

## **Descriptive analysis of sustainable manufacturing indicators in Malaysian manufacturing firms**

**N. Nordin\* and H. O. Adebambo**

School of Technology Management and Logistics, Universiti Utara Malaysia,  
06010 UUM Sintok, Kedah, Malaysia

\*Email: rani@uum.edu.my

Phone: +6049287015; Fax: +6049287070

### **ABSTRACT**

Manufacturing companies have been forced to give considerations to sustainable manufacturing practices due to the alarming social and economic factors. However, very few studies have investigated the extent of sustainable manufacturing practices within the context of developing countries, particularly in Malaysia. This study seeks to explore the extent of sustainable manufacturing implementation among Malaysian manufacturing firms. One hundred and four usable questionnaires were collected and analysed by using SPSS version 20. The findings revealed that among the three dimensions of sustainable manufacturing, the social well-being and economic have shown to be practiced to a large extent by Malaysian manufacturing firms. However, the lowest sustainable manufacturing practices implemented dimension is environmental. More efforts are needed to ensure that the Malaysian manufacturing firms consider the sustainable manufacturing practices more seriously. This study suggests that the scenario of sustainable manufacturing in Malaysia is yet to be strategic. Hence, more efforts are needed to ensure that the Malaysian manufacturing firms consider the sustainable manufacturing practices as a strategic measure to enhance performances.

**Keywords:** Sustainable manufacturing; environmental stewardship; economic growth; social well-being

### **INTRODUCTION**

The manufacturing sector is one of the most important sectors that hugely contribute to the GDP of Malaysia. The contribution has been noticeable, especially in terms of export products and employment creation opportunities [1]. The drive for sustainable practices in the manufacturing sector has been on an increasing momentum since the beginning of the new millennium [2-4]. Manufacturing industries have been making an effort to achieve sustainable manufacturing practices by shifting their manufacturing operation from an end-of-pipe solution to more sustainable manufacturing practices such as the product life cycles, integrated environmental strategies, and environmental management systems [5]. The effort has also been made by manufacturing firms to create the closed-loops, circular production systems and adoption of new business models towards achieving sustainable manufacturing practices [5]. Manufacturing companies have been forced to give considerations to sustainable manufacturing practices due to the alarming social and economic factors, especially among the countries in the Asia-pacific regions and USA [5]. Many previous studies in the Europe have concurred on the needs for the nation to uphold sustainable manufacturing practices [3]. Within the context of Malaysia,

studies [5-8] have also asserted the need for Malaysian manufacturing companies to become sustainable. Apart from the needs of the manufacturing firms in Malaysia to become environmentally friendly, the sustainable manufacturing practices are needed by these firms as a strategic factor to enhance the achievement of competitive advantage and better firm performance [9]. Efforts have been taken by many automotive industries in Malaysia to inculcate environmental friendliness into their manufacturing practices. Thus, understanding the scenario and current level of the implementation of sustainable manufacturing practices will help the Malaysian manufacturing firms consider sustainable manufacturing as a strategic factor towards achieving competitive advantage and better firm performance [9, 10]. As such, this study seeks to explore the extent of sustainable manufacturing implementation among Malaysian manufacturing firms.

According to the Brundtland report, sustainability is defined as a growth that meets the needs of the present without compromising the capability of the upcoming generation to meet their own needs [5]. Sustainability has been applied in many fields such as manufacturing, engineering, and design. Manufacturers are more concerned about sustainability issues, for example, in recognition of the relationship between the natural environment and manufacturing operations, which plays an important role in the decision making among industrial societies [2]. Sustainability is seen as having three dimensions which are economic, environmental and social (including political). Consequently, the achievement of sustainability requires an integration of the indicators of the economy and environment of the community and society. Figure 1 presents the summary of the integrated approach to sustainability.

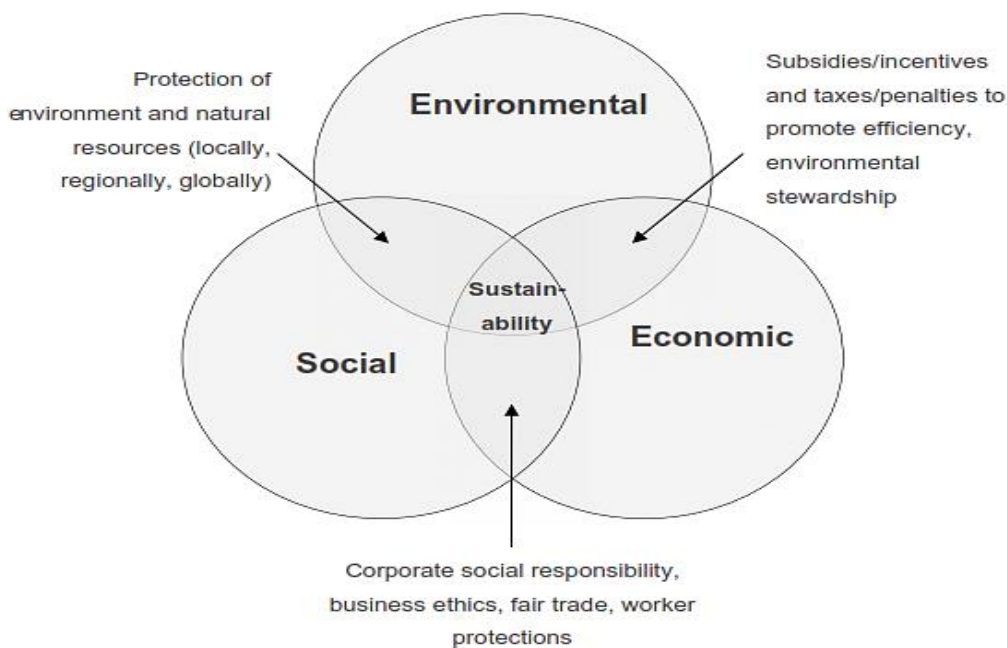


Figure 1. Integrated approach to sustainability [11].

No single definition has been posited for sustainable manufacturing because it is a journey that does not have an end. According to the U.S. Department of Commerce [10], sustainable manufacturing is defined as the creation of manufactured products that apply processes which are non-polluting and natural resources, and conserve energy and economically-sound process that minimizes the negative impacts of the environment and it also enhances safety for employee, communities, consumers and products. On the other

hand, the technical version of this sustainable manufacturing definition is known as a system that approaches for the creation and distribution of innovative products and services, which can minimize the resources of inputs, eliminate toxic substances and produce zero waste that in effect reduces the greenhouse gasses (GHG) [12]. The National Strategy for the Ecologically Sustainable Development defined sustainable manufacturing as conserving, using and enhancing the community resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future can be increased [5]. According to The Queensland Government, sustainable manufacturers are defined as those who improve their company profitability by using the world-class manufacturing and environmentally friendly practices. Traditionally, comparisons of the volume/variety of products have been considered in manufacturing process [13], however, manufacturing companies are now considering the production and process including other parameters of practices in order to incorporate the philosophical and other elements into the manufacturing strategies. Hence, a general viewpoint was created. Manufacturing operations are increasingly linked to the natural environment; therefore, incorporating environmental impact measurement requires the measurement of the environmental impact on the manufacturing strategies based on the assessment of the environmental impact (EI) on the society. The drive for sustainable manufacturing practices has increased in many parts of businesses since the beginning of new millennium [3, 14]. Thus, manufacturing industries have shifted their effort from the end-of-pipe solutions to more sustainable practices such as product life cycle, integrated environmental strategies and management systems [3]. In addition, efforts have been made in creating a closed loop, circular production, and adoption of new models for business.

Many studies have been conducted on sustainable manufacturing practices in the developed countries but very few studies have investigated the extent of sustainable manufacturing practices within the context of developing countries, particularly in Malaysia. According to Ijomah [15], sustainable manufacturing has become a critical issue for industries and in order to survive in today's competitive business environment, adopting sustainable manufacturing practices has become a necessity.

Empirically, few studies have been conducted on sustainable manufacturing practices in Malaysia. The majority of which were conducted in the automobile industry [5, 7] and electrical and electronic industries [16]. Among the literature on the sustainable manufacturing practices in Malaysia, Nordin et al. [17] in a case study conducted found that the responsive product strategy, lean practices, supply chain restructuring and sustainable material and design are the practices towards sustainable manufacturing in Malaysia. However, irrespective of the initiatives put in place to ensure sustainable manufacturing practices in Malaysia, Omar and Samuel [18] stated that the environmental practices in Malaysia are still in a stage where it is considered as an ethical behaviour rather than a strategic tool for achieving competitive advantages. As such, this study seeks to investigate the extent of sustainable manufacturing practices among Malaysian manufacturing industries.

## **MATERIALS AND METHODS**

The manufacturing sector is one of the most important sectors that hugely contribute to the GDP of Malaysia. The contribution has been noticeable, especially in terms of export products and employment creation opportunities. Therefore, the population of this study is the Malaysian manufacturing industry due to its huge contribution to the GDP of the

economy and is also a great contributor to the environmental degradation of the nation due to its operational activities. A mail survey questionnaire technique was used to collect data from the selected respondents who are the operation managers, manufacturing managers and environmental, safety and health managers of manufacturing firms in Malaysia. The list of the respondents was obtained from the directory of the Federation of Malaysian Manufacturers [19]. These respondents are thought of being aware and well versed in the issues of sustainable manufacturing practices in their firms. The five (5) indicators of sustainable manufacturing practices in this study were adapted from NIST [20] which includes (1) Environmental stewardship, (2) economic growth, and (3) Social well-being. The respondents were asked to indicate the extent to which they agree with sustainable manufacturing practices in their firm based on a Likert scale ranging from 1 to 5 in which 1 = Limited extent and 5 = Large extent. From this, 104 usable questionnaires were collected and analysed by using SPSS version 20. The next section presents the findings of the study.

## RESULTS AND DISCUSSION

### Demographic Profile of the Respondents

The results of the general background of the respondents which include job position and years of employment in the company are presented in this section. As shown in Table 1, the majority of the respondents occupy the position of environmental/health and safety management position (37.5%). The demographic analysis result also revealed that 42.3% of the respondents are between one to five years in their position. More so, the largest percentage (43.3%) of the respondents has spent between one to five years in their current company. The indication of this result is that the respondents are the appropriate personnel and in the right position to understand the practices of sustainable manufacturing in their companies. Also, the respondents are knowledgeable about manufacturing practices in their respected companies and able to provide useful information concerning sustainable manufacturing practices of their companies.

Table 1. Demographic profile of the respondents.

	Frequency	%
<b>1. Position</b>		
Operation	12	11.5
Production/manufacturing	13	12.5
Quality	15	14.4
Environmental/ Health and safety	39	37.5
Others	25	24.3
<b>2 Years of employment (in the current position)</b>		
Less than 1 year	15	14.4
1-5 years	44	42.3
6-10 years	14	13.5
More than 10 years	31	29.8
<b>3 Years of employment (in current company)</b>		
Less than 1 year	13	12.5
1-5 years	45	43.3
6-10 years	16	15.4
More than 10 years	30	28.8

**Background Profile of the Companies**

In this section, the demographic profile of the companies investigated in this study is presented. As depicted in Table 2, the Electrical and Electronic industry represents the major percentage (29.8%) of the respondents’ industrial sector. Furthermore, the frequency analysis of the certification of the companies revealed that the majority of the companies (48.1%) are certified in the Environmental Management System (ISO 14001). 21.2% of the companies have been certified in quality management (ISO 9001), only 1.9% of the companies have quality system (QS 9000) certification, 3.8% of the companies are certified in ISO/TS 16949 while 25% of the companies have other certification which ranges between Halal certification and integrated management system certification. In respect of the company ownership, 38.5% of the companies are privately owned and also, 38.5% are multinational companies. The size of the company is measured by the number of full-time employees of the company. The majority of the companies are large (51.9%), having more than 251 full-time employees.

Table 2. Demographic profile of the companies.

	<b>Frequency</b>	<b>%</b>
<b>Category of industry</b>		
<b>1</b> Electrical, electronic, computing machinery parts	31	29.8
Rubber and plastics	15	14.4
Food products and beverages	9	8.7
Chemical and allied products	9	8.7
Paper and allied products	6	5.8
Transport equipment	7	6.7
Textile, wearing apparel	2	1.9
Others	25	24.0
<b>2 Certification</b>		
ISO 14001	50	48.1
ISO 9001	22	21.2
ISO/TS 16949	4	3.8
QS 9000	2	1.9
Other	26	25.0
<b>3 Ownership</b>		
Private Enterprise	40	38.5
Multinational Company	40	38.5
Foreign	16	15.4
Joint Venture	4	3.8
State Owned Enterprise	4	3.8
<b>4 Company size (based on number of employees)</b>		
Large (more than 251)	54	51.9
Small (51 – 150)	27	26.0
Medium (151 – 250)	23	22.1

**Descriptive Analysis of Sustainable Manufacturing Practices in Malaysia**

In this section of the study, the statistical descriptive analysis of the constructs is presented. The analysis contained the means and standard deviation. The sustainable

manufacturing practice in this study was measured by the three different dimensions of sustainability (Environmental stewardship, Economic growth, and Social well-being). The environmental stewardship dimension of sustainable manufacturing practices is divided into four dimensions consisting of the emission, resource consumption pollution, and natural habitat conservation. The result of the descriptive analysis on the environmental stewardship revealed a mean value of 2.50 with a standard deviation value of 0.890 indicating that the practices of the environmental stewardship within the context of this study is to the medium extent. Furthermore, Table 3 revealed that pollution reduction practices among the surveyed companies had a mean value = 3.0 and a standard deviation value = 1.257 indicating that manufacturing companies in Malaysia have implemented the practices of pollution reduction to a certain extent. The result of the standard deviation shows that the practices have not been evenly implemented among the companies. Concerning the natural habitat conservation, the mean value was 2.06 and the standard deviation was 1.718. This indicates that the natural habitat conservation practices are in limited extent among Malaysian manufacturing companies and the practice has not been evenly adopted to be used in the Malaysian manufacturing.

Table 3. Means for sustainable manufacturing practices.

	Constructs	Mean	SD
<b>1.</b>	<b>Environmental Stewardship</b>	<b>2.50</b>	<b>0.890</b>
	Emission	2.47	1.046
	Resources Consumption	2.48	0.972
	Pollution	3.00	1.257
	Natural Habitat	2.06	1.718
<b>2.</b>	<b>Economic growth</b>	<b>3.18</b>	<b>0.838</b>
	Manufacturing Cost	3.41	0.076
	Investment	2.94	1.148
<b>3.</b>	<b>Social Well-Being</b>	<b>3.82</b>	<b>0.641</b>
	Employees	4.05	0.672
	Customers	4.09	0.685
	Community	3.30	1.226

The economic growth dimension of sustainable manufacturing practices is divided into two which consist of the manufacturing cost and cost of investment. The descriptive analysis result of this study revealed that economic growth is to a certain extent within the context of Malaysian manufacturing as indicated by the mean value = 3.18 and the standard deviation value = 0.838. In addition, the result shows that the manufacturing cost dimension of economic growth had a mean value of 3.41 and standard deviation value of 0.766 which indicates that the cost of manufacturing with the Malaysian manufacturing industry has been reduced to a certain extent and the practices have been evenly spread all over the entire industry. Furthermore, the investment dimension of the economic growth construct revealed a mean value of 2.94 and a standard deviation value of 1.148 which indicates that the investment in sustainable manufacturing practices has been implemented to a certain extent in the Malaysian Manufacturing, though the result of the standard deviation revealed that the practices of investment in sustainable manufacturing are still scantily implemented. The social well-being in this was measured from the dimension of the employee, customer and community well-beings. The result in Table 3 shows that social well-being in the Malaysian manufacturing

industry is practiced to a large extent as revealed by the mean value of 3.82 and standard deviation of 0.650. In addition, the result of the employee well-being in Malaysian manufacturing is practiced to a large extent as revealed by the mean value = 4.05 and a standard deviation value = 0.672. Also, a mean value of 4.09 and a standard deviation value of 0.685 indicate that the customer well-being has been maintained to a large extent across the Malaysian manufacturing companies. While the mean value of 3.30 and the standard deviation value of 1.226 revealed that community well-being practices have been implemented among the Malaysian manufacturing firms to a certain extent. However, as shown by the result of the standard deviation, it is deduced that the community well-being practices have not been evenly practiced by all manufacturing companies in Malaysia.

## **CONCLUSIONS**

This study investigates the extent of sustainable manufacturing implementation among Malaysian manufacturing firms. As mentioned in the previous sections, sustainability is seen as having the three dimensions which are environmental, economic and social. Among these three dimensions, the social and economic well-being has shown to be practiced to a large extent by the Malaysian manufacturing firms. However, the lowest sustainable manufacturing practices implemented dimension is the environmental. These results suggest that the scenario of sustainable manufacturing in Malaysia is yet to be strategic. More efforts are needed to ensure that the Malaysian manufacturing firms consider the sustainable manufacturing practices more seriously.

## **ACKNOWLEDGEMENTS**

The authors would like to be obliged to Universiti Utara Malaysia for providing the financial assistance under the PBIT research grant S/O no 12619.

## **REFERENCES**

- [1] MIDA. Malaysian Investment Performance. In: Authority MID, editor. Kuala Lumpur: Government of Malaysia; 2011.
- [2] Rosen MA, Kishawy HA. Sustainable manufacturing and design: Concepts, practices and needs. *Sustainability*. 2012;4:154-74.
- [3] Seidel R, Shahbazpour M, Oudshoorn M. Implementation of sustainable manufacturing practices in SMEs—case study of a New Zealand furniture manufacturer. Katholieke Universiteit Leuven: Leuven, Belgium. 2006.
- [4] Andrew-Munot M, Ibrahim RN. Remanufacturing process and its challenges. *Journal of Mechanical Engineering and Sciences*. 2013;4:488-95.
- [5] Zubir FM, Habidin FN. The development of sustainable manufacturing practices and sustainability performance in Malaysian automotive industry. *Journal of Economics and Sustainability Development*. 2012;3.
- [6] Adebambo HO, Ashari H, Nordin N. Antecedents and outcome of Sustainable environmental manufacturing practices. *International Journal of Management and Sustainability*. 2014;3:147.
- [7] Amrina E, Yusof SM. Key performance indicators for sustainable manufacturing evaluation in automotive companies. *Industrial Engineering and Engineering Management*, 2011 IEEE International Conference on: IEEE; 2011. p. 1093-7.

- [8] Ismail AR, Abdullah SNA, Abdullah AA, Deros BM. A Descriptive analysis of factors contributing to bus drivers' performances while driving: A case study in Malaysia. *International Journal of Automotive and Mechanical Engineering*. 2015;11:2430-7.
- [9] Adebambo HO, Ashari H, Nordin N. An empirical study of the Influence of sustainable manufacturing practice on firm performance. *Journal of Sustainability Science and Management*. 2015;10:42-51.
- [10] Adebambo H, Ashari H, Nordin N. Moderating role of perceived benefits between sustainable environmental manufacturing practices and firm performance. *Jurnal Teknologi*. 2015;77.
- [11] Wagner B. Implementing and managing economic, social and environmental efforts of business sustainability. *Management of Environmental Quality: An International Journal*. 2015;26:195-213.
- [12] Apple. Environmental Responsibility Report: Progress Report, Covering FY2014. Apple; 2015.
- [13] DOC. Sustainable manufacturing initiatives (SMI): A true public-private dialogue. 2010.
- [14] Millar HH, Russell SN. The adoption of sustainable manufacturing practices in the Caribbean. *Business Strategy and the Environment*. 2011;20:512-26.
- [15] Ijomah WL, McMahan CA, Hammond GP, Newman ST. Development of design for remanufacturing guidelines to support sustainable manufacturing. *Robotics and Computer-Integrated Manufacturing*. 2007;23:712-9.
- [16] Heng TB, Lee CL, Foong YP, San OT. A framework of a sustainable performance measurements (SPMs) model for the Malaysian electronic and electrical industry. *World Applied Sciences Journal*. 2012;20:107-19.
- [17] Nordin N, Ashari H, Rajemi MF. A Case Study of Sustainable Manufacturing Practices'. *Journal of Advanced Management Science Vol*. 2014;2:12-6.
- [18] Omar R, Samuel R. Environmental management amongst manufacturing firms in Malaysia. *Sustainable Energy & Environment (ISESEE), 2011 3rd International Symposium & Exhibition in: IEEE*; 2011. p. 148-51.
- [19] FMM. Federation of Malaysian Manufacturer, Directory 2010: : Malaysian Industries. In: *Manufacturer FoM*, editor. 41 ed. Kuala Lumpur: Federation of Malaysian Manufacturer; 2010.
- [20] Feng SC, Joung CB. An overview of a proposed measurement infrastructure for sustainable manufacturing. *Proceedings of the 7th Global Conference on Sustainable Manufacturing, Chennai, India2009*. p. 360.