

SUSTAINABLE ASSESSMENT IN MANUFACTURING COMPANY

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Dedicated to

My father, Yasak bin Younos, whose sacrifice

My mother, Noriah binti Ahmad, whose patience

and Nor Atiqah Zolpakar

Lead to achieve my postgraduate studies

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ABSTRACT

Knowledge of sustainability concepts and the application of sustainability assessment in Malaysian industries are rather limited. A practical approach towards understanding sustainability concepts and its advantages is by conducting sustainability assessment. Sustainability assessment should consider the three pillars of sustainability via the environment, economic and social. The objectives of the study were to perform sustainability assessment on a popular power tool by determining its sustainability score and to propose improvement to increase the sustainability score. Sustainability assessment was performed using the Math Lab fuzzy logic toolbox. The sub element for environment were solid waste and global warming, whereas for economic, the sub element were cost, quality, technology and process. Finally for social sub element it was the social performance. Outcomes of this study demonstrate the integration between fuzzy logic and sustainability assessment yield the sustainability score for a popular power tool. Methods for improving the sustainability score of the chosen product were also proposed. Finally, some recommendations for future studies were proposed.

ABSTRAK

Pengetahuan tentang konsep kelestarian dan aplikasi penilaian kelestarian di kalangan pengusaha industri di Malaysia adalah terhad. Pendedahan yang praktikal untuk menjelaskan tentang konsep dan kelebihan kelestarian adalah dengan menjalankan penilaian kelestarian. Penilaian kelestarian hendaklah mengambil kira tiga tiang utama kelestarian, iaitu alam sekitar, ekonomi dan juga sosial.. Tujuan kerja kursus adalah untuk menjalankan penilaian kelestarian ke atas alatan kuasa tinggi yang popular untuk mengetahui tahap kelestarian alatan tersebut di samping untuk mencadangkan penambah baikkan ke atas alatan untuk meningkatkan tahap kelestarian alatan tersebut. Kajian kelestarian dijalankan ddengan menggunakan perisian Math Lab aplikasi logik rawak. Alam sekitar mempunyai dua pecahan utama iaitu lebih pepejal dan pemanasan global, manakala untuk unsur ekonomi, mempunyai empat pecahan utama, iaitu kos, kualiti, teknologi dan proses. Akhir sekali adalah sosial, di mana hanya keupayaan sosial sahaja sebagai pecahan utama. Kajian kelestarian yang di gabungkan dengan logik rawak telah berjaya mengukur tahap kelestarian alatan berkuasa tinggi tersebut. Kemudian mencadangkan beberapa kaedah untuk meningkatkan tahap kelestarian untuk alatan yang telah di kaji. Akhir kata, beberapa cadangan untuk kajian masa hadapan telah diberikan.

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LIST OF SYMBOLS

I	-	Sub sustainability element
I_{ij}	-	Sub sustainability element index of i-th elements of j-th categories
I_j	-	Index of sustainability element for j-th categories
I_{cost}	-	Cost index
I_{envi}	-	Environment index
I_{econ}	-	Economic index
I_{gw}	-	Global warming index
$I_{solid\ waste}$	-	Solid waste index
I_{pro}	-	Process index
$I_{quality}$	-	Quality index
I_{social}	-	Social index
I_{tech}	-	Technological index
j	-	Sustainability element (environment, social and economy)
n	-	Number of element
w_{cost}	-	Weight for cost
w_{gw}	-	Weights for global warming
w_{ij}	-	Weight of sub sustainability element of j-th categories
$w_{solid\ waste}$	-	Weights for solid waste
w_{res}	-	Weight for resource
w_{sp}	-	Social performance

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Every natural system, like the earth, has limits. The continuously growing population, consequently increase in global economy, due to the increase in technologies, has driven mother nature to a near collapse. Over the past century, the growth of the human population, the need for natural resources and the industrialization of society have threatened the environment and ecology of the earth (Liu, 2005). Brown *et al.* (2000) stated that due to the growing population, ozone depletion, global warming,

depletion of aquifers, species extinction, collapse of fisheries, forest destruction, soil erosion and so on are the major concern nowadays.

Since the Industrial Revolution, more and more natural resources have been over exploit by industrial sectors to manufacture their product. By this rate, the will be no natural resources left to be used by the next generation. Moreover, the by-product of manufacturing often hazardous and gives negative affect towards the environment, society and economy. In term of cost, an unsustainable product can lead to excessive waste and use of toxic material, subsequently these costs will increase the production and operational costs of the manufacturing company (Ghadimi *et al.*, 2012). The only solution for this problem is through sustainability development.

1.2 Problem Background

The only way for present generation to preserve the natural resources for future generation without sacrifice their own need is towards sustainable development. The initial step toward achieving sustainable development is throughout sustainability assessment. By conducting the assessment, the manufacturing company will have knowledge about their product's current level of sustainable and consequently, changes can be made towards their products in order to improve the sustainability level. Ghadimi *et al.* (2012) stated that, an organization can move toward sustainable manufacturing by

manufacturing a more sustainable product. In order to manufacture more sustainable products, the manufactured products first should be assessed.

Another reason for having sustainability assessment has been mentioned by Krajnc and Glavic (2005). They stated that, in normal practices, many companies only use standard financial indicators to track their business. This further proved by report produce by GRI (2002). The report conclude that, due to demands from various parties such as customers, suppliers, national regulators, banks and insurance company, sustainability reports are emerging as a new trend in corporate reporting, integrating into one report, constitutes the elements of financial, environmental and social of a company.

1.3 Problem Statement

Sustainability is difficult to define or measure because it has unclear and complex concept, also involves many aspects of environmental, society and economic impacts. The aspects include organizational goals and objectives, local and international policies to be considered in fulfilling sustainability needs. Phillis and Andriantiatsaholiniaina, (2000), Howarth and Hadfield (2006), De Silva *et al.*, (2009) and Hinterberger *et al.* (1997) mentioned that although sustainability is a goal for international and national policy-makers, there is no measuring yardstick against which to assess practical policy.

The most challenging questions is how to assess, build and maintain a sustainable economy that can allow humanity to enjoy a sufficiently high standard of living without destroying the natural and biological support Phillis and Andriantiatsaholiniaina (2001). Despite the complexities of sustainability, yet dozens of assessments or indicators have been suggested for use in determining sustainability in industries. Such industries are chemical process, a manufacturing site, or a manufacturing enterprise (Sikdar, 2003)

1.4 Objectives of Study

The objectives of this study are as follow:

- I. To conduct sustainability assessment for a selected product.
- II. To suggest and assess the improvement in term of sustainability for the selected product.

1.5 Scopes of the Study

The scopes of this study are as follow:

- I. Hand grinder (XX-100M) has been selected as the case study.

- II. Cradle to gate boundary is adopted in this project.
- III. Math Lab software is used to analyze the data.

1.6 Research Questions

The research questions of this study are as follow:

- I. What is the assessment method to be used to assess the sustainability of the selected product?
- II. What is the current sustainability score for the selected product?
- III. What are the sustainability indicators to be used for the selected product?

1.7 Significant of Study

Many of the manufacturing company in Malaysia does not have clue about sustainability manufacturing. This study can give exposure of sustainability towards the manufacturer. The findings of the study and case study can be an example of how to conduct a typical sustainability assessment onto the

product. Consequently helps manufacturers to move toward having a more sustainable product and achieve sustainable manufacturing.

1.8 Organization of Report

This report consists of six chapters, as summarized in the following:

I. Chapter 1 Introduction

Chapter 1 is the introduction of the study. This chapter explains about the research statement, problem statement, objectives of study, scope of study and matters that have relate to the introduction of project.

II. Chapter 2 Literature Review

Chapter 2 is the literature review of the project and contains topic related to this study. The chapter describe definition, principle and approach that been used during conducting this project. Topics reviewed include sustainability definition, life cycle assessment, Green Pro, past researchers works related to sustainability, fuzzy logic approach, sustainability and fuzzy logic and some existing methodologies regarding sustainability.

III. Chapter 3 Research Methodology

Chapter 3 discusses the chosen sustainability indicators that will be used in the assessment. Next discussion is about steps in conducting fuzzy logic approach using the Math Lab software.

IV. Chapter 4 Case Study and Data Collection

This chapter is about the collected information related to the product (hand grinder) to be assessed. Math Lab fuzzy logic were utilized in this chapter.

V. Chapter 5 Results and Discussions

Chapter 5 displays the result and data analysis that assess by the Math Lab fuzzy logic toolbox. Discussion of data gathered also available and some recommendations were provided to improve the sustainability score.

VI. Chapter 6 Conclusion

Chapter 6 consists of a summary of the whole study. Findings of the research are presented in brief. Finally, some future researches are suggested.

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