

On the other hand, public buildings such as courthouses, hospitals and schools are driven more by community service needs than commercial imperatives, and longer service life timeframes are more likely to be considered.

Ecologically Sustainable Development

Ecologically sustainable design requires that service life considerations be integrated in the design process to reduce the environmental impact by encouraging the conservation of finite resources and the selection of appropriate materials and construction methods. This philosophy points to buildings that have a long service life that minimises the drain on resources and the attendant environmental effects from the impacts such as the level of embodied energy to the emission of harmful and potentially volatile organic compounds (VOCs).

In response to the multitude of factors that influence the service life of a building, the flexibility or adaptability of a building can be a critical determinant of its ultimate life span. This allows it to respond to changing business requirements. It is similarly important to design for deconstruction, and maximise reuse and recycling, particularly when the building is not likely to stand for a long time for one reason or another.

Life Cycle Cost Considerations

Having negotiated the various internal and external business drivers, an important objective, “will be to ensure that the most advantageous combination of capital, maintenance and operational costs is achieved over the life of the building.” (ISO 15686-1:2000)

A major incentive for planning the service life of the building and components is that it helps determine the total cost of ownership. Estimating the future cost of running and maintaining a building provides organisations with a profile of the cost of ownership and sustainment over its life, thereby assisting their business planning and risk management.

Predicting Service Life

Due to the number of disparate influences and the inherent variability of buildings, their environment, workmanship and future maintenance management, it is rarely possible to forecast service life with any degree of certainty. The objective then becomes one of making an appropriately reliable forecast of the service life using available data. One of the outcomes of service life planning will be a sense of the expected service lives of components and a projection of the associated maintenance and replacement needs and timings.

In terms of the physical building, the length of the service lives of the envelope, components, assemblies and materials is determined by two key factors. The first is the extent to which the differential service lives of the various components, assemblies and materials are harmonised, and the second relates to a host of agents that can impact on their durability.

\[\text{1 Table 1 - Suggested Minimum Design Lives for Components (from ISO 15686-1:2000) based on their accessibility for maintenance.}\]
Harmonise Component Service Life Replacement

Buildings are an amalgam of components and assemblies comprised of a broad palate of materials, each with varying service lives. The issue for service life planning is to ensure that components with shorter service lives can be easily replaced.

Impact of Degradation Agents on Durability

In terms of the physical building, service life is a function of the durability of the materials, components, assemblies and systems, and their ability to withstand a host of agents that cause deterioration or degradation over time.

Consider for example, mechanical sources such as wind, traffic vibration, or the action of water, heat, solar radiation, chemical reaction and biological forces, all of which can act both separately and in combination.

The severity and frequency of these degradation agents (e.g. cycling from wet to dry, through to freezing, or between hot and cold temperatures or exposure to salt spray) have a bearing on the durability of the building envelope, its components, assemblies and materials and therefore the likely length of service life.

Given the many determinants affecting the physical life of the building envelope, components, assembles and materials, implementation of an effective and efficient sustainment strategy including maintenance, operation and replacement actions is critical to countering the effects of degradation and realising the intended service life.

For very long design lives (e.g. for important state buildings) the level of maintenance and ease with which it can occur is likely to significantly influence the service life. If the service life of an essential component is less than the design life of the building, it should be replaceable or maintainable.

Service Life Forecasting Methods

ISO 15686-1:2000 makes reference to two methods of forecasting a building’s service life. One is based upon knowledge of the predicted lives for all the material, components and assemblies forming the building and the other is based on applying a series of modification factors to reference service lives. Appendix 1 Service Life Forecasting Methods outlines these two approaches.

Optimising Service Life through Integrated Building Design

Decisions critical to the service life should be taken at the earliest stages of design when the design team is best placed to influence the built form and life cost.

The skill and expertise of the design team undertaking the building service life planning will be crucial to meet the stated key strategic objectives. The process will need to integrate the complexities of these objectives and deliver a built form to accommodate the service functions in an enclosed, controlled environment.

Furthermore, planning for a building’s service life requires consideration of the likely performance of the building over the whole of its life within the context of the many influences previously outlined.
Service Life Planning Considerations for Buildings

The design team is therefore faced with the challenge of including consideration of and making judgement about a broad range of factors affecting performance and hence service life including:

- the contextual market, business and social environment;
- high performance, innovative design;
- flexibility, adaptability and disassembly;
- material selection;
- construction & assembly detailing;
- ease of construction;
- skill & quality of on-site installation;
- usage, operation and maintenance;
- obsolescence; and
- life cycle costing.

Attachments

- Table 1 - Suggested Minimum Design Lives
- Appendix 1 - Service Life Forecasting Methods

Contact

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References

Athena Institute, ‘Building Service Life and Green Building Rating Systems’, April 2006
Service Life Planning Considerations for Buildings

Table 1

<table>
<thead>
<tr>
<th>Building Design Life</th>
<th>Inaccessible or structural components</th>
<th>Components where replacement is expensive or difficult</th>
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Note that:
- Easy to replace components may have design lives of 3 or 6 years
- An unlimited design life should very rarely be used as it significantly reduces design options.

Table 1 gives suggested minimum design lives of components for particular design lives of buildings, based on their accessibility for maintenance. It is included to give a starting point for discussions about appropriate design lives, but should not inhibit choice of design lives for appropriate economic reasons.
Appendix 1

Service Life Forecasting Methods

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Predicted Exposure Evaluation Method

According to ISO 15686-1, a forecast service life is referred to as the ‘predicted service life’ if it is based on procedures which usually involve tests to determine length of service life for a specific material, component or assembly.

Provided the conditions are known, relevant and complete, at least for the most important degradation agents, a service life prediction derived from exposure and performance evaluation is possible, but accessing a comprehensive and reliable data set is problematic.

Factor Method for Estimating Service Life

Rather than relying on the availability of empirical evidence another approach makes use of a reference service life that can be adjusted to reflect local, project-specific factors. This is referred to as the ‘estimated service life’.

This method allows a series of modifying factors to be applied to an estimate of the service life to be made for a particular component.

Factors less than 1 reduce the estimated service life and factors greater than 1 increase it.

\[
\text{ESLC} = \text{RSLC} \times \text{factor A} \times \text{factor B} \times \text{factor C etc.}
\]

Where:
- \( \text{ESLC} \) - Estimated Service Life of Component or Assembly
- \( \text{RSLC} \) - Reference Service Life of Building

The ISO Factor Method of estimating service life is based on the following seven factors:

A. Quality of materials
B. Design level of a component’s or an assembly’s installation
C. Installer skill level
D. Indoor environment
E. Outdoor environment
F. In-use condition and
G. Maintenance level.