



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**EFFECT OF MANUFACTURING SUSTAINABILITY ON
MANUFACTURING PERFORMANCE**

This report submitted in accordance with requirement of the Universiti Teknikal
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Engineering
(Manufacturing Management) with Honours

by

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DECLARATION

I hereby, declared this report entitled “Effect of Manufacturing Sustainability on Manufacturing Performance” is the result of my own research except as cited in the references.

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfilment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Management) (Hons.). The member of the supervisory is as follows:

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ABSTRACT

Nowadays, sustainable manufacturing has become a serious issue for the industries worldwide. It is considered as an important concept for industries to survive in today's challenging business environment. Nevertheless, its implementation still be regarded as low. The purpose of this study is to investigate what is the effect or impact of manufacturing sustainability on manufacturing performance focusing in automotive related manufacturing industry. In this study, the factors of sustainability is adopted from the triple bottom line of sustainability consisting of social performance factors, environmental, and economic. The initial three factors are divided into nine criteria and further breakdown into a total of 41 sub criteria. A survey was conducted to a sample of Malaysian automotive manufacturing companies listed in Proton Vendor Association. Respondents were from companies that manufacture a variety of products within the scope of the automotive industry and are well represented among the population of automotive industry. Most of the companies stated that occupational health and safety, reduce waste and environment are the characteristic of manufacturing sustainability that are important to their company. Manufacturing sustainability is said to give competitive advantage to the company, reduction in waste disposal and stimulation of innovation and growth of the company.

Keywords: automotive, competitive, sustainable manufacturing.

ABSTRAK

Pada masa kini, pembuatan mampan telah menjadi satu isu yang serius kepada industri di seluruh dunia. Ia dianggap sebagai satu konsep yang sangat penting bagi industri-industri ini untuk terus hidup dalam persekitaran perniagaan yang mencabar pada hari ini. Walau bagaimanapun, pelaksanaannya masih boleh dianggap sebagai rendah. Tujuan kajian ini adalah untuk menyiasat apakah kesan atau impak kemampuan pembuatan terhadap prestasi pembuatan dengan memberikan tumpuan pada industri berkaitan pembuatan automotif. Dalam kajian ini, faktor-faktor kemampuan digunakan dari tiga asas utama kemampuan yang terdiri daripada faktor-faktor prestasi sosial, alam sekitar dan ekonomi. Selepas itu, tiga faktor awal itu dibahagikan kepada sembilan kriteria dan dibahagikan pula kepada sejumlah 41 sub kriteria. Kemudian satu kaji selidik telah dijalankan terhadap syarikat pembuatan automotif Malaysia yang tersenarai dalam Persatuan Vendor Proton. Responden terdiri daripada syarikat-syarikat yang mengeluarkan pelbagai produk dalam skop industri automotif dan dikenali di kalangan populasi industri automotif. Kebanyakan syarikat menyatakan bahawa kesihatan dan keselamatan pekerjaan, mengurangkan sisa, dan alam sekitar adalah ciri-ciri kelestarian pembuatan yang penting bagi syarikat mereka. Kemampuan pembuatan dikatakan memberikan kelebihan daya saing kepada syarikat, pengurangan pembuangan sisa dan rangsangan inovasi dan pertumbuhan syarikat.

DEDICATION

I would like to thank the Almighty God for the grace and love that has been given. To my respected supervisor, Prof. Dr. Mohd Razali Bin Muhamad who has taught me a great deal in completing this project. Most importantly, I would like to thank my family for the continuous support and make my life wonderful.

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CHAPTER 1

INTRODUCTION

This part is about background of the research, problem statement, objectives and scopes of the project. The background of study is about what is mean by manufacturing sustainability, and what its effect on performance of manufacturing is. This chapter also will state about what is the importance of manufacturing industries and challenges in achieving manufacturing sustainability. Besides, the problem statement, objectives, and scopes are discussed in the sub header provided.

1.1 Background of Study

Manufacturing is the process in which the manufacture of goods whether for own use or for selling by hiring workers and using machineries, equipment, biological and chemical processing, or using formulations. The term can refer to a range of human activity, from the handcrafts to high technology, but it is most often used for industrial manufacturing, where the raw materials converted into finished products on a huge scale. Those finished products may be used to manufacture other product that has more complexity, for example home appliances or automobiles, airplanes, or sale to wholesalers, which then sell it to retailers, and then sell it to end users that is the consumers.

Manufacturing encompass all types of the economic system. In free market economy, manufacturing are typically targeted towards large volume production of goods for sale

to consumers to earn profit. In collectivist economy, the manufacturing is more regularly directed by the government to prepare a centered economic program. Within a mixed market economy, manufacturing happens below some regulations of the governments.

According to some economic experts, the manufacturing was the sector that generates wealth of the economy, while the services sectors tend to consume wealth (Joseph, K. 1976 cited in Wikipedia, 2014). Some new growth in opportunities of advanced manufacturing jobs was provided by the new and emerging technologies. Manufacturing provides essential support of materials to the country's infrastructure and for national defense. Instead, most manufacturing probably involves social and environmental costs significantly. Hazardous waste cleanup costs, for instance, may exceed the profits of the item that make it happens. Dangerous substances may expose workers to health risks. These expenses are currently well known and there are efforts to deal with it by increasing proficiency, lessening waste, utilizing mechanical beneficial interaction, and eliminate hazardous chemicals. Expanded utilization of technology for example, 3d printing additionally offers the possibility to decrease the ecological effect of delivering finished products via a distributed manufacturing.

The negative expense of manufacturing can also be handled by law. Developed countries regulate manufacturing activities with labor legislation and environmental legislation. Around the world, the manufacturer may be liable to regulations and contamination expenses to balance environmental expenses of manufacturing activity. Labor unions have assumed verifiable part in the arrangement of worker's rights and wages. Environmental laws and workers assurances accessible in developed countries may not be accessible in the third world. Product liability will result in additional costs to the manufacturing. This is an important dynamic in a continuous process, which happen over the past few decades, the manufacturing-based industries to migrate their operations to the "developing world" economy where manufacturing expenses are much lower than in the "developed world" economy. Review and investigation of patterns and issues in

manufacturing and investment worldwide concentrate on matters, for example, the nature and source of changes that could be considered which happen cross-broadly in the level of manufacturing and more extensive development of industrial-economic; competitiveness; and direct attractiveness to foreign. Recent article on manufacturing (“Manufacturing and investment,” 2014) has stated that researchers have studied the characteristics and factors that affect certain aspects of key of the manufacturing development. They have compared production and investment in a scope of Western and non-Western nations and presents case studies of the development and performance of key individuals in the industry and the market sector of the economy.

Manufacturing industry is refers to any industry that involved in manufacture and processing of products and revels either the production of another product or as a worth expansion (Economy Watch, 2010). Fabrication industry covers for a noteworthy offer of the industrial segment in developed nations. The end product can function whether as both ready available to be purchased by clients or as moderate products utilized as a part of the manufacture process. Manufacturing industry exists with the event of changes in innovation and financial improvement in Western nations amid the eighteenth to nineteenth century. This is known as the industrial revolution. It started in Britain and supplanted the textile production that requires labor with machine utilization and fuel consumption. Manufacturing industries is the main driver of sector that generates wealth of an economy. These commercial enterprises use assortment of advances and strategies known as manufacturing process administration.

Manufacturing industries comprehensively arranged into the metalworking industry, engineering industry, chemical industry, power industry, textile industry, food and beverage industry, construction industry, plastics industry, electronic industry, transport, and telecommunications industries. Manufacturing industries is important to the economy because they take a large share of the workforce and supply materials needed by the sector of strategic interest such as infrastructure and national defense. However, as stated in

(Economy Watch, 2010) not all manufacturing industries would profit the nation as some of them produce negative externalities with colossal social expenses. The expense of letting such commercial enterprises prosper may even surpass the profits created by them. Every manufacturing industry is one of a kind and has its own particular working environment and sets of technical prerequisites. Most of it has its own principles or targets; one of them was manufacturing sustainability, a term that to be given priority, which are increasingly of concern to most industries recently.

However, to achieve sustainability is not a simple matter, it is not easy, and it requires a comprehensive efforts from the industry. Nowadays, there are too many challenges that have to be faced by the industry of the manufacturing industry in ensuring their manufactured product are sustainable as well as to improve their manufacturing performance from time to time. Sustainable is characterized as the production of produced items that utilize processes that are non-contaminating, save energy and natural assets, and are monetarily sound and safe for workers, residents, and consumers (NACFAM, 2008). Thus, implementation of manufacturing projects was subject to many constraints which limit the initiation or expansion of operations, which often have significant negative effects on the overall performance of the project. By definition, constraints allude to any condition, for example, transient/spatial limits and wellbeing/quality concerns, which may keep a project an undertaking to accomplish its objectives.

Jayal et al. (2010) claim that accomplishing sustainability in manufacturing obliges a comprehensive perspective traversing not simply the item, and the manufacturing procedures included in its fabrication, additionally the whole supply chain, including the manufacturing systems crosswise over various item life-cycles. This obliges enhanced models, metrics for sustainability assessment, and streamlining methods at the item, process, and system levels. This research project will provide an overview about manufacturing sustainability and how it affects the manufacturing performance.

1.2 Problem Statement

The importance of developing a product that can sustain over time has long been a matter certified by the industry. This is because, the times that occur require the industry to create a product that can be used not only on that particular time, but also can be used in the future. So, whether the industry wants it or not, they had to follow the current requirements that are constantly changing with the times. However, there is no doubt that there are myriad challenges ahead to enable them to achieve it because the manufacturer not only want to sustain their products but, at the same time they also want to improve their manufacturing performance to ensure they can compete with others to be the best. Here we can see that the need for the industries to examine what aspects or factors that should be identified to address these issues. For sure it requires a proper understanding of what is meant by manufacturing performance.

This is very important because if they do not understand the concept of sustainable manufacturing and what is meant by manufacturing performance in the true sense, probably all the effort or changes or improvements that they did does not give the results or effects, such as what they expect. Perhaps what they are doing will only causing a lost to them because it is not in line with their main goal that is to achieve sustainable manufacturing and simultaneously ensuring their manufacturing performance are at their best. In this context, performance can be meant by financial or non-financial related. Indeed, it is presently broadly acknowledged that the key drivers of future financial performance is non-financial related. The manufacturing performances are evaluated from various viewpoints which are from the viewpoint of investors, customers, employees, and also supplier's viewpoint (Benchmark Index, n.d.).

Investors are individuals who make money for investment products with the expected financial returns. Here it can be seen that the performance of the company or industry plays an important role to attract investors to invest with them. Definitely, investors will only invest in an organization that has a good performance because their focus is to reduce the risk, but at the same time they expect high returns. From a customer perspective, only

those clients who describe themselves as 'very satisfied' with the product and organizational performance are possible to demonstrate the characteristics of loyalty. Finding solutions to this matter are becoming one of the primary concerns faced by governments, industry and communities across the world.

To attain sustainability, items, courses of action, and services should meet the difficulties not only related with their capacities and performance but as well as to environment, economy, and social issues (NIST, n.d.). Companies that are interested in development of sustainable product must be sensitive to sustainability related guidelines, design, and manufacturing systems and apparatuses. Guaranteeing a sustainable future obliges a coordinated arrangement of systems approach. Interlinked pathways in various stages characterize the system. This stage covers the issues of technical, economic, environmental and societal. The connections inside and over these levels are discriminating to the basic understanding of sustainable design and manufacturing, in light of the fact that tending to any of the issues in segregation could bring about unintended results (NIST, n.d.).

Nowadays, there are a lot of articles and studies about manufacturing sustainability as well as manufacturing performance but some related questions about it may remain unanswered, or a more detailed understanding of these issues has yet to be concluded. This may be due to the challenges that come in many different forms, flexible, changing over time (Dearing, A., 2000), and so on. So, it is necessary to identify effective factors on sustainability to provide related courses of actions to reach a sustainable improvement and at the same time manufacturing performance can be improved from time to time to face greater challenges in the future without neglecting the quality in every aspect of the product or service provided. An article on sustainability (NAM, 2014) has stated that there are some principles that supported by manufacturers for sustainability in manufacturing among these are exhibiting that sound economic, social and performance of environmental is a component of sustainable organizations, minimizing effect of natural

resource by expanding efficiencies and protection in optimizing raw material input and to lessen waste yield; keeping on improving the ecological, wellbeing and safety profile of manufacturing and its workforce by enhancing performance courses of action and items, overseeing land, utilize and natural resources to give financial profit while safeguarding biodiversity, working together and associating with supply chain members to mindfully oversee total ecological effects, building sustainable practices to endorse, draw in, create and retain a highly skilled and various workforce.

Amrina and Yusof (2011) states that lately automotive companies facing the pressure to reduce the environmental impact of their products and operations. For sustainability, it is necessary to achieve a balance among the triple bottom line involving economic growth, environmental endorsement, and social equity. It was a big challenge for automotive companies to give a serious attention to sustainability. Although issues of sustainability have become broadly throughout the years, only some of studies have been directed on consolidating sustainability into performance of manufacturing.

In summary, there is a need for a better understanding of what is meant by manufacturing sustainability as well as manufacturing performance. It is necessary to identify what are the factors that influences or need to be given attention in order to achieve manufacturing sustainability as well as to ensure performances in manufacturing industries are at the best.

1.3 Research Questions

The following research questions will be addressed:

1. What are the factors that can affect the sustainability of various manufacturing industries?
2. Why sustainability in manufacturing becomes one of the primary concerns by the governments, industry and communities across the world?
3. How sustainability can affect the performance of manufacturing?

1.4 Objectives

The primary goal of this research is to gain an understanding of what is meant by sustainable manufacturing, efforts needed to achieve it, and what is their impact on the performance of an industrial manufacturing. Particularly, the study has the following objectives:

1. To identify the elements and activities to achieve sustainability in automotive manufacturing industry;
2. To comprehend manufacturing performance of automotive manufacturing industry;
3. To find out the impacts of sustainability on the performance of manufacturing.

1.5 Scope of the Project

This research is conducted to find out the effect of manufacturing sustainability on manufacturing performance. The scope of this study is devoted to automotive industry only. There are some other limitations in this study, where only the automotive industries in Malaysia are to be involved and the respondents are only from listing of Proton Vendors Association (PVA). This study focused on the understanding of manufacturing sustainability. Challenges and factors involved to achieve it will be addressed through this research. Besides that, this study will also focused on the importance of manufacturing sustainability and the impact on manufacturing performance. Possible approaches that might be useful that contribute towards it are to be addressed.

1.6 Organization of the Report

Chapter 1 is about the introduction of the report. This chapter is about the background of study, problem statement, objectives and scopes of the project. The background of study is about what is mean by manufacturing sustainability, and what its effect on performance of manufacturing is. This chapter also will state about what is the importance of manufacturing industries and challenges in achieving manufacturing sustainability. Besides, the problem statement, objectives, and scopes are discussed in the sub header provided.

Chapter 2 presents about the literature review. This chapter describes about the review study from the previous research by the others. The objective of this chapter is to know the previous study that related to this paper and analyze the content to come out with the conclusion of this paper. The sources of literature are from the academic journal, internet, and article that related to the title.

Chapter 3 discuss about the methodology. This chapter emphasize the methods been used in this study. Methods for each of the objectives are included in this chapter in order to achieve the targeted goals. The appropriate methodology to finish this study which is been anticipated are to be outline through this chapter.

Chapter 4 is about result and discussion. In this chapter, a study of the effect of manufacturing sustainability on manufacturing performance will be carried out. This chapter presents the result analysis and discussion of three objectives; (i) to identify the elements and activities to achieve sustainability in automotive manufacturing industry; (ii) to understand manufacturing performance of automotive manufacturing industry; and (iii) to find out what are the impacts of sustainability on the performance of manufacturing.

Chapter 5 is about the conclusion and future work. This chapter presents the conclusion of all the previous results. This chapter provides overall significance of the study based on the results of the findings according to the objectives that have been conducted. The relevant recommendations and future work of the study are also included to improve this research.

CHAPTER 2

LITERATURE REVIEW

This chapter describes about the review study from the previous research by the others. The objective of this chapter is to know the previous study that related to this paper and analyze the content to come out with the conclusion of this paper. The sources of literature are from the academic journal, internet, and article that related to the title.

2.1 Manufacturing Sustainability

2.1.1 Definition of Manufacturing

Manufacturing is defined as the process of converting raw materials, components, parts or materials into finished goods that meet customer expectations or specifications (Business Dictionary, n.d.). Manufacturing typically use a human-machine setup with division of work in mass production. Manufacturing is very important because every single thing that we used in daily life cannot escape from its relationship with the manufacturing process. Besides that, manufactured products are needed for trade. According to the World Trade Organization, 80% of inter-regional trade is in goods, and only 20% are in services. Goods are needed to trade for example, to trade with foreign goods or we rack up a large and growing trade deficit. Services industry is very dependent on goods produced by the manufacturing industry. This is because their operations are dependent on the goods and the same goes for their technological progress.

Poverty and war can be eliminated if all regions in the world have a strong manufacturing background (Global Teach-In, 2012). Manufacturing is also very important because it contributes to the economic growth of any country in the world. Through manufacturing productivity, it's stated that each year there is an increase of approximately 3 percent in the U.S. In the meantime, producing merchandise makes up around two-thirds of all UK trades. The UK workforce makes 4% of the world's gross domestic product and 6% of the world's exports, from a country with one percent of the world's populace. In its earliest stage, manufacturing is typically done by a single talented artisan with an assistant. Training was by apprenticeship. In a significant part of the preindustrial world, the society framework secured the benefits and competitive advantages of urban artisans. An article on The History of the Manufacturing Industry (John Briggs, n.d.) has stated that before the Industry Revolution, (divided into two nearly seamless periods of productivity, the Industrial Revolution endured just about a century, from 1760-1850), most manufacturing happened in country regions, where family unit based manufacturing served as a supplemental subsistence method to farming (and keeps on doing so in places). Manufacturers composed various numbers of manufacturing households into a single organization through the putting-out framework. Toll manufacturing is a plan in which the first firm outfitted with specific machinery processes the raw materials or semi-completed merchandise for a second firm.

2.1.2 Definition of Sustainability

Sustainability is a term that is becoming one of the primary concerns by governments, industry practices and communities across the world. There are many ways the term is defined. The easiest and the most basic understanding of sustainability is "the ability to sustain" or, put another way, "the capacity to endure" (Sustainability Ltd., n.d.). Sustainability is not just about the future of our society, for today's industries and businesses, but it is also about commercial success. The effective organizations of tomorrow will be those that lead and make esteem both inside and outside the dividers of the organization. This will mean overseeing for the long haul and the short-term, creating plans that balance rivalry and participation, outlining and conveying items and services