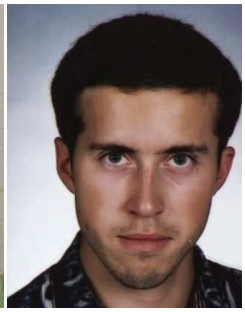
AIMING AT SUSTAINABILITY BY USE OF LIFE CYCLE COST ASSESSMENT IN DECISION MAKING IN PLANNING AND DESIGN OF NEW BUILDINGS AND IN REFURBISHMENT

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Summary

Life Cycle Cost Assessment could be a comprehensive tool used in analysis of alternatives and for decision making aiming for more sustainable buildings. The analysis is particularly of interest in early stage of the planning and design, before the major decisions are taken.

LCC as efficient tool requires available and reliable input data for the analysis, which can be statistical information, key numbers, generic information, or further in the process more and more specific information for the building or refurbishment project.

Keywords: LCC, decision making, optimisation, planning, design, sustainability

1 Introduction

Sustainable buildings take aim at the minimisation of resource consumption, focusing on energy, and emissions and environmental impact during the whole life span of the building. Decisions for achieving these goals are made in all phases, as in planning, construction, operation, renovation and demolition. Other environmental and social issues, human health and well-being are also taken into consideration.

In order to achieve these goals and to optimise the total costs during the life-cycle of buildings, instruments like Integrated Planning and Life Cycle Cost Analysis (LCCA) need to be established during the planning process for new constructions and for building refurbishment as well.

The LCC Analysis takes the investment costs and costs in operation (e.g. energy, maintenance, cleaning) of all phases into consideration. As the operational costs make up the main part of the total costs over the whole lifetime of a building, the comparison of the LCCs of different scenarios creates the necessary (cost) transparency for the decision-making process.

Operating, maintenance and rehabilitation costs of new and existing facilities amount to more than 80 % of the total life-cycle costs. The majority of decisions about these costs are predetermined at the design stage. The opportunities to modify or influence these decisions diminish as projects progress through their natural process of development. Hence, risks and consequences of these decisions on the total cost of ownership of assets must be considered and planned. This is why it is important to establish a mechanism that brings together the life-cycle cost, service life and environmental life-cycle assessment.

LCC as efficient tool requires available and reliable input data for the analysis, which can be statistical information, key numbers, generic information, or further in the process more and more specific information for the building or refurbishment project.

Many projects the last years, both national and international, have focused on increased use of LCC in planning and decision making, and some of the discussions and results from these projects will be presented.

2 Life Cycle Cost and Performance requirements

ISO TC59 SC14 Design life has developed a standard, ISO/DIS 15686-5 “Buildings and constructed assets – Service life planning Part 5 – Life cycle costing”[1], which has the following definitions for LCC:

Definitions used in this
- Life Cycle Costing: A technique which enables the systematic appraisal of life cycle costs over a period of analysis, as defined in the agreed scope.
- Life Cycle Cost: Assessment expressed in monetary value taking into account all significant and relevant costs over the life cycle, as defined in the agreed scope. The projected costs are those needed to achieve defined levels of performance, including reliability, safety and availability over the period of analysis.

The performance requirements for the building are defined by different stakeholders, which requirements may also be opposed. The client or building owner has to decide, which performance requirements to fulfil, and the LCCA will show some of the consequences connected to the set of requirements. An important task is the translation of client and user requirements into performance requirements that are objective and measurable.

Using LCC in planning and decision the cases to be analysed always have to fulfil the performance requirements.

3 Use of LCC in construction

LCC may be applied in a wide range of circumstances in construction, for example in a project to invest in:
- A single complete constructed facility such as a building or civil engineering structure
- An individual component or assembly within a facility
- A portfolio comprising a number of facilities.

LCC may also be applied in the context of existing constructed assets, for example as a means of assessing future operational budgets or for evaluating refurbishment and renewal options.

The period of analysis adopted when looking at LCC may similarly vary. LCC may be employed to inform decisions throughout the complete life cycle of a constructed asset or for a selected limited period within it. However, irrespective of how or when LCC is applied, the core evaluation process remains the same.

3.1 Use of LCC in decision making in construction and refurbishment

The SAVE project LCC Refurb Integrated Planning for Building Refurbishment Taking Life-Cycle-Costs [2] into Account was focusing on use of the experiences with integrated planning and LCCA in new construction, and transfer this know-how – methodological as well as organisational – to comprehensive building refurbishment. An important issue was drawing up decision processes that make sure that LCC are taken into account in the different stages of the planning process.

The SAVE project LCC DATA "Life-Cycle-Costs in the Planning Process. Constructing Energy Efficient Buildings by Taking Running Costs into Account" is focusing on achieving more standardised and available input information for doing LCCA in construction projects, especially in early design phase.

One main result from LCC Refurb was that many building owners, architects and engineers lacked the knowledge of use of LCC, and that they found it difficult to find appropriate input data as different kinds of future costs for their assessments. Later in the planning process more decisions were taken, and more accurate input information were available, but on the other hand, all important decisions were taken and it was difficult to change anything even when the LCC showed that it would be economically better to make other choices. A conclusion from this was to try to make input information available on an early stage, which is the goal of LCC Data.

3.2 LCC in European context

In 2006 the European Commission appointed Davis Langdon to develop a common European methodology for Life Cycle Costing (LCC) in construction. The origins of the project lay in the Commission's Communication 'The Competitiveness of the Construction Industry' and, more specifically, in the recommendations of the Sustainable Construction Working Group established to help take forward key elements of the Competitiveness study. These recommendations proposed that a Task Group (TG4) should be established to prepare a paper on how Life Cycle Costing could be integrated into European policy making. The Task Group recommended the development of a common LCC methodology at European level, incorporating the overall sustainability performance of building and construction. The project was undertaken in recognition that a common methodology for LCC in construction is required across Europe in order to:

- Improve the competitiveness of the construction industry
- Improve the industry's awareness of the influence of environmental goals on LCC
- Improve the performance of the supply chain, the value offered to clients, and clients' confidence to invest through a robust and appropriate LCC approach
- Improve long-term cost optimisation and forecast certainties
- Improve the reliability of project information, predictive methods, risk assessment and innovation in decision-making for procurement involving the whole supply chain

- Generate comparable information without creating national barriers and also considering the most applicable international developments.

It was recognised early on in the research process that LCC is applied in various ways and with differing parameters across the EU, and that a single prescriptive methodology would not be appropriate. Therefore the goal was changed to provide a methodological framework for the common and consistent application of LCC across the EU without attempting to replace country-specific decision models and approaches.

3.3 Nordic Innovation project

The Nordic project LCC for Building and Constructions run 2002-2004, with the main goal of establishing a joint Nordic classification system for life cycle costs (LCC) [3]. The system should ease the benchmarking of key numbers within the building and real estate industry which will increase continuously within these markets.

4 LCC in decision making in planning and design

4.1 Methods and tools

Many different tools are available, but no standardised methodology or methods are used. Methods differ from software to software and country to country. Basically all software deal with costs, time and interest rate, giving results in Net Present Value or Net Present costs, while other options are available, as Annual Cost or Annual Equivalent Value, or Payback. Being able to have solid grounds for the decision making, additional software tools are often needed for environmental assessments, energy calculations, check of fulfilment of performance requirements etc.

Different tools could be used, but they have to fit the purpose of the LCCA, and necessary input data has to be available.

4.2 Available input data and sources of information

LCCA at design stage are depending on available input data. Costs based on experiences, statistical information as key number, may be used as input. A well defined classification system for the categorisation of expenses and other input data is important for a successful collection of information, and hence credible (credibility is one of the most important attributes of the LCCA-utility awareness process aimed to building owners) and easy use of LCCA.

Key numbers may be found from statistical treatment of collected data. For instances energy use or energy costs per sq. m., cleaning costs per sq. m., or cost used for management or maintenance for different building categories (function and age). If building information, as type of heating system, cooling system, etc are available, the ground for making, and then using key numbers as basis for LCCA for decision making are improved.

Key numbers may also be used for benchmarking, as all users may compare their actual data with the collected data, and hence know how their use and management of the building is effective in comparison to others.

For a well defined cost classification system some basic factors are essential:
- Every item has to be well defined at each cost level so that it is clear and significant in order to facilitate the decision making process,
- Different users can subdivide the different costs on a two or three number level.

Investment cost for different actions, i.e. new installations, repairs or refurbishment, could be found from different sources:
- Experience data from other projects,
- Information from supplier or other actors.

For LCC-calculations information of service life, life time, or maintenance periods are an important input. For building products the supplier should give the necessary information. This information should be compared to experience. Maintenance costs may be given by suppliers, or collected from experience. Collected key numbers might be of significant use. When working in early design phase using key numbers or statistic information the need for service life information is partly removed.

5 Conclusions

More focus on LCC will increase the availability of comparable input data and methodology used for calculations. This will also strengthen the quality of the analysis and the certainty of the results, making the LCC more useful in decision making for more sustainable buildings.

References

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