

BIFMA SAS Background on Life Cycle Assessments (LCA)

DIFFERENTIATE BETWEEN LIFE CYCLE THINKING AND LIFE CYCLE ASSESSMENTS

Life Cycle Assessment (LCA) is a tool for the systematic (methodological) evaluation of the environmental aspects of a product or service system through all stages of its life cycle. An LCA is generally quantitative and **REQUIRES** that the results are normalized to a functional unit. An LCA is inclusive of both product AND process. An LCA is an analytical tool to implement *life cycle thinking*.

Life Cycle Thinking is a conceptual approach that addresses environmental problems from a whole-systems or holistic perspective. The **ESSENTIAL** difference to a LCA is that the results are **NOT** normalized to a functional unit, and the results may be expressed qualitatively or quantitatively.

The two approaches can be seen as the two extremes of a continuum of impact assessment tools, ranging from qualitative on end (life cycle thinking) to quantitative on the other end (LCA). Yet, both maintain a whole-systems (holistic) perspective.

An LCA is one of several available techniques or tools to support decision-making activities towards integrating environmental issues into the strategic intent of an enterprise. An LCA is a highly specific technique to support both environmental management systems (e.g. ISO 14000) and other environmental programs (e.g. Pollution Prevention, Design for the Environment, Extended Producer Responsibility). An LCA is often limitedly viewed as a pollution prevent tool; however, since more than 75% of the ecological impact of a product is determined at the design stage, a life cycle approach (whether conceptual or methodological) is also valuable as a tool for Design for the Environment and Extended Producer Responsibility.

STANDARDIZATION OF THE LCA METHODOLOGY

International Organization for Standardization (ISO) Technical Committee TC-207 on Environmental Management Systems

The LCA standards are formalized within the ISO 14040 series:

ISO 14040:2006 - Principles and Framework

ISO 14041:1998 - Goal and Scope Definition and Inventory Analysis

ISO 14042:2000 - Life Cycle Impact Assessment

ISO 14043:2000 - Life Cycle Impact Interpretation

ISO 14047:2003 - Environmental Management – Life Cycle Impact Assessment

ISO 14048:2002 - Data documentation format

ISO 14049:2000 - Examples of application of ISO 14041 to goal and scope definition and inventory analysis

Other similar standards:

- American Society for Testing and Materials (ASTM) [e.g. ASTM E1991-05 *Standard Guide for Environmental Life Cycle Assessment (LCA) of Building Materials / Products*]
- Canadian Standards Association [e.g. CSA Z760-95 *Life Cycle Assessment*]

COMPONENTS OF A LIFE CYCLE ASSESSMENT

(1) Life Cycle Management (LCM)

(2) Life Cycle Inventory (LCI)

- (3) Life Cycle Impact Assessment (LCIA)
- (4) Life Cycle Impact Interpretation

Many companies have found it advantageous to explore ways to move beyond compliance using pollution prevention strategies and environmental management systems to improve their environmental performance. One such tool is the LCA. This concept considers the entire life cycle of a product.

Life cycle assessment is a “cradle-to-grave” approach for assessing industrial systems. “Cradle-to-grave” begins with the gathering of raw materials from the earth to create the product and ends at the point when all materials are returned to the earth. LCA evaluates all stages of a product’s life cycle from the perspective that they are interdependent, meaning that one operation leads to the next. LCA enable the estimation of the cumulative environmental impacts resulting from all stages on the product life cycle, often including impacts not considered in more traditional analyses (e.g. raw material extraction, material transportation, ultimate product disposal, etc.). By including the impacts throughout the product life cycle, LCA provides a comprehensive view of the environmental aspects of the product and process selection.

The term “life cycle” refers to the major activities in the course of the product’s life-span from its manufacture, use, and maintenance, to its final disposal, including the raw material acquisition required to manufacture the product. The illustration below shows the possible life cycle stages that can be considered in an LCA and the typical inputs/outputs measured.

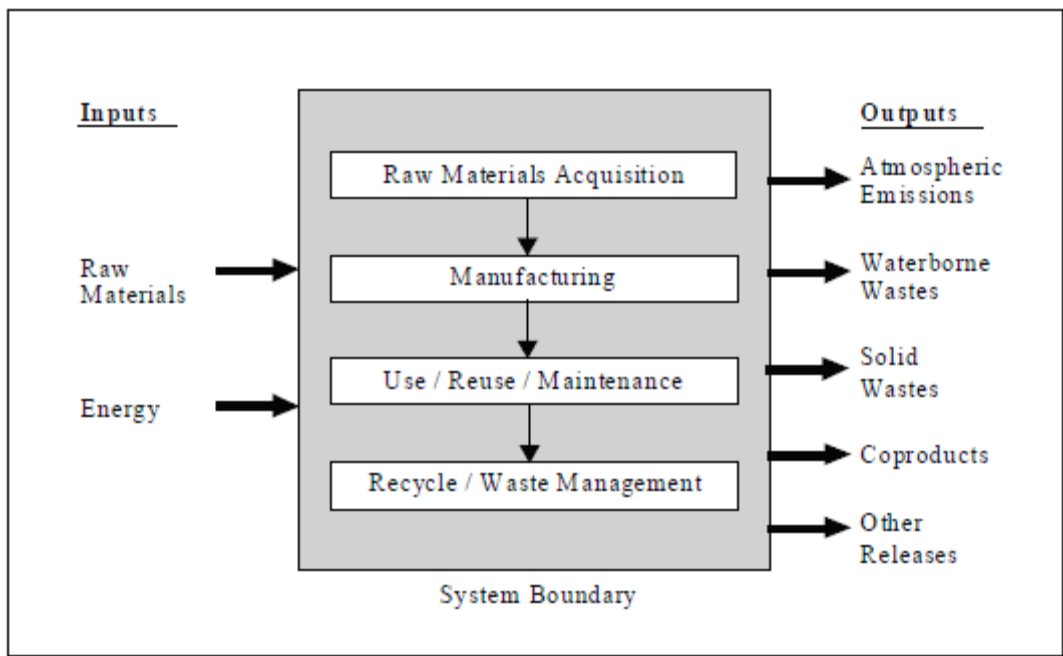


Exhibit 1-1. Life Cycle Stages (Source: EPA,1993)

LIFE CYCLE STAGES

Both an LCA and Life Cycle Thinking take a whole-systems approach towards determining the environmental aspects of a product or service, recognizing the following main life-cycle stages:

- Raw material acquisition
- Manufacturing
- Transportation
- Consumer use (including reuse and maintenance)
- Final disposition (end-of-life management)

The above life-cycle stages capture the “cradle-to-grave” concept of the environmental impact of a product or service.

ENVIRONMENTAL ASPECTS & IMPACTS

An *environmental aspect* can be defined as an element of an organization's activities, products or services that interacts with the environment at any of the life cycle stages. The manner in which an element interacts with the environment is defined as an impact. A *significant environmental aspect* is one that has a significant impact on the environment. Critical life cycle stages would represent those life cycle stages in which the significant impacts are occurring.

The LCA methodology broadly divides environmental impacts into two large impact categories, viz “**Human and Ecological Health**” and “**Resource Depletion**”. A number of relatively homogenous “stressor categories” (also commonly called Life Cycle Impact Categories) have been identified, which can be assigned to the larger impact categories. The following ten “stressor” categories are commonly included in a Life Cycle Impact Assessment (LCIA):

- Global warming (greenhouse gases)
- Stratospheric ozone depletion
- Acidification
- Eutrophication
- Photochemical smog
- Terrestrial toxicity
- Aquatic toxicity
- Human health
- Resource depletion
- Land use

The “stressor categories” recognize the environmental impacts of BOTH product and process at all life-cycle stages.

LCI DATABASES

- Franklin US LCI Database
- US EPA TRACI
- US Life Cycle Inventory Database
- Proprietary LCI databases associated with LCA software programs

ALTERNATIVES TO FULL LCA

1. Abridged (partial) LCA
2. Environmental Value Chain Analysis
3. Economic Input-Output Life Cycle Assessment

What is the Staff Recommendation for the BIFMA SAS Process?

Life Cycle Management

Life Cycle Management (LCM) is the application of life cycle thinking to modern business practice, with the aim to manage the total life cycle of an organization's product and services toward more sustainable consumption and production (Jensen and Remmen 2004). It is an integrated framework of concepts and techniques to address environmental, economic, technological, and social aspects of products, services, and organizations. LCM, as any other management pattern, is applied on a voluntary basis and can be adapted to the specific needs and characteristics of individual organizations (SETAC 2004).

Resources:

1. Five Winds International
2. International Organization for Standardization. ISO 14040 series
3. The International Journal of Life Cycle Assessment
4. United Nations Environment Programme / Society for Environmental Toxicology and Chemistry Life Cycle Initiative (UNEP/SETAC Life Cycle Initiative)
5. U.S. Environmental Protection Agency and Science Applications International Corporation. *LCAccess - LCA 101*. 2006. Retrieved from:
http://www.epa.gov/ORD/NRMRL/lcaccess/pdfs/chapter1_frontmatter_lca101.pdf
6. US Life Cycle Inventory Database