LIFE CYCLE ASSESSMENT

Life Cycle Assessment (LCA) is an environmental management technique used to assess the environmental impacts throughout an entire life-cycle of a product or service (i.e. cradle-to-grave) from raw material, material processing, product manufacture, distribution and storage, use, to disposal or recycling(figure 1). [1]

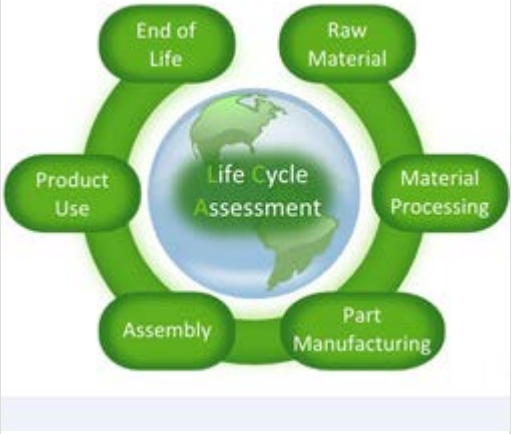

Figure 1 Cradle-to-grave Life Cycle Assessment

LCA is a technique for assessing the environmental aspects and potential impacts associated with a product, by

- compiling an inventory of relevant inputs and outputs of a product system;
- evaluating the potential environmental impacts associated with those inputs and outputs;
- interpreting the results of the inventory analysis and impact assessment phases in relation to the objectives of the study.[2]

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Intended improvement in Sustainability

Environmental, economic, and social concerns are often described as the “triple bottom line” of sustainability and sustainable development.[3]

Sustainable design, like quality, time to market, and cost, will soon dictate how engineers approach most every product they develop. Choosing products based on their carbon footprint will be equally as important as design validation. One way to assess product sustainability is to use a Life Cycle Analysis tool. LCA is the detailed analysis that gives the information need to make the most environmentally friendly decisions throughout product design. The analysis looks at a product’s entire life, which encompasses ore extraction, material production, manufacturing, product use, end-of-life disposal, and all of the transportation that occurs between these stages.[4]

In many applications, it is relevant to model future systems. This may, for example, be the case for consequential LCA where the impacts of a future possible decision are assessed, or in attributional LCAs aiming at assessing future technologies or systems.[5]

Historical Background

As environmental awareness increases, industries and businesses are assessing how their activities affect the environment. Society has become concerned about the issues of natural resource depletion and environmental degradation. Many businesses have responded to this awareness by providing “greener” products and using “greener” processes. The environmental performance of products and processes has become a key issue, which is why some companies are investigating ways to minimize their effects on the environment. Many companies have found it advantageous to explore ways of moving beyond compliance using pollution prevention strategies and environmental management systems to improve their environmental performance. One such tool is LCA. This concept considers the entire life cycle of a product.[6]
Enter life cycle assessment, or LCA. This approach emerged in the later 1980s, but until recently was popular mainly in Europe, manufactures’ associations, and a few eco-conscious R&D departments. It is only starting to be adopted on a larger scale by U.S. companies looking to better understand the full environmental impact of their products. The aim is to quantify the environmental impacts of a given product throughout its life cycle in order to identify opportunities for improvement.[7]

Variant of LCA

The scope of LCA can extend to various stages and processes in a product's life. Depending on the purpose of conducting the LCA, one of two primary means for conducting the LCA can be considered:process-based LCA and economic input-output-based LCA. Within each variant, there exists a number of options to be considered.[8]

Process-based LCA Method:

In a process-based LCA, one itemizes the inputs (materials and energy resources) and the outputs(emissions and wastes to the environment) for each step required to produce a product.[9] LCA methods implemented in the building construction industry are based primarily on process-based LCA.[10]

Economic Input-Output Based LCA Method

The Economic Input-Output Life Cycle Assessment (EIO-LCA) method estimates the materials and energy resources required for, and the environmental emissions resulting from, activities in a given economy.[11]
In terms of the building industry, the EIO-LCA method is not an appropriate tool for use in determining whether specific actions are environmentally beneficial or harmful within a given project. Rather, the EIO-LCA method is better suited to track the overall impact of one aspect, e.g., the use of fly ash in concrete, in the entire construction industry as a whole.[12]

Advantages of LCA:

- LCA provides a comprehensive overview of a product or service and avoids simply shifting the source of the pollution from one life cycle stage to another
- LCA can, for example, guide a company's decision-making process (micro-economic level) and help governments define a public policy (macro-economic level)
- LCA challenges preconceived notions by distinguishing between the information that is relevant for objective quantification and the issues that pertain to policies, priorities, and social choices[13]

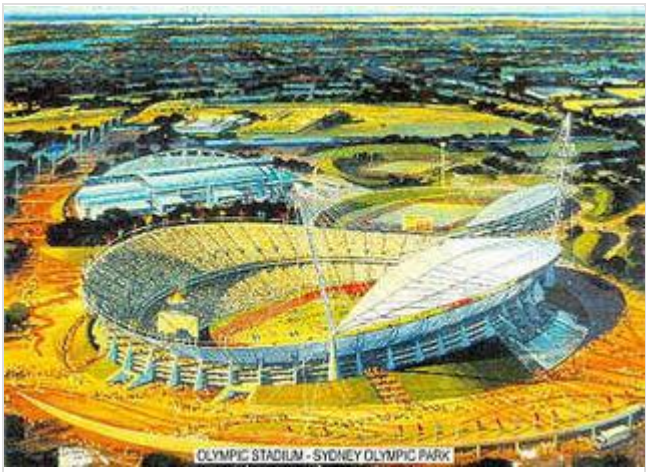
Disadvantages of LCA:

- A LCA study is prohibitive economically for most of the organisations interested in applying it. This is because a holistic LCA is a very data-intensive and time-consuming procedure. The more comprehensive a LCA is the more time-consuming and expensive it will be. High costs are partly caused by the need for professional consultation and expert knowledge in the stages of impact and improvement analyses.
- The accuracy of a LCA study depends on the quality and the availability of the relevant data, and if these data are not accurate enough, the accuracy of the study is limited. These facts affect the precision of the final results.[14]

Construction applications

Construction materials constitute a major percentage of the resources humans use today. By the end of the 20th century, approximately 75% of allmaterial consumption in the United States consisted of construction materials, and this number does not even include industrial minerals such as the cement that goes into concrete.[15] Life-cycle assessment (LCA) has been used to assess product development processes “from cradle to grave” for many years. With the current push toward sustainable construction, LCA has gained importance as an objective method to evaluate the environmental impact of construction practices. [16] Life cycle assessment is an essential tool to help civil and structural engineers understand how they can contribute to lowering the embodied energy of any structure. The potential for paradigm shifts in structural design due to the lessons learned from LCA could be significant.[17]

Case Study: Stadium Australia, New South Wales, Australia



View of Stadium Australia

This case study was reviewed as it presents one of the most early and successful example of using whole-building LCA to review design options during the schematic design phase and review impacts of each life-cycle stage during the construction phase. Two LCA studies were conducted for the project, one at the project tender stage and the other during construction.[18]

How LCA was used:
Multiplex and Stadium Australia used Life Cycle Assessment in the original design optimization of the Stadium. Three main designs were assessed.

- A conventional stadium design,
- A better environmental practice design and
- A best practice design.

Using a mixture of Life Cycle Assessment and cost/benefit analysis, the better environmental practice design was chosen.[19]Future incentives for using the LCA methodology can be anticipated, given the evolution of current rating systems and the emergence of green building codes.[20]

Recent Development

The LCA methodology has developed and somewhat matured during the last decades. Current activities regarding databases, quality assurance, consistency, and harmonization of methods contribute to this. It is also interesting to note the development of new application areas indicating the need to assess and communicate environmental impacts of products.[21]
At present time, the incentives of using LCA in building projects are minimal. The present incentives are available in form of Green Globes™[22] green building rating system, ASHRAE Standard 189.1 and the Carbon Cap-and-Trade Bill. In the future, it is anticipated that there will be many other incentives for the use of whole-building LCA and that the method will be easier to use due to improvement in LCA tools

Source : http://letu-cefs.wikispaces.com/Life+Cycle+Assessment