CHAPTER 1

INTRODUCTION

1.1 Background

Lack of environmental awareness has led us to mistakenly consider ourselves to be outside the global ecosystem and, consequently, to satisfy our needs according to the sole criterion of "the greatest efficiency at the lowest cost." the resulting environmental crises has shown how the eco-system has been seriously degraded by the use of modern means of production, conceived without concern for either the environment or the balanced use of resources. Above all, the widespread idea that profit and respect for the environment are incompatible (a dangerous prejudice delaying a processes of recovery that can no longer be postponed) is based on an inadequate vision of the problem (Günther, 2007).

Any costs avoided by a production system in neglecting environmental issues will fall, redoubled, onto the community. Clearly, industry must respect the elementary condition of earning more than it spends, but it is crucial that profit is made while

reducing environmental impacts to a minimum. This has increased the need for sustainable development.

The main influencing factors include an expanding regulatory framework and more stringent environmental protection standards. However, if a better match between the corporate behavior and the principles of sustainable development is to be achieved, businesses themselves will have to be active in seeking ways of meeting social, environmental and economic objectives (Labuschange, 2005). Manufacturers will have to assume a larger degree of responsibility for activities related to the life cycle of their products after the purchasing and installation stage (Westkaempfer, 2000).

Life cycle management (LCM) is an approach supporting sustainable development and the most efficient possible use of resources. Based on the life cycle concept the costs and benefits of strategic aims and choices can be understood and justified in a comprehensive manner. LCM covers the entire life cycle of a product with a view to maximizing value along the life cycle while meeting cost and environmental requirements. Integral components of this value are, for example, reliability, costs, manufacturability, operational capacity, usefulness, usability, recycling capacity and other environmental aspects (Prasad, 1999).

One important part of LCM is life cycle cost analysis (LCCA). The objective of this analysis is to optimize the manufacturing, maintenance and operation of a product (e.g. manufacturing equipment) for the period of its usability based on establishing all the important cost items over this period.

This facilitates a quantified assessment of various product design alternatives, comparison of cost items at various stages of the product life cycle and comparison between the stages with a view to choosing the optimal alternative.

The cost items monitored include all costs incurred in relation to manufacturing of a product until its disposal at the end of its life cycle. The items should be structured so as to allow for identification of potential links between various items with a view to establishing optimal life cycle costs. The structure of cost items will always depend on the nature of the product and it should always facilitate life cycle cost analysis. The purpose of estimating cost links is to express cost items as a function of one or more independent variables. The final stage of the calculation process is determination of a method for formulating life cycle costs.

Some would say that LCCA is to help engineers "think like MBAs but act like engineers." That is true, but LCCA is broader in sense. According to Emblemsvag (2003), the main purpose of LCCA is to help organizations apply knowledge about past performance and their gut feelings to future issues of costs and risks. This is done not in the traditional sense of budgeting, but in meaningful predictions about future costs of products, process, and their associated risks.

1.2 Statement of The Problem

The pressure for implementation of principles of sustainable development in corporate decision-making processes is increasing continuously. Other aspects concerning product life cycle management are also subject to this pressure.

Life cycle cost analysis appears to be a useful approach to a comprehensive assessment of economic, environmental and social impacts of the life cycle of a product. It is necessary to realize the importance of costs throughout the full life cycle of a product in order to adopt measures to optimize the product value in relation to the financial resources used. Literature also increasingly emphasizes that rapid technological change and shortened life cycles have made product life cycle cost analysis critical to organizations (Ray and Schlie, 1993; Barfield et al., 1994; Murthy and Blischke, 2000).

Despite this growing awareness of aspects related to LCCA, the use of this method in Small & Medium-Sized Enterprises (SMEs) is still insufficient. There are a number of reasons for the generally lower level of acceptance of the life cycle costing methods. One of the major reasons is lack of motivation resulting, above all, from insufficient trust in the outcomes and achievements of the methodology.

Therefore, it is important to overcome the current situation where preference is given to assessing products based on manufacturing costs, and to short-term effects, where the link between manufacturing and future costs is ignored and where there is a lack of knowledge of the LCCA methods and their use.

This study will focus on the development of a user-friendly product life-cycle cost analysis tool that will include all identifiable cost categories of product from conception until disposal. The tool in the form of software is expected to assist SMEs carry out LCCA in their product/process decision-making. With the help of this tool, designers can substantially reduce the life-cycle cost of products by giving due consideration to life-cycle implications of their design decisions. In this role, LCCA becomes an operational instrument used to implement one of the basic strategies for achieving sustainable development, the integrating economic and environmental considerations in to the decision-making process (WCED, 1987).

1.3 Objectives of the study

The primary objective is to develop a life-cycle cost analysis (LCCA) tool that can assist designers in making choices regarding the definition of product characteristics, integrating a series of analysis, calculation, and decision-making tools in the most appropriate manner in order to compare different alternatives of their product.

A secondary objective is to simplify the usage of the tool in the form of simple software so that minor modifications of the model can lead to many other applications.

1.4 Scope of the study

The project surveys several LCCA methodologies, product design considerations until disposal are surveyed and a framework for the development of LCCA process is developed, and to validate this framework in actual practice, simple software is developed to enable different decisions to be considered with respect to their effect in the life-cycle costing.

The purpose of the tool is to enable different design configurations (different materials, different design, and different processes) to be compared not only from an environmental compliance view but also from a cost perspective. The tool offers support in the decision-making process at the early phases of the design process. The inclusion of cost permits more informed business decisions and considerations to be undertaken by the designer.

1.5 Significance of the study

The importance of estimating and controlling costs during the design process, with the aim of limiting the cost of producing a product, is now considered and ineluctable factor in the development of an efficient product. Such products are able to respond to a market demanding high standards of quality and ever-shorter development times combined with contained costs (Weustink et al., 2000).

LCCA plays a primary role in this specific context due to the fact that not only production costs, but also those costs incurred during use and disposal are greatly conditioned by the initial design choices. By some assessments, more than half of the total cost of a product's life-cycle is determined by the concept design phase alone (Fabrycky and Blanchard, 1991), and up to 85% can be considered fixed by the end of the completed design phase (Dowlatshahi, 1992), although only a limited fraction of this cost will have actually been spent on these phases of the development process.

The field of application of LCCA is particularly wide and includes evaluation and comparison of alternative designs; assessment of economic viability of projects and products; identification of cost drivers; and cost effective improvements; evaluation and comparison of different approaches for replacement, rehabilitation, life extension, and disposal; optimal allocation of available funds to activities in a process of product development; and long term financial planning.

Figure 1.1 highlights an important paradox – the effectiveness of design choices in controlling the costs of the life-cycle is greatest in the design preliminary phases of product development, and decreases as the design level evolves. On the other hand, the possibility of establishing a relation between design choices and costs is lower in the preliminary phases of product development, and increases as the design as the design

level evolves. This is a direct consequence of how adequate knowledge and information about the design problem and the product under development is the end of the design process.

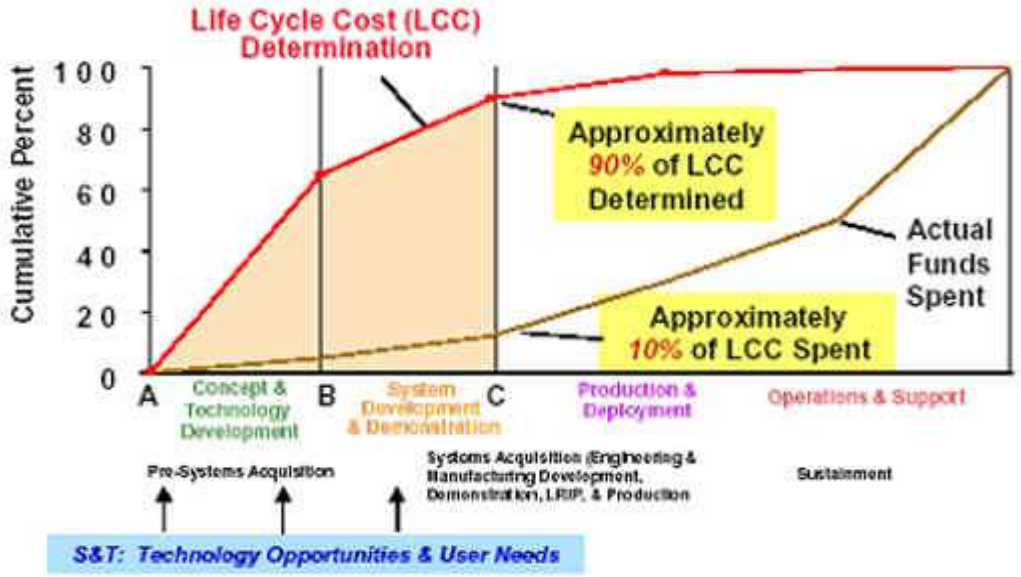

Figure 1.1 Life Cycle Cost in various stages of product development

With this premises, LCCA becomes the assessment of all costs associated with the life-cycle of a product "that are directly covered by the any one or more of the actors in the product life-cycle (supplier, producer, user/consumer, end-of-life actors), with complimentary inclusion of externalities that are anticipated to be internalized in the decision-relevant future" (Hunkeler and Rebitzer, 2003).

1.6 Structure of the thesis

This thesis is structured into six main chapters. Chapter 1 introduces the concept of LCCA, problem statement, significance of study, scope and main objectives of this project. Chapter 2 emphasis mainly on literature review regarding LCCA, application of LCCA in product development, manufacturing cost strategies, and different LCCA models. Chapter 3 defines the methodological framework of LCCA, chapter 4 emphasizes the development of analytical LCCA model and software development, chapter 5 focuses on discussions related to the application of LCCA, and finally chapter 6 is conclusion and opportunities for further study.