Communication of Life Cycle Assessment Results

Life Cycle Key Performance Indicators

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Akademisk avhandling

som med vederbörligt tillstånd av Rektor vid Umeå universitet för avläggande av filosofie doktorsexamen framläggs till offentligt försvar i Triple Helix, Universitetsledningshuset den 10 oktober, kl. 13:00.

Avhandlingen kommer att presenteras på engelska och försvaras på svenska.

Fakultetsopponent: adjungerad Professor, Åsa Wahlström,

Institutionen för bygg- och miljöteknologi vid Lunds Universitet, Sverige.
The global warming that we are on track for will result in a severe loss of natural capital leading to significant losses in economic capital when urban infrastructure is destroyed, agricultural productivity declines and poverty spread among other disasters. Climate change due to emissions does not only affect the polluter, the hazardous effects becomes evident on a global level. An essential tool to enable decision-making with concern to the welfare of the global commons is life cycle assessment (LCA). LCA compile and evaluate the inputs, outputs, and potential environmental impacts of a product system throughout its life cycle.

The reviewed literature frames a gap regarding interpretation of LCA-results and inquire for guidelines that address a wide range of stakeholders to enable informed decision-making with regard to the welfare of the global commons. Some studies even argue that an apparent weakness of LCA-result communication is the understanding of what the results mean for the economic key performance indicators (KPIs) of the stakeholder. Thus, this thesis aims to contribute to the development of guidelines for interpretation of LCA-results by introducing an approach for communicating LCA-results that is compatible with the economically driven nature of stakeholders. The specific research questions (RQ) of this thesis are: (RQ1) How can well-established economic KPIs be utilised to quantify environmental impact? and (RQ2) How does incorporation of monetary valuation of environmental impacts and related environmental aspects affect the LCA-result and communication of results?

These research questions have led to life cycle key performance indicators (LC-KPIs) that quantify life cycle economic and environmental impacts in a way that take after the traditional economic KPIs of the stakeholders, which is outlined as essential to improve the understanding of LCA-results. The LC-KPIs utilize the traditional economic KPIs of return on investment (ROI) and annual yield (AY). Additionally, to manage the large amount of non-commensurate units of holistic life cycle sustainability assessment, monetary valuation has been applied. Hence, contributing to the research area of monetary valuation in LCA by introducing and testing new approaches.

The introduced LC-KPIs have been specified for building LCA and exemplified by applying them to a number of Swedish case buildings. The result show that the
climate-economic assessment of building refurbishment differs compared to the traditional economic assessment when monetary valuation is utilized in LCA with the LC-KPI of ROI_{Economy}. However, in the comparative assessment of building refurbishment and new construction, the LCA-result does not change compared to the traditional economic assessment when monetary valuation is utilized in LCA with the LC-KPI of ELCCA. This is explained by the high costs associated with the investment and energy use of buildings and may not be the case if products with lower investment and energy use costs and high life cycle greenhouse-gas emissions would be studied. Still, if a purely environmental assessment of a product is wished for, the LC-KPI should only include monetary valuation of environmental impact factors and exclude traditional economic performance. Thus, the case study result defines further scope for research on the subject of monetary valuation in LCA and inquire for a wider spectrum of LC-KPIs that utilizes monetary valuation.

The introduced approach of this thesis contribute to the development of guidelines for interpretation of LCA-results. Nevertheless, there are still challenges that needs to be addressed in the development of robust LCA-result interpretation. Still, the LC-KPIs used in this thesis address the “cognitive logics” of a wide range of stakeholders and provide an approach for communication of LCA-results which improve the understanding of LCA-results.

**Keywords**
Life Cycle Assessment, Monetary Valuation, Climate Impact, Life Cycle Key Performance Indicators, Global Warming Potential, LCA-result communication, Interpretation of LCA-results

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