# DESIGN IMPROVEMENT OF EXISTING PRODUCT USING LIFE CYCLE ASSESSMENT

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To my beloved father, mother, wife, brother,
sister and my supportive friends…

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# ABSTRACT

Nowadays, environmental issues have become one of the hot issues. Many of the manufacturing industries have established life cycle assessment (LCA) studies to improve their products performance and it is important for the industry to continue to be proactive in these areas. While life cycle assessment (LCA) conscious design considerations have been integrated into the design of products and processes, life cycle assessment (LCA) has not been fully implemented to reduce the overall environmental impacts. By using life cycle assessment (LCA) methodology, it is can achieve cooperative approaches to protecting the global environment and also to compete in the global market. In this project the using of life cycle assessment (LCA) approach to help designer to improve the current product in order to reduce the environmental impacts. So a significant improvement in the evaluation of green consumer products can be approached by the complementary use of the methodologies of life cycle assessment (LCA) and risk assessment, which will be discussed.

# ABSTRAK

Pada masa kini, isu alam sekitar telah menjadi salah satu isu panas. Ini menyebabkan banyak industri pembuatan telah menjalankan penilaian 'life cycle assessment' (LCA) bagi produk untuk meningkatkan penilaian produk dan ia juga penting bagi industri untuk terus proaktif dalam bidang ini. Sementara 'life cycle assessment' (LCA) digunakan sebagai pertimbangan rekabentuk, ia telah diintegrasikan ke dalam rekabentuk produk dan proses, penilaian 'life cycle assessment' (LCA) tidak dilaksanakan dengan sepenuhnya untuk mengurangkan kesan persekitaran secara keseluruhan. Dengan menerapkan 'life cycle assessment' (LCA), ini boleh mencapai metadologi target untuk melindungi persekitaran dan produk boleh bersaing di peringkat antarabangsa. Dalam projek ini, penggunaan 'life cycle assessment' (LCA) akan membantu perekabentuk mengurangkan kesan kepada persekitaran. Jadi signifikan pembaikan dalam evaluasi penghasilan produk berasaskan kumpulan persekitaran boleh dikajian melalui penggunaan metodologi 'life cycle assessment' (LCA) dan penilaian risiko, ini semua dipertimbangkan dalam projek ini.

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# CHAPTER 1

# INTRODUCTION

## 1.1 Background of the Project

Presently the world population is 6.7 billion people and it is increasing at a fast pace everyday. With this increase in population a lot of emphasis is made in order to produce better products and to sustain this growing population. Everyday, every second in different part of the world new products are being produced in order to improve livelihoods of people. When we talk about sustainability of human population we come across the sustainability of the environment, which has to play a great role in human sustainability. Deterioration of the environment is one of the threats to the human race. Advancement in life and increased production of goods to meet the growing needs of people has lead to the environmental deterioration, which is one of the threats to human race.

Recently with the increased awareness of environmental degradation among the people has led the producers as well as consumers towards achieving environmental sustainability. Today the producer is aligned towards producing more environment friendly products and the consumer is more interested in products that bear a green label. With this awareness more tools are being introduced that study the impact of various products on the environment, one such tool is Life Cycle Assessment.

Life Cycle Assessment (LCA) is a process to evaluate the environmental burdens associated with a product, process or activity by identifying and quantifying energy and materials used and wastes released to the environment, and to assess the impact of those energy and material used and released to the environment (SETAC, 1993). Therefore, Life Cycle Assessment can help the industries to identify change to operations, including product design, which can lead to both environmental benefits and cost savings.

## 1.2 Problem Statement

Nowadays, companies face great challenges to maintain its competitiveness in the global marketplace. The green product design capabilities become very critical for companies to stay competitive globally. In the EU green directives, RoHS and WEEE are specific regulations developed for specific purposes of environmental concerns. Because of the strict environmental regulations and directives and the short lifespan of consumer products, companies need IT-based tools or methods to effectively and efficiently support Research & Development during the stages of product conceptual designs. Therefore, companies keep putting afford in Research & Development to design new eco-products in order to reduce environmental impact such as carcinogens, radiations and etc.

## 1.3 Objective of the Study

The aim of the study is implement the Life Cycle Assessment knowledge into an existing product and attempts to evaluate the environmental burdens associated with a product, process, use and disposal or recycle by:

1. To identify and evaluating the types of impacts being considered such as carcinogens, radiation, land use and fossil fuels which related to the human health, ecosystem, and resources.

2. To develop and analyse alternatives by design improvement in order to reduce the environmental impacts.
3. To compare all alternatives and select the optimum alternative which will bring the greatest environmental benefit.

## 1.4 Scope of the Study

Scope of the study covers the entire life cycle of the product encompassing raw material selection, processing, manufacturing, transportation, use, recycling and disposal. This study concentrates on the material selections, energy emission and waste emission released within the life cycle of selection material for produce automotive part which contributes to the impact of resource and energy consumption. Therefore, this paper focuses on selected product from "cradle to grave" according to LCA perspective. The product will be select according to the largest contribution of resource and energy impact among the automotive parts.

Life Cycle Assessment (LCA) is a tool to evaluate the impacts associated with all stages of a product's lifecycle from "cradle to grave" on both downstream and upstream. The basis of an LCA study is an inventory of all the inputs and outputs of industrial processes that occur during the life cycle of a product. This includes the production phase and the life cycle processes including the distribution, use and final disposal of the selected product. In each phase the LCA inventories define the inputs and outputs, after that assesses their impacts. Once the inventory has been completed, the impacts in a LCA will be considered. This phase of the LCA is called the impact assessment. After both inventory and impact have been done, the interpretation assessment will be started. LCAs can be very large scale studies by quantifying the level of inputs and outputs. Besides that, the facilities and equipment have traditionally been neglected in life cycle assessments, because they often make up less than 5% of all process inputs and outputs (Boustead and Hancock, 1979).

## 1.5 Significance of the Study

An LCA will help designers select the product or process that bring least environment impact during the design stage. This information also can be implementing into other factors, such as performance and cost data to select a product or process. LCA data identifies the shift of environmental impacts from one life cycle stage to another. If an LCA was not carry out, the shift might not be recognized and properly excluded this shift in the analysis because it is outside of the typical scope or focus of product selection process.

The ability to track and record shifts in environmental impacts can help designers, decision makers and managers fully characterize the environmental trade-offs associated with product or process alternatives. LCA also allows the automotive manufacturers to identify an effective ways of designing and manufacturing the products themselves. To overcome the rapidly changing requirements on solid waste, persistent toxic chemicals, emissions and effluent discharges, manufacturers can implement LCA to help them be a step ahead's in these issues. In addition, life cycle strategies for pollution prevention and minimizing energy costs are beginning to reveal economic benefits in term of more efficient production, improved product quality and minimization of the environmental risks.

## 1.6 Thesis Structure

This project report consists of five chapters, as summarized below:

- **Chapter 1 Introduction**
  Chapter 1 gives a brief introduction to the study. It includes the background of the project, problem statement, objective, scope and significant of the study.

- **Chapter 2 Literature Review**

  Chapter 2 discusses on several topics related to this study. Topics reviewed include the life cycle assessment in detail, including the historical background, methodology of LCA, principles of LCA, limitation of LCA, uses and application of LCA.

- **Chapter 3 Methodology**

  Chapter 3 breaks down the LCA methodology into details, explains major categories that are been used to evaluate environmental impacts, explains the assumptions that been made in this project and discuss the life cycle assessment boundary.

- **Chapter 4 Results and Discussions**

  Chapter 4 develops the process-by-product input-output life cycle assessment methodology. Life cycle assessment software (SimaPro 7) being use to evaluate the environmental impacts and compare among current design and several alternatives. Results of evaluation and comparison will be discussed.

- **Chapter 5 Conclusions and Recommendations**

  Chapter 5 is the last chapter of the report which actually a summary of the study. It consists of the recommendations for future work and conclusions from this LCA study.

## 1.7 Summary

This chapter has given a general introduction about the life cycle assessment study. At the beginning of the study, the background of the project was being discussed. It followed by the problem statement that facing by current manufacturing companies. The objectives and scope of the study have been addressed. The significant of the study was discussed. Lastly, the thesis structure of the entire report was explained.

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