Life Cycle Analysis (LCA)

What It Is

Because the term "life cycle analysis" is becoming a more frequently used phrase in multiple industries, it is important to understand the process. Life cycle analysis (LCA) is the systematic approach of looking at a product's complete life cycle, from raw materials to final disposal of the product [1]. It offers a "cradle to grave" look at a product or process, considering environmental aspects and potential impacts [2]. When LCAs were first developed in the 1960s, they were motivated by the economic struggles of the time. Through the 1970s and 80s, this analytical process became less popular due to the lack of standardization. The LCA concept has once again become important to industry and academia [3]. *Life Cycle Assessment: Principles and Practice*, published by the U.S. Environmental Protection Agency (US EPA) in 2006 [3], provides a detailed guideline for a systematic LCA approach. The EPA report, as well as other reports from the *International Journal of Life Cycle Analysis* and reports written by the European Commission regarding life cycle analyses, were used as sources for this description of basic life cycle concepts. Good examples of life cycle assessments can be found in Choi et al. [4] and Lu et al. [5].

How LCA Works

Life cycle analysis examines the environmental impacts of a product by considering the major stages of a product's life, which are:

- Raw material acquisition, which includes material harvesting and transportation to manufacturing sites;
- Processing, which involves materials processing and transportation to production sites;
- Manufacturing, which includes product manufacture and assembly, packaging, and transportation to final distribution;
- Product life, which includes energy and emissions during normal product life, required maintenance, and product reuse (refurbishing, material reuse); and
- Waste management/end of life, which includes recycling, landfills, liquid waste, gas emissions, etc.

The LCA technique can be narrowed down to four main steps which address one or more of the product's life stages at a time:

- The definition and scope is determined along with information needs, data specificity, collection methods, and data presentation.
- The life cycle inventory (LCI) is completed through process diagrams, data collection, and evaluation of the data.

- The life cycle impact assessment (LCIA) is determined with impact categories and their weights, as well as any subsequent results.
- The final report should include significant data, data evaluation and interpretation, final conclusions, and recommendations.

Figure 1 shows that the first three steps of a life cycle analysis are related to one another. More importantly, however, data interpretation is an integral part of all three steps and should be done after each of the sub-analyses is completed.

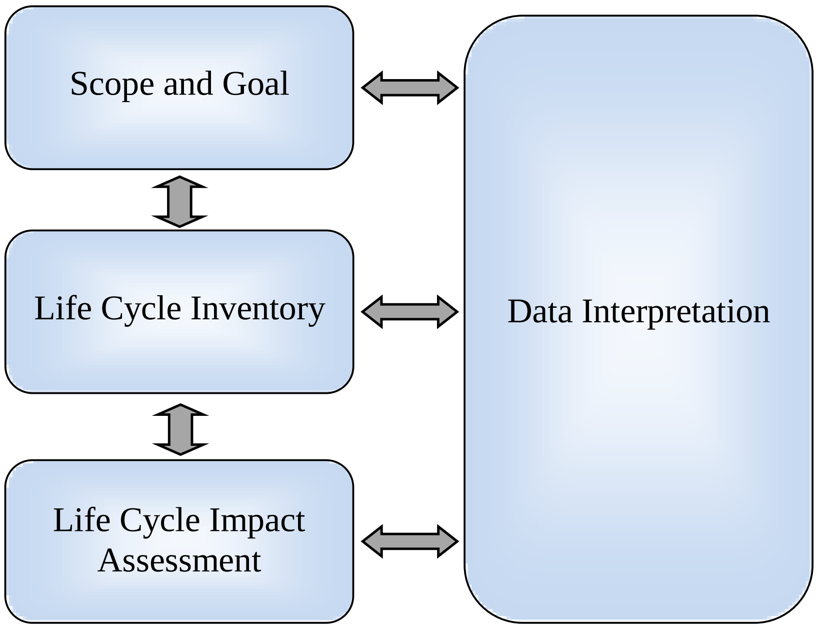

Figure 1: Phases of a Life Cycle Analysis [3]

Why Use LCA?

An effective LCA allows analysts to:

- Calculate a product's environmental impact
- Identify the positive or negative environmental impact of a process or product
- Find opportunities for process and product improvement
- Compare and analyze several processes based on their environmental impacts
- Quantitatively justify a change in a process or product

The LCA method provides researchers or companies with quantitative data for their current products. By looking at a product's life from the raw material extraction to its disposal, the environmental impact of each process and material can be analyzed. The LCA allows analysts to determine and analyze the technological, economical, environmental, and social aspects of a product or process necessary to manage the complete life cycle. With this quantitative data, desired changes can be justified with respect to the cost and environmental impacts of a product or process.

For more detailed life cycle analyses information, please refer to the *Life Cycle Analysis: A Step-by-Step Approach*, ISTC Technical Report (TR-40), available online at http://www.istc.illinois.edu/info/library_docs/TR/TR040.pdf.

References

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[4] Choi, B.C., H.S. Shin, S.Y. Lee, and T. Hur. 2006. "Life Cycle Assessment of a Personal Computer and Its Effective Recycling Rate." *International Journal of Life Cycle Assessment* 11 (2): 122-8.

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For more information

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