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SUSTAINABLE MANUFACTURING PRACTICES IMPLEMENTATION IN MALAYSIA INDUSTRIES

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Abstract

Implementation of sustainable manufacturing practices brings lot of gains and benefits not alone to the manufacturing industries but also to their immediate environment. Such benefits includes increase the manufacturing capacity, good industry image, environmental friendly product, enhance business profile, consumer perceptions and corporate reputation. Nevertheless, many manufacturing industries are still unable to properly implements sustainable manufacturing practices. Hence, this paper identifies the sustainable manufacturing practices among manufacturing industries. Data were collected based on quantitative research method using self-administered questionnaires. A total of 104 manufacturing industries were selected based on stratified random sampling technique and SPSS was used to analyze the data. The result identified some applicable and non-applicable factors that affect proper implementation of sustainable manufacturing practices among manufacturing industries. Thus, the study will assist manufacturing industries to strengthen their implementation strategies on sustainable practices.

Keywords: Sustainable practices; manufacturing practices; implementation; environmental friendly; manufacturing industry

1.0 INTRODUCTION

In recent time, manufacturing industries are more concern on how their operations and activities can positively impact the environment. This concern has necessitated the need to implement sustainable manufacturing practices which is aim at reducing the negative impact of manufacturing industries operations and activities on the environment. The practice must be sustainable because it creates the balance between the economic, social and environmental aims of the industries. Also, it is the outcome of the relationship between the natural environment and manufacturing operations, which plays an important role in decision making among industrial societies. Thus, it is important to use environmental friendly manufacturing practices that equally improve the profitability of the industries.
Although, there have being many studies [1], [2], [3], [4], [5], [6] that have explored issues on sustainable manufacturing practices whereas only few explored on drivers and barriers to sustainable implementation [7], [8], [9], [10], [11], [12]. However, none of these studies have explicitly identified factors that enhance implementation of sustainable manufacturing practice in the manufacturing industries especially in developing manufacturing countries. Therefore, this study will investigate factors that affect implementation of sustainable manufacturing practice. The study seeks to pinpoint the applicable and non-applicable factors that manufacturing industries should pay greater attention to in order to properly implement sustainable manufacturing practices.

2.0 LITERATURE REVIEW

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 term of export products and employment creation opportunities [13]. The drive for sustainable practices in the manufacturing sector has been on an increasing momentum since the beginning of the new millennium [14], [15]. Manufacturing industries have been making an effort to achieve sustainable manufacturing practices by shifting their manufacturing operation from an end of pipe solutions to more sustainable manufacturing practices such as product life cycles, integrated environmental strategies and environmental management systems [15]. The effort has also been made by manufacturing firms to create closed-loops, circular production systems and adoption of new business models towards achieving sustainable manufacturing practices [15], [16].

Manufacturing companies have been forced to give considerations to sustainable manufacturing practices due to the alarming social and economic factors [14], especially among the countries in the Asia-pacific regions and the USA [15]. Many previous studies in the Europe have concurred on the need for nation to uphold sustainable manufacturing practices [14]. Within the context of Malaysia some studies [15], [17], [18] have asserted the need for Malaysian manufacturing companies to become sustainable. Efforts have also been taken by many automotive industries in Malaysia to inculcate environmental friendliness into their manufacturing practices.

Researchers concerned with ecological issues have asserted that many organizations respond to environmental issues based on their drives in implementing the initiatives [19]. Various drivers have been highlighted as being responsible for the implementation of sustainable manufacturing practices but these drivers may be diverse depending on the political, economic and social region within which firms operate. As such, it is pertinent to investigate the factors that drive the implementation of sustainable manufacturing practices in Malaysia. Though, many studies have been conducted on the sub-domains of sustainable manufacturing practices, however, only few studies have investigated the factors that motivate and de-motivate the implementation of sustainable manufacturing practices, especially in Malaysia.

3.0 METHODOLOGY

3.1 The Study Design

This study made used of quantitative research method by using cross-sectional survey approach because the data collected covered the period of the study only [20]. The choice of a cross-sectional survey instead of longitudinal survey research method was because the result was aimed to reflect peoples' opinion and attributes that cannot be obtained through other sources such as secondary sources [21]. The target population for this study was the Malaysia Manufacturing Industry. The list of Malaysia Manufacturing Industries was accessed via the directory of the Federation of Malaysia Manufacturer [22] whereas 104 industries were selected for the study. The selection of the sample size was achieved by using a stratified random sampling technique. This involves segregating the population into strata and followed by randomly selecting the industries from each stratum as suggested by study [23].

3.2 The Study Instrument

The questionnaire in this study was divided into eight sections which were based on study [24]. Section A contains items for measuring environmental stewardship. Four dimensions of environmental stewardship were identified in this study; emission, resource consumption, pollution and natural habitat. Eight items were developed for measuring emission. Resource consumption was measured by 10 items, pollution was measured with 5 items and natural habitat was measured with three items. Also, Section B of the questionnaire measured the economic growth variable. There were two dimensions of the variable; manufacturing cost and the investment. The manufacturing cost was measured by 12 items and investment measured by four items.

Similarly, Section C measured the social well-being which is dimensioned into three; Employees, customers and community. Employee dimension was measured by 12 items, 5 items were developed for measuring the customer's dimension of social well-being while the community dimension was measured by 3 items. Likewise, Section D contains 8 items for measuring the technological advancement variable while Section E measured the performance management variable of sustainable manufacturing practices with 13 items.

The measurement of the factors of sustainable manufacturing practices was presented in section F of the questionnaire. The respondents were asked to rank the presented questionnaire according to their importance. Furthermore, the respondents were asked to rank the listed factors to the implementation of sustainable environmental practices in section G in accordance of their importance.

On the other hand, the demographic information of the respondents was elucidated in section H of the questionnaire. The section contains seven questions which include the industry category of the respondents, quality system used in the Respondents industry, type of respondent's industry ownership, industry's size, respondent's position and the respondent's working experience. For all the section, 6 likert type scale ranging from 0 – 5, in which 0 = Not applicable and 5 = Applicable to a Large extent were used. The respondents were asked to tick the appropriate response from the options given in the section.

3.3 Data Collection

To ensure a robust and rich data for this study, a preliminary study was undertaken with three manufacturing practitioners. The three practitioners were interviewed in order to identified factors involves in the implementation of sustainable manufacturing practices among the manufacturing industries. Upon the completion of the preliminary study, a mail survey questionnaire technique was used to collect data from the selected respondents of this study, which are the operation managers, manufacturing managers and the environmental, safety and health managers of manufacturing firms in Malaysia. These respondents were thought of being aware and well versed with the issues of sustainable manufacturing practices in their industries. Respondents were asked to identify by choosing critical success and failure factors for sustainable manufacturing implementation in their industries. From this, fifty six (56) usable questionnaires were collected and analyzed by using SPSS version 20. The section below presents the findings of the study.

4.0 RESULTS AND DISCUSSION

Analysis on the demographic information of the respondents and their industries are presented in Table 1 and 2. Table 1 shows the general background of the respondents such as job position, and years of employment in the company. The respondents of this study were mostly environmental/health and safety managers (39%). Majority of the respondents have occupied their current position between 1 to 5years (41.1%) and most of them have worked in the same company for more than one year. The indication of this is that the respondents are well represented and have vast knowledge of sustainable manufacturing practices of their companies.

Table 1 Demographic information of respondent

		Percentage
1.	**Position**	
	Operation	11.5
	Production/manufacturing	12.5
	Environmental/ Health and safety	37.5
	Others	38.5
2	**Years of employment (in current position)**	
	Less than 1 year	14.4
	1-5 years	42.3
	6-10 years	13.5
	More than 10 years	29.8
3	**Years of employment (in current company)**	
	Less than 1 year	12.5
	1-5 years	43.3
	6-10 years	15.4
	More than 10 years	28.8

Table 2 shows the demographic of the industries involved in the study. The factors investigated were quality type of industry, system certification, company ownership, and company size. The result revealed that the respondents were mostly from large companies (50%) having more than 251 full time-full-time employees and from Electrical and electronic industrial category (30.4%). This is evidence that the Malaysian manufacturing sector is dominated by the electrical and electronic companies. Most of the companies are multinational companies (44.6%) certified with environmental management system - ISO 14001 (48.2%). The indication of this result is that these companies are technological and financially capable of implementing sustainable manufacturing practices.

Table 2 Demographic profile of industries

		Percentage
1	**Category of industry**	
	Food products and beverages	8.7
	Textile, wearing apparel	1.9
	Paper and allied products	5.8
	Chemical and allied products	8.7
	Rubber and plastics	14.4
	Basic metallic parts	4.8
	Electrical, electronic, computing machinery parts	29.8
	Transport equipment	6.7
	Others	19.2
2	**Certification**	
	ISO 9001	21.2
	ISO/TS 16949	3.8
	QS 9000	1.9
	ISO 14001	48.1
	Other	25.0
3	**Ownership**	
	State Owned Enterprise	3.8
	Joint Venture	3.8
	Private Enterprise	38.5
	Multinational Company	38.5
	Foreign	15.4
4	**Company size (based on number of employees)**	
	Small (51 – 150)	26.0
	Medium (151 – 250)	22.1
	Large (more than 251)	51.9

The environmental stewardship dimension of sustainable manufacturing practices was dimensionalised into four consisting of the emission, resource consumption pollution and natural habitat conservation. The result analyzed on environmental stewardship revealed a mean value of 2.50 with a standard deviation value of 0.890 indicating that the practices of environmental stewardship within the context of this study is at the medium extent. Though, the result revealed 3.8% of the sampled industries notified emission reduction as not applicable. However, as shown in Table 3, emission reduction has a minimum value = 0, maximum value = 5, mean value = 2.47, while the standard deviation result =1.046. The indication of this is that there is a limited extent to the practices of emission reduction among Malaysian manufacturing industries. In addition, the analysis on the resource consumption revealed that resource consumption reduction is not applicable in 2.9% of Malaysia industries. Though, the result shows a mean value of 2.48 and standard deviation value of 0.972. The result indicates that resource consumption is generally practiced at limited extent among Malaysian manufacturing companies.

Table 3 Summary of environmental stewardship

Constructs	Min	Max	Mean	Std. Dev
Environmental Stewardship	0	4	2.50	.890
Emission	0	5	2.47	1.046
Resource Consumption	0	5	2.48	.972
Pollution	0	5	3.00	1.257
Natural Habitat	0	5	2.06	1.718

Furthermore, it can be seen that pollution reduction practices among the surveyed companies has a mean value = 3.0 and a standard deviation value = 1.257 Indicating that manufacturing companies in Malaysia has implemented the practices of pollution reduction to a certain extent. Even though just 1.9% of the companies have not seen pollution reduction as applicable, the result of the standard deviation shows that the practices have not been evenly implemented among the companies. Concerning the natural habitat conservation, it was shown in the descriptive analysis result that a large proportion (31.7%) of the Malaysian manufacturing companies does not view the conservation of the natural habitat as applicable in their field. The mean value is 2.06 and the standard deviation is 1.718. This indicates that, 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.

More so, from Table 4 it can be indicates that technology advancement shows a mean value of 3.19 and a standard deviation value of 1.119, which indicates that technological advances in sustainable manufacturing in Malaysia has been practiced as a certain extent. However, the advancement of these technologies has not been fully initiated by manufacturing firms in Malaysia. The economic growth dimension of sustainable manufacturing practices was dimensioned into two, which consist of the manufacturing cost and the cost of investment. The analysis result of this study revealed that economic growth is at a certain extent within the context of Malaysian manufacturing as indicated by the mean value = 3.18 and the standard deviation value = 0.838.

Also, the result shows that manufacturing cost dimension of economic growth has a mean value of 3.41and standard deviation value of 0.766 which indicates that, cost of manufacturing with the Malaysian manufacturing industry has been reduced to a certain extent and the practices has 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 investment in sustainable manufacturing practices has been implemented to

a certain extent in Malaysian Manufacturing, though the result of the standard deviation revealed that the practices of investment in sustainable manufacturing is still scantly implemented. The descriptive analysis of economic growth is presented in Table 4.

Table 4 Summary of economic growth

Constructs	Minimum	Maximum	Mean	Std. Dev
Economic Growth	1	5	3.18	.838
Manufacturing Cost	1	5	3.41	.766
Investment	0	5	2.94	1.148
Technology Advancement	0	5	3.19	1.119

On the other hand, Social well-being in this was measured from the dimension of the employee well-being, customer well-being and the community well-being. The result of the descriptive analysis as presented in Table 5 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. Furthermore, the result of the employee well-being in Malaysian manufacturing is practiced at a large extent, has 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 customer well-being has been maintained to a large extent across the Malaysian manufacturing industries. While the mean value of 3.30 and the standard deviation value of 1.226 revealed that community well-being practices has been implemented in among 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 has not been evenly practiced by all manufacturing industries in Malaysia.

Table 5 Summary of social well-being

Constructs	Min	Max	Mean	Std. Dev
Social Well-Being	1	5	3.82	.641
Employee	2	5	4.05	.672
Customer	1	5	4.09	.685
Community	0	5	3.30	1.226

This study further found that many of the investigated manufacturing industries in Malaysia identified some of the indices of sustainable manufacturing practices as not applicable to their operations. Table 6 presents the details description of those non-applicable indices of sustainable manufacturing among Malaysian manufacturing industries. The result shows that non-treated waste water emission is not applicable in 41 (39.4%) of the companies. treated waste water emission in not applicable to 36 companies. Reusable waste produced, recyclable waste produced, re-manufactured waste produced, Disposal waste by landfill, Waste energy emission in form of heat, vibration and air emission re not applicable in 22, 10, 31, 24, 27 and 19 out of 104 industries respectively.

Table 6 Non-applicable environmental stewardship practices

Items	Frequency	ercentage (%)
EMISSION		
Non-treated waste water	41	39.4
Treated waste water	36	34.6
Reusable waste produced	22	21.2
Recyclable waste produced	10	9.6
Re-manufacturable waste produced	31	29.8
Disposal waste by landfill	24	23.1
Waste energy emission (in form of heat, vibration, etc)	27	26
Air emission	19	18.3
RESOURCE CONSUMPTION		
Specific virgin material used	10	9.6
Specific recycled material used	12	11.5
Specific reused material used	12	11.5
Specific remanufactured material use	20	19.2
Fluid consumption (including: cleaners, lubricants, oils, coolants, etc.)	7	6.7
Reclaimed or recycled packaging material from suppliers	14	13.5
Non-renewable energy consumption	29	27.9
Renewable energy consumption	44	42.3
Recycled water used	31	29.8
Land used	34	32.7
POLLUTION		
Hazardous substances	11	10.6
Green House Gases	26	25
Noise emission	2	1.9
Acidification substances	36	34.6
Particulate emission	16	15.4
NATURAL HABITAT		
Biodiversity management conservation of protected areas)	32	30.8
Policies to conserve and protect surrounding natural habitats	33	31.7

Items	Frequency	ercentage (%)
Habitat management (habitats protected or restored, especially forests and sustainable forests)	41	39.4
TECHNOLOGICAL ADVANCEMENT		
Applies new technology for manufacturing operations	4	3.8
Add high efficiency resources	6	5.8
Add high efficiency technology	5	4.8
Applies the experience of the R&D personnel for the benefits of process or product development	10	9.6
Invest adequate monetary resource into R&D projects in sustainable product/process	11	10.6
Invest adequate time resources into R&D projects in sustainable product/process	11	10.6
Establishes organization's level in innovative concept through Patent	14	13.5
Establishes organization's level in innovative concept through publishing scientific papers	18	17.3

In the aspect of resource consumption, the use of specific virgin material is not applicable in 10 out of 104 industries, specific recycled and reused material in 12 industries, specific remanufactured materials in 20 companies and consumption of fluid materials including cleaners, lubricants and oil are not applicable in 7 companies. Also, reclaimed or recycled packaging material from suppliers, non-renewable energy consumption, renewable energy consumption, recyclable water use and land use are not applicable in 14, 29, 44, 31 and 34 industries respectively.

Regarding to pollution, reduction of hazardous substances is not applicable in 11 out of the 104 sampled industries, 26 industries stated the reduction of Greenhouse Gases as not applicable to their manufacturing practices. Likewise, reduction of noise pollution emission, acidification substances and particulate emission are not applicable in 2, 36 and 16 industries respectively. Also, the analysis shows that a biodiversity management of the natural habitat is inapplicable in 32 out of the 104 industries, policies to conserve and protect the natural habitat does not relate to 33 industries, while 41 out of the 104 industries indicated that they do not apply habitat protection or restoration, especially forests and sustainable forests is not applicable to them.

Furthermore, Table 7 presents the result of the analysis of the economic growth index of sustainable manufacturing practices that are not-applicable to the industries. The result shows that only 1 out of the 104 industries identified Energy costs including fuel costs, labor costs, electricity costs and delivery costs as inapplicable in their company. Waste management and brand management costs are not applicable to 12 manufacturing industries. Also, packaging costs is not applicable in 2 manufacturing industries, while responsibility, risk and crisis management cost, employment and employee benefits cost and environmental protection expenditure are not applicable in 2, 3 and 4 manufacturing companies respectively.

Table 7 Summary of not-applicable economic growth practices

	Frequency	Percentage
Manufacturing Cost		
Energy costs (Includes fuel costs, electricity costs, etc.)	1	.96
Labour	1	1
Waste treatment costs	12	11.5
Packaging costs	2	1.9
Delivery costs	1	1
Brand management costs	12	11.5
Responsibility, risk & crisis management	2	1.9
Employment costs and employee benefits	3	2.9
Environmental protection expenditures	4	3.8
INVESTMENT		
Innovation & R/D investments	12	11.5
Investments and impacts of community development (job creation, infrastructure , technology transfer, and social capital)	9	8.7
Renewable energies investments	14	13.5
Energy efficiency investments	7	6.7

Table 8 shows social well-being index of sustainable manufacturing practices that are not applicable in some Malaysian Manufacturing industries. One out of the 104 investigated industries stated that encouraging employees to give suggestion towards sustainable improvement, reduction of injuries, occupational diseases, lost days, and absenteeism, education, training, counseling, prevention, and employee empowerment to limit the risk of work place injuries, human rights training for

security personnel and employee performance and career development review are not applicable in their company. However, Encouragement of line stops due to safety concern and provision of skills management program are not applicable in 2 among the 104 investigated industries.

Concerning the customers' social well-being, reduction of customer's complaints and the provision of the information services required by the customers are not applicable in 1 out of the 104 investigated industries. Also, assessment of the life cycle of the product towards the health and safety impacts on customers is not applicable in 2 among the 104 industries. Relating to the social well-being of the community, 9 of the companies do not apply the management of the public service. 8 out of the 104 industries do not participate in the development of public policy, while community service responsibility program is not applicable in 4 industries.

Table 8 Non-applicable social well-being of sustainable manufacturing practices

Items	Frequency	Percentage
EMPLOYEE		
Encourage employees to give suggestions towards sustainable improvement	1	1
Encourage line stops due to safety concerns	2	1.9
Reduction of injuries, occupational diseases, lost days, and absenteeism	1	1
Education, training, counseling, prevention, and employee empowerment to limit the risk of work place injuries	1	1
Human rights training for security personnel	1	1
Skills management programs	2	1.9
Employee performance and career development review	1	1
CUSTOMER		
Product life cycle assessment for health and safety impacts	2	1.9
Reduce customer complaints	1	1
Provide product and service information required by customers	1	1
COMMUNITY		
Public service management	9	8.7
Participation in public policy development	8	7.7
Community Service Responsibility (CSR) programs	4	3.8

One plausible reason for the non-applicability of the indices of sustainable manufacturing practices in these industries may be due to the perception of sustainable manufacturing practices in Malaysian industries. According to study [25] the implementation of sustainable manufacturing initiatives in Malaysia regardless of the industry ownership is in a stage where environmental practices are mainly implemented based on ethical obligation to satisfy the stringent requirement of the regulations. This stage is witnessed by putting necessary resources in place as a reaction to pressure from high manufacturing standards and regulation, but it has not been considered to be a strategic factor in achieving better operational performance [26]. Study [27] asserts that this stage of implementation only witnesses the incorporation of certain objectives of the industry by the management. Although the sustainability variables might have been utilized by the firms in some certain aspects of production and processes, but it is yet to be considered as relevant as a strategic factor of the entire division of the industries [28].

5.0 CONCLUSION

This paper has explored recent trend of sustainable manufacturing practices among Malaysia manufacturing industries. It was revealed that environmental stewardship practices are found to be implemented at a medium level. Economically, sustainable manufacturing in Malaysia is implemented at a certain level, while the social well-being aspect of sustainable manufacturing has been practiced at a large extent. Similarly, it was discovered that many industries in Malaysia are yet to implements certain indices because they are considered as not relevant in Malaysia.

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