Too often, project decision-making is focused on achieving the lowest initial construction cost. It is important, however, to also consider the operational costs incurred throughout the life cycle.

Life Cycle Costing shows the real cost of building and owning.

Optimising the balance between construction and long term operational costs, for example by implementing energy efficient design solutions, helps us provide best value for the owners and users of our assets. Life Cycle Costing is an essential tool to achieve and help communicate these shared value enhancements.
Skanska has developed an in-house Life Cycle Cost Optioneering (LCCO) technique to identify the optimal design solutions (those providing the best long term value for money). It involves assessing alternative design options against project-specific criteria, which can be weighted depending on their importance to the project. As part of this process, we develop comparator models to evaluate the initial capital cost in addition to the long term operational costs over an asset’s life to identify the options with lower life cycle costs.

The terms

**Life Cycle Cost (LCC)** is the cost of a product, asset (e.g. building, power plant or road) or process throughout procurement, construction, operation, maintenance and/or replacement and disposal. Life Cycle Costing is an economic evaluation technique using LCC.

**Whole Life Cost (WLC)** is often used interchangeably with LCC but specifically includes wider costs such as land acquisition costs and income generated from rental etc.

**Life Cycle Assessment (LCA)** is not to be confused with LCC. This is an assessment of the environmental impact of a product or service from cradle to grave. For example, LCA can be used to calculate the total amount of both embodied and emitted carbon.

**Efficient lighting at Maple Cross, UK**

Our LCCO tool was used when considering energy efficient lighting options during the greening of our UK head office, Maple Cross. A life cycle cost comparison of the existing lighting and new LED light fittings showed us that whilst the existing lighting incurred no initial costs, their total life cycle cost was USD1.4m (SEK9m). The LED lighting option had an initial cost of USD494,000 (SEK3.2m) but a much lower operating cost of USD443,000 (SEK3m). The result was a 35% cost saving of USD505,000 (SEK3.3m) over the 20 year evaluation period with an expected payback of 8-9 years.

I look forward to the day when life cycle thinking becomes business as usual in the design and construction industry. For example, when energy efficiency and ongoing maintenance is considered from the early stages of the building design.

Niina Rajakoski
Construction Manager, Ilmarinen, a leading Finnish pension insurance company

Taking a long term view can deliver significant financial and environmental benefits. Using life cycle or whole life costing tools enable a holistic approach to project decision-making that considers the cost and environmental impact of materials, equipment and technology not only now, but in the future.

Life Cycle Costing also provides a better understanding of risk and helps Skanska to identify opportunities for exceeding customer expectations.

*Niina Rajakoski*

John Chick
Director, Cementation Skanska
Promoting green solutions

Often, design solutions with the lower LCCs are actually the greenest (due to consuming less energy and resources). The LCCO tool enables our project teams and customers to understand the long term financial and environmental benefits of these solutions. We're now also working with and supporting our supply chain partners in carrying out project alternative assessments using life cycle tools.

Life cycle cash flow modeling

The life cycle expertise we have developed also enables us to offer our customers cost forecasts for the long term maintenance and replacement of their assets. In existing facilities, this allows us to provide LCC and refurbishment cost estimates based on asset condition survey information.

Skanska uses Building Information Modeling (BIM) to help drive optimum LCC analysis. BIM is the process of generating and managing asset data through the whole life cycle, allowing for more accurate estimates and understanding of impacts and costs. This approach supports our aspiration to be the leading green contractor. It is supported by a goal set in 2008 by President and CEO Johan Karlström for all projects for which we have design responsibility to use BIM.

Life Cycle Fund Risk Management is about making the best maintenance and asset replacement decisions over a project's life cycle to enhance value for the owner. For example, by providing enhanced maintenance to a boiler, its useful life cycle could be extended, resulting in cost savings over the long term. This provides a huge market-making opportunity for Skanska construction businesses by leveraging their existing relationships with owners and developers.

Benefits for customers

- LCCO delivers overall cost savings, a key driver for its increasing uptake.
- LCCO gives customers an understanding of where the costs are and the options available to them.
- Demonstrates payback periods and return on investment (ROI).
- It reduces risk, particularly in longer-term projects and investments.
- The lower operational and maintenance costs delivered by LCCO contribute to increased value of buildings and rental incomes.

Benefits for Skanska

- Essential tool to achieve and help communicate green benefits and associated asset value enhancements, enabling our Journey to Deep Green™.
- Initially developed as a business driver for Skanska Infrastructure Development, LCCO is now becoming more commonplace in other parts of Skanska, with growing demand for the tool in conventional construction projects as well as long term contracts.
- With the help of BIM, LCCO promotes and drives a more integrated design approach which benefits the green performance of projects.
- Our leadership position in LCCO gives us a competitive advantage in PPP bids. We also use LCCO for promoting green market-making and developing new business opportunities.

Why do we do it?

Whole Life Cost = Construction costs + Operational, maintenance and replacement costs
Optimal Whole Life Cost = Value for Money
The LCCO Process

Preliminary design - LCCO is carried out with emphasis on assisting the team in making strategically important decisions.

Design - Once a short list of design ideas has been decided, calculations and analysis are refined to enable the ideas to turn into plans.

Construction - During construction it is important that procurement of items is in line with design specifications. LCC calculations are checked to ensure conclusions are still valid.

O&M (Operations and Maintenance) - During operation of the building, further LCC calculations are carried out to ensure optimization of the operation and maintenance plans.

Life Cycle Costing in Practice

Ecological Treatment System (ETS), UK

LCC assessments have been carried out to evaluate the implementation of an Ecological Treatment System (ETS) for contaminated surface water arising from depot operations within this Highways Agency maintenance project. By replacing expensive waste water disposal, the ETS can deliver both financial savings and reduced environmental impact. Our LCCO tool was used to compare the total LCC of the two options. The results have demonstrated that whilst the disposal option has no initial costs, its LCC due to maintenance is higher. With no operation or maintenance costs, the ETS will deliver a 38% cost saving of USD156,000 (SEK1m) compared to the wet waste water disposal option.

Härmälänranta, Finland

We undertook Life Cycle Costing at the residential development Härmälänranta, Finland to evaluate the life cycle outcome of alternative energy system designs in an urban development. An urban energy simulation was implemented, the results of which were used to create a Life Cycle Costing model. The evaluation demonstrated that within the selected period of 40 years, the two most costly design alternatives in the investment phase are in fact the most affordable from a life cycle perspective. Additionally an LCA model of carbon emissions during operation also supported these two options.

Harvard Art Museum, USA

For the renovation of Harvard Art Museum, Skanska worked with Clear-Vu Lighting to propose a different approach to overcome the common problem of inefficient jobsite lighting - the use of a low voltage LED-based solution. By replacing the conventional lighting, the project received LEED Innovation in Design (ID) Credits, awarded for exceptional or innovative performance beyond LEED requirements. It also resulted in significant cost savings. Whilst conventional lights had lower upfront costs, the expenses accrued over the project life cycle meant an electricity bill of up to USD395,000 (SEK2.6m). The use of LED lighting however reduced this to USD45,000 (SEK294,000). Following the success, the system has been recommended for application as standard across Skanska worldwide.

It’s a way to earn a LEED credit that I don’t think anyone’s really thought of. This is the first time the US Green Building Council awarded a LEED credit for temporary lighting.

Daniel Lax
Clear-Vu Lighting

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Surrey Street Lighting, UK

We introduced a flexible and sustainable lighting solution to improve illumination at the Surrey Street Lighting Private Finance Initiative (PFI). Using lighting columns and lamps designed and positioned to promote a long lifespan, the system will use around 18% less energy and result in annual energy savings of over 5,300,000 kWh once the entire county’s stock of streetlights has been replaced. The project will also make significant initial savings of over USD550,000 (SEK3.6m) per year for the council over the 25-year PFI through more efficient lamps, and the monitoring and control capabilities of the Central Management System (CMS).

Impington Village College, UK

As part of an Energy Performance Contract (EPC), Skanska will work with Impington Village College over a period of 8 years to reduce its energy consumption, halve its carbon emissions, save money and create long term revenue. The green interventions have been selected so as not to create a new maintenance and life cycle burden on the school. Where a new technology is being introduced to the school, we're providing the ongoing specialist maintenance required for the duration of the managed service. Where we are upgrading existing systems, we can demonstrate a positive effect on the school’s LCCs.

New Karolinska Hospital, Sweden

As Skanska’s largest ever project, the first PPP building in Sweden and the world’s largest PPP hospital, the New Karolinska Solna will benefit from LCC analysis throughout its design and development. Skanska and investment partner Innisfree will be responsible for financing, construction, building, and the operation and maintenance of the new hospital until 2040. Given the long term nature of the project, understanding, managing and optimizing LCCs was crucial. For example, Life Cycle Costing was used to analyze different energy source solutions and justify the construction of boreholes to use thermal energy from the ground. The new hospital will have the best possible facilities to separate flows for patients, the public and staff, and decrease patient transfers within the building, resulting in faster treatment and shorter waiting lists. The increase in the number of intensive care beds and intermediary care facilities will enable New Karolinska Solna to treat more than twice as many seriously ill or injured patients than today. The high level of care and LCC savings will also make the hospital competitive in attracting high quality staff and research funding.

Facts and trends

Skanska has set up a Life Cycle Costing Group to promote training, adoption and development of good practice in the field of Life Cycle Costing through shared knowledge and expertise across Skanska.

Carbon footprinting techniques exploiting BIM can incorporate cost estimation, which can compare both economic and environmental costs and promote the delivery of cost-efficient green buildings.

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The EU Energy Performance of Buildings Directive (EPBD) requires Member States to define cost optimal minimum levels of energy performance requirements, optimizing the balance between the investments involved and the energy costs saved throughout the lifecycle of the building. It is expected to see the demand for life cycle costing increase significantly.

Green Certification systems such as LEED, BREEAM and CEEQUAL increasingly reward Life Cycle Costing and Assessment.

Skanska has set up a Life Cycle Costing Group to promote training, adoption and development of good practice in the field of Life Cycle Costing through shared knowledge and expertise across Skanska.

The price of oil in Europe (Brent crude) has risen over 400% in the last 10 years. A key benefit from the output of Life Cycle Costing is often a better understanding of the long term impact of energy costs.
Facts and trends

25year

An office building will typically consume three times its initial capital cost over a 25 year period.

5%

A major pump supplier says only 5% of the total cost of owning a pump is in the initial capital cost - Life Cycle Costing takes account of the other 95% of the total cost of ownership.

BS ISO 15686-5
ISO 14040

Standards such as BS ISO 15686-5 and ISO 14040 provide a framework for LCC and LCA, demonstrating the industry’s growing use of life cycle thinking whilst also driving its uptake.

50%

Life Cycle Costing demonstrates that 50% of the cost of an HVAC system over 30 years is energy cost.

Life Cycle Costing was used to demonstrate a 5 year pay back for Skanska’s Empire State Building fit-out based on energy saving.

Our business-as-usual

Skanska is leading the industry in its LCC-based approach to green building. Rather than considering Life Cycle Costing as a bolt-on, we are working to embed this thinking into our business-as-usual. In collaboration with organizations such as Green Building Councils, we are assisting in the education of the construction and real estate industries on the principles of Life Cycle Costing. We will continue to develop and implement new technologies and techniques to support a LCC approach, increasing its uptake and implementation across the industry.