

An Integrated Model for Life-Cycle Cost Analysis

René Sigg, Dipl. Ing., NDS Umwelt Univ.
Managing Director, Intep – Integrated Planning, IFMA Switzerland Board Member

Life-cycle cost (LCC) analysis supports an integral approach whereby cost information on all the life-cycle phases of a property are fed into the financial decision-making processes. To promote its application, IFMA (International Facility Management Association) Switzerland has developed a model plus associated LCC analysis tool. This allows comparisons between different design options in terms of a wide variety of parameters and highlights their implications for investment decision-making.

Economic sustainability

A precondition for sustainable real estate management is that investment decisions are taken in full knowledge of the life-cycle costs. The balanced view of property development achieved by LCC analysis thus eliminates the risk of one-sided optimizations, e.g. to reduce initial investment costs. To this end, IFMA Switzerland has developed a life-cycle costing model, plus associated tool, for real estate applications, which also supports one of the design objectives ("life-cycle costs" criterion under heading "viability") that can be explicitly agreed between clients and designers under Swiss Recommendation SIA 112/1 "Sustainable construction – buildings" ("Nachhaltiges Bauen – Hochbau").

Moreover, various sustainability certification systems, such as the label awarded by the German Sustainable Building Council, also require verification of life-cycle costs. For the above-mentioned label, the "life-cycle costs" criterion has a strong weighting and thus a major impact on the grade of the awarded certificate: low life-cycle costs are a key prerequisite for achieving the highest "gold" rating.

Proof of life-cycle cost optimization can also earn buildings vital additional credits in the Innovation in Design category of the internationally recognized LEED (Leadership in Energy and Environmental Design) certification system. Here, additional innovation points are essential for achieving the top "platinum" rating.

Model with LCC analysis tool

IFMA (International Facility Management Association) Switzerland and GEFMA (German Facility Management Association) have jointly developed a life-cycle costing model for real estate. The resulting publication is in two parts: the first ("Model") covers the fundamentals, while the second ("Application") describes an Excel-based analysis tool, which is included in the package. Academic supervision was provided by Prof. Dr. Andrea Pelzeter from the Berlin School of Economics and Law (BSEL).

Key methodological elements are based on development work in the field of life-cycle costing carried out by the City of Zurich. As part of the City of Zurich's Policy Area 3 "Sustainable design, construction, facility management", in fulfilment of Legislative Priority 4 "Sustainable City of Zurich – on the way to the 2000 Watt society", a detailed analysis was performed on the construction costs and cost-in-use of seven municipal properties, and the associated benchmarks derived. Following further refinement, the resulting life-cycle costing method now serves as an important mechanism for the integration of sustainability criteria in municipal new-build and refurbishment projects.

The life-cycle costs are estimated using the net present value (NPV) method. This method factors the time value of money into the life-cycle costs by discounting future payments back to their value at the base date. The capital value of the life-cycle costs is equal to the aggregate net present value of all payments. The capital value can also be used to calculate a uniform annual payment over the period of analysis, referred to as the equivalent annual cost (EAC). To determine the life-cycle costs, various computational parameters such as discount rate, general inflation rate and specific inflation rate need to be defined. The assumptions made for these parameters have a major impact on the results.

The LCC-related definitions applied in the IFMA model are based on international standard ISO 15686-5 "Life-cycle costing". The life-cycle costs cover all expenditure from project development to deconstruction/demolition. The life-cycle cost groups applied in IFMA Switzerland's model are as follows: construction, management, insurance, utilities and disposal, security and surveillance, cleaning and care, inspection, building and grounds maintenance, repair and refurbishment. All costs are therefore directly related to the property. No allowance is made for any other user-related costs, e.g. for particular services needed by the building occupants.

Design optimization

The scope for influencing life-cycle costs is at its greatest during the early design stages of a development project. The LCC analysis tool provides for the estimation and optimization of life-cycle costs in the following phases: Project Definition (sub-phase 21 to SIA 112 service model), Project Competition (sub-phase 22 to SIA 112 service model) and Outline Proposals (sub-phase 31 to SIA 112 service model). The input parameters required by the tool are designed to reflect the state of knowledge at the specific design stage, and so comparable results are obtainable at each phase despite the differences in the amount of project information available. While the investment costs posted in the tool are based on an estimate using the Swiss eBKP-H building cost classification, the cost-in-use entries are derived from empirical benchmarks and cost-group-specific computational algorithms using a "bottom-up" approach. The example in Figure 1 shows the annual dynamic costs, based on a 30-year period of analysis, for an office building with an approximate gross floor area of 7,200 m².

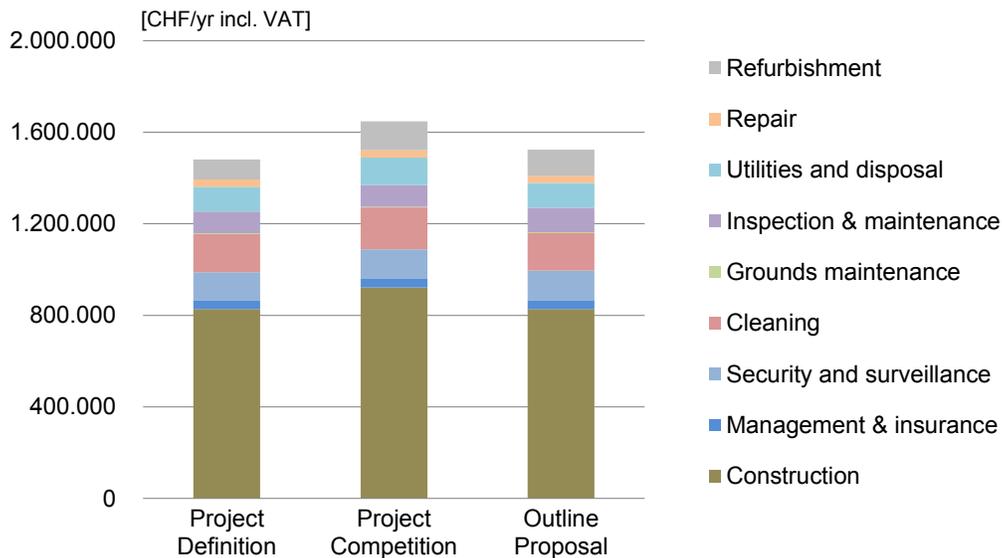


Figure 1: Comparison of annual dynamic costs in early design stages for an office building

Comparison of project competition entries

In the case of project competitions, the outcome of a comparative LCC analysis for the individual entries may prove to be a key decision-making factor. The LCC analysis tool is applicable to the following occupancy types: old people's/nursing homes, production, research and laboratory buildings, schools, hospitals, shopping centres, office and administrative buildings, apartment buildings.

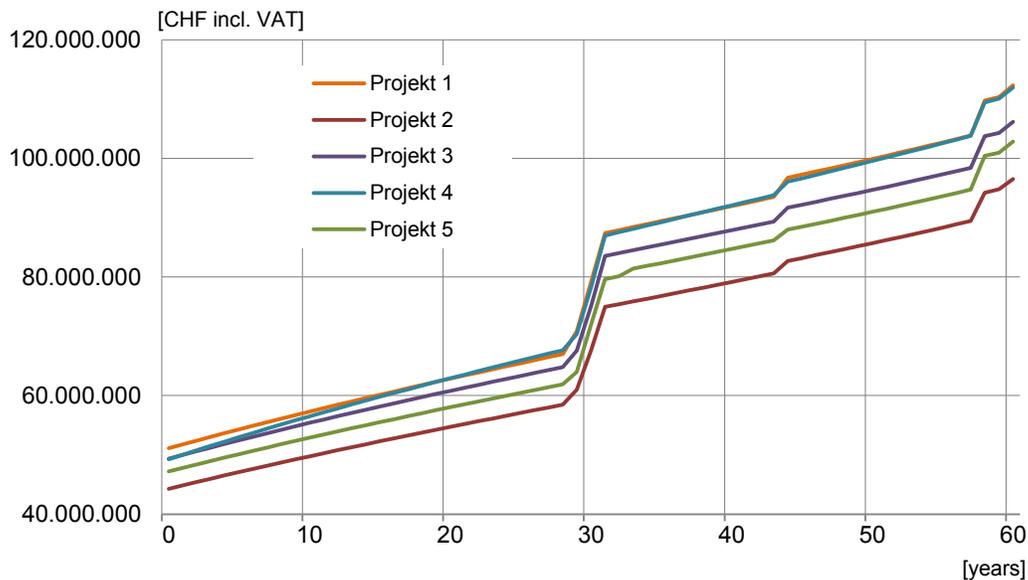


Figure 2: Life-cycle cost profiles over a 60-year period of analysis for five competition entries

Figure 2 shows life-cycle cost profiles, over 60 years, for five school projects in a competition. Clear differences emerge between the cost patterns for the various schemes during the 60-year period, starting from the construction costs incurred in Year 1.

In a similar way, LCC analyses can also be used as a criterion for comparing design options – even where the proposed buildings are based on completely different concepts. In such cases, additional investment can be shown to pay off in the long term where, at the end of the period of analysis, the extra initial expenditure results in lower life-cycle costs than for the standard variant.

Transparent budgetary planning

For private and public-sector institutions with large property stocks, LCC analyses and the identification of cost drivers pave the way for the budgeting and optimization of repair and refurbishment costs. Figure 3 shows the refurbishment costs for building fabric and building services (i.e. mechanical and electrical) installations over an 80-year period of analysis, based on a static (non-discounting) model and assuming standard service lives for the building components. The building services installations can be clearly seen to account for a major share of refurbishment costs in the first 30 years.

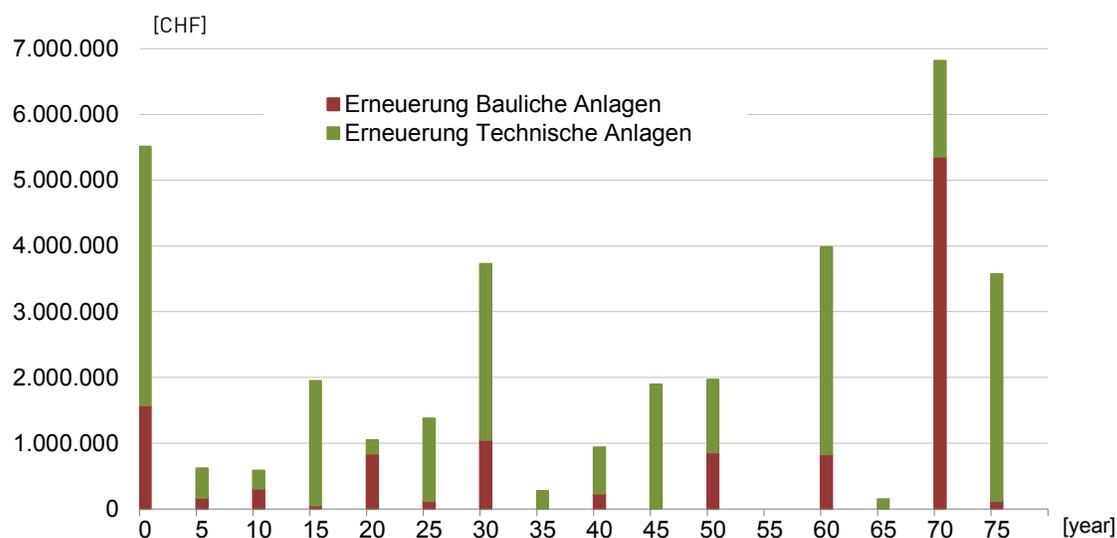


Figure 3: Refurbishment costs for building fabric and services installations over an 80-year period of analysis

Inevitable forecast uncertainty

The assessment of forecast uncertainty surrounding the future events in a property's life-cycle is an inescapable part of any LCC analysis. The analysis results depend on the applied discount rate, the anticipated cost trends (e.g. for energy) and the assumed service lives of the incorporated components. The performance of sensitivity analyses or the investigation of best- and worst-case scenarios offers useful support in the interpretation of results.

Twinking the cost profile

As the above discussion shows, LCC analyses are presented differently according to their purpose. Of more or less universal interest, however, is the question as to how life-cycle costs can be influenced and what factors act as cost drivers and cost cutters for the LCC of properties. The scope for influencing life-cycle costs is at its greatest in the strategic planning phase of project.

Key factors amenable to optimization include the construction costs, layout flexibility and adaptability to varying use requirements, favourable constructional and logistical conditions for cleaning, a straightforward and appropriate building services (M&E equipment) concept coupled with easy access to the associated components and installations, a long service life for components and systems, plus a high energy standard. Other variables influencing life-cycle costs are, on the other hand, under the control of other players. These factors may, for example, include occupancy-specific service requirements, facility management service levels, hourly rates for internal and external services etc. This makes it all the more important for facility management issues and past experience from building operation to feed into the design process at an early stage. Swiss Recommendation SIA 113 "FM-compatible building design and construction" ("FM-gerechte Bauplanung und Realisierung") provides a useful framework in this regard.

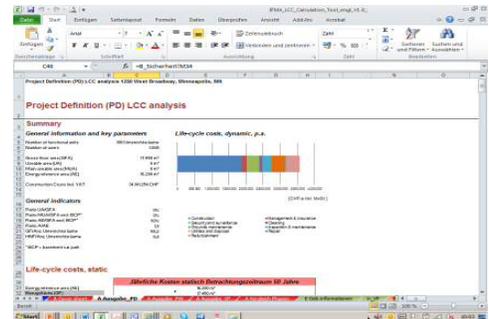
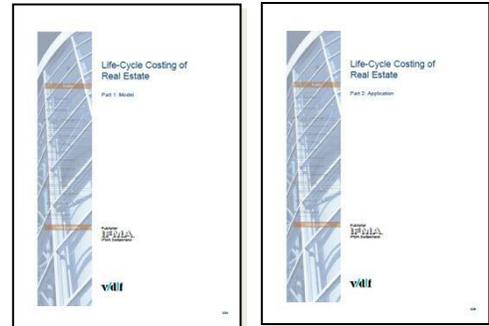
Given the extremely long period of time during which properties incur costs, life-cycle cost optimization at the design stage can bring about significant long-term savings that may justify higher construction costs. The life-cycle costing model for real estate developed by IFMA Switzerland lays the foundation for pinpointing and exploiting this potential.

Life-Cycle Costing of Real Estate

This publication, complete with LCC analysis tool, targets all property professionals who act as decision-makers or are involved in the design and optimization of entire buildings or individual parts and systems. These include property owners, investors, developers, designers, consultants, building contractors and facility managers.

Part 1 of the publication ("Model") starts by discussing the application of and background to life-cycle costing, before focusing more closely on key determining factors – specifically, the period of analysis, system boundaries, forecasting approach, computational method and parameters. It then proceeds to give recommendations on the management of forecast uncertainty and assessment of analysis results.

Part 2 ("Application") comprises an easy-to-use, Excel-based life-cycle costing tool, which is equally suitable for new-build and modernization projects. The applied computational parameters and benchmarks can be adapted to the specific property features.



Project partners

Amstein + Walthert AG; Robert Schneider | armasuisse Immobilien; Markus Klopstein | Canton of Zurich Planning Authority – Real Estate Department; Hans-Peter Huber | Swiss Federal Office for Buildings and Logistics; Daniel Koller | F. Hoffmann-La Roche AG; Hanspeter Suter | Implenia AG; Bret Kraus | Intep - Integrale Planung GmbH; René Sigg | Liegenschaften-Betrieb AG; Reto Bühler | pom+ Consulting AG; Thorsten Busch | PSP; Thomas Kraft | Roche Diagnostics; Felix Schleuniger | City of Zurich Public Buildings Department and Finance Department; Ian Jenkinson

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