Sustainable Manufacturing Practice: Knowledge Sharing by Malaysian SMEs

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***Abstract*— Sustainable manufacturing has been widely studied and practise among manufacturing company around the world. This approach is one of the best approaches to reduce the environmental impact that produce during the manufacturing process. In Malaysia, this approach has been implemented in several SMEs company. This article will present four case studies that have been conducted on four SME company in Malaysia that had implemented SMP. The four companies were selected to share their knowledge and experience on the implementation, best practice and sustainability performance. The findings show that SMP has been well practice by those companies. All companies' emphasis on reducing environmental and social issues by implementing a number of sustainable manufacturing practices such as cleaner production, eco-efficiency, employee-oriented sustainable practices, supplier-oriented sustainable practices, and customer-oriented sustainable practices. This finding can be used as a guideline for Malaysian SMEs in implementing the sustainable manufacturing practices in their organization**

***Keywords*—** *Include at least 5 keywords or phrases*

1. Introduction

Sustainability and sustainable manufacturing (SM) have been defined in various ways in the literature. Some researchers viewed SM as production methods or technologies that focus on environmental protection while pursuing economic development. For example, [1] defined SM as the means for manufacturers to add the most value to their products and services by making the most efficient use of the earth's limited resources, generating the least pollution to the environment, and targeting for environmentally clean production systems [1]. Allwood described SM as the developing technologies to transform materials without the emission of greenhouse gases, use of non-renewable or toxic materials or generation of waste [2]. As per the Department of Commerce in the US, SM is defined as the creation of manufactured products that use processes that are non-polluting, conserve energy and natural resources, and are economically sound and safe for employees, communities, and consumers [3]. Three aspects of sustainable yield are identified namely economic, environmental and social, implying that SM is not simply assumed as value creation's processes that aim to enhance economic and environmental performance but also includes the achievement in the social aspect.

Recognizing the interdependence of the three pillars of sustainability (i.e. economic, environmental, and social), the Triple Bottom Line (TBL) approach suggests that apart from concentrating on economic goals, organizations necessitate to engage in activities that positively affect the environment and social performance [4]. Advocating the wider context of sustainability, the present study defines SM as a broad notion that was developed through the integration of sustainability concepts into the manufacturing system with an aim to achieve sustainability in industrial production. Economic sustainability refers to the extent to which a firm improves operational and business performance [5]. While operational performance measures the ability of a firm in reducing lead time and cost as well as improving product quality, customer service and productivity, business performance addresses the market and financial outcomes such as market share, corporate and product image or reputation,

revenues and new market opportunities. The efforts towards social sustainability extend the corporate responsibilities beyond the organizational boundaries and normally address the demands and needs of other key stakeholders such as customers, suppliers, governments, local communities, non-government organizations, and so forth [5]. With regard to cover "green" issues from natural environment conservation to energy consumption, environmental sustainability refers to the ability of firms in reducing the level of resource usage, pollution emitted, and waste generated [5].

2. Sustainable Manufacturing Practice

The efforts towards sustainable production in manufacturing industries have shifted from the application of technology for the treatment of pollution at the end of the pipe to more integrated systems of production which support the collaborations across functional areas within a firm as well as inter-organizational level [6]. The evolution of SMP can be seen in the three levels, i.e. product, process and system.

At the product level, the traditional 3R concept (reduce, reuse, recycle) has been expanded to a more sustainable 6R approach, changing the paradigm from single life cycle to multiple life cycles ([7]; [6]). At the process level, various efforts have been undertaken in optimizing technological improvements and process planning for reducing resource consumption, waste generation, occupational hazards, and so forth, as well as improving product life by manipulating process induced surface integrity [7]. While, at the system level, the orientation of sustainable practices has been transformed from a mere focus on manufacturing operations and interdepartmental cooperation, sustainable thinking has been expanded beyond the organizational level to include the product life cycle and industrial relations ([7];[6]).

In order to be more sustainable, the issues of sustainability on all levels must be considered altogether instead of standalone approaches [7]. In this study, SMP is defined as a firm's intra- and inter-organizational practices that integrate environmental, economic and social aspects into operational and business activities.

3. Research Method

A case study approach was conducted in this study in order to gather in-depth, rich data on sustainability and sustainable manufacturing practices. Since there is still lacking empirical research that studies sustainability and SMP in Malaysian SMEs industries within its real-life context, exploratory case study technique was chosen to gather and analyze data comprehensively in this research. The firms were chosen based on a set of specific criteria including:

1. The number of full-time employees is less than 200 or annual sales turnover is less than RM50 million since the focus of this study is SMEs.

2. Having recognizable standard related to quality management system and environmental management system such as ISO 90001 (Quality Management System Standard) and IS0 14001 (Environmental Management System Standard).

3. Implementing sustainable manufacturing practices for a period of at least three years.

4. Findings

4.1 Firm A

Firm A tries to manage sustainability issues by implementing various types of sustainable manufacturing practices such as cleaner production, eco-efficiency, employee-oriented sustainable practices, supplier-oriented sustainable practices, and customer-oriented sustainable practices. Leading by the chief executive director, the top management of Firm A put a high priority in protecting the natural environment. The full commitment toward improving environmental and social sustainability from the top fosters the adoption of cleaner production in the operations department as well as eco-efficiency approach at the whole department within the firm. Firm A acquires new technology, digital print machine, which is more sustainable compared to a conventional machine. Besides that, the firm also continuously make efforts to optimize manufacturing process to reduce waste and emissions, adopt 3R (reduce, reuse, recycle)

approach and seek alternative resources to substitute non-environmental friendly materials and supplies. For the time being, Firm A spend a significant amount of investment for a new big project to produce renewable energy through solar technology.

Embracing the notion of employees as an asset of the organization, Firm A emphasizes the welfare of its employees. Aside from adhering industry safety regulations, the firm care for employees' personal development, and involving employees in making decisions particularly related to the daily operations. In order to support work-life balance, Firm A provides accommodation and facilities such as prayer room, reading corner, and karaoke room. The employees also only work 5 days per week.

With regard to the customers, Firm A has its own philosophy, "customers pay salary to the firm". Being socially responsible toward customers become a high priority in this firm. For example, the firm develops a close relationship with the customer to get mutual benefits simultaneously with protecting the natural environment. The firm will advise its customers in product design. Lastly, Firm A also monitors and collaborates with its suppliers to improve environmental sustainability. Beside cost factor, the firms choose suppliers based on environmental criteria. Firm A and suppliers will share the know-how and problems with each other to improve operational and business performance.

4.2 Firm B

As demands from both internal and external stakeholders, Firm B tries to be environmentally and socially responsible by adopting several sustainable manufacturing practices such as cleaner production, eco-efficiency, employee-oriented sustainable practices, supplier-oriented sustainable practices, and customer-oriented sustainable practices. In order to reduce resource consumption, pollution emission and waste generated in the operations department and within the entire level of organization as well as increase employee skill, occupational health and safety, and employee satisfaction, Firm B continuously tries to improve its process design, optimize manufacturing processes, apply 3R approach, acquiring cleaner technology, and improve work practices and maintenance. All of such practices must be aligned with nine predetermined objectives which were monitored regularly by the top management including:

1. Reduce and minimize the generation of scheduled waste.
2. Reduce usage of paper.
3. Reduce usage of electricity.
4. Reduced usage of liquefied petroleum gas (LPG).
5. Recycle paper.
6. Achieve zero leakage, spillage and burst of chemicals, and scheduled wastes.
7. Achieve zero overflows of waste.
8. Achieve zero fire breakout.
9. Achieve zero accident and injury.

Beside guaranteed observation of industry safety regulations, Firm B also provide some accommodation (such as hostel) and facilities to the employees to support work-life balance (such as pantry). While being socially responsible toward employees, Firm B also put a high priority on its suppliers and customers welfare. For example, the firm will brief suppliers to set up their own environmental programs, and sending internal auditors to appraise the environmental performance of suppliers once a year. The selection of suppliers also is made by a set of criteria including their environmental performance.

The main customer of the firm is local and international automotive makers. Being socially responsible toward customers, Firm B use reuse boxes for packaging, provide credible information about product materials and processes to the customers and integrate the customers' feedback into its business activities. Firm B also spends a significant amount of money to hire a qualified contractor for managing its waste in a sustainable manner. The firm needs to fulfill customers' expectation as indicating by good performance rating for ensuring continuous business relationships.

4.3 Firm C

Firm C implemented various sustainable initiatives and practices such as eco-printing, eco-lamination, and corporate social responsibility (CSR) projects. Embracing the concept of eco-printing and eco-lamination in daily operations, Firm C use environmentally responsible printing and laminating process which translated by using eco featured machine, implementing environmental management system (method) and consuming environmental friendly materials. In the printing process, the firm used the eco featured press and substituted non-environmental friendly materials with more environmentally friendly such as vegetable-based inks and recycled paper. While, in the lamination process, Firm C adopted solvent-free lamination process and used cellulose diacetate and polyurethane adhesive as materials. The firm cooperated with a number of green suppliers.

Acquiring cleaner technologies and equipment, Firm C used eco featured machine which is energy efficient, clean, and green (e.g. less paper wastage and less ink wastage). However, due to several limitations, the study found that the firm merely focused on 3R approach (i.e. reduce, reuse, recycle) in its daily operations and unable to adopt a more sustainable 6R approach which extends the concept of 3R to include the other '3R' (i.e. recover, redesign, remanufacture).

Firm C also involved in some CSR projects especially to create environmental awareness and sustainable society such as tree planting, fund raising, and eco-design workshop. Recognized the importance of corporate social responsibilities in managing environmental and social issues, top management encouraged the firm to engage with activities related to the stakeholders such as business partners, customers, suppliers, employees, and local communities.

4.4 Firm D

Firm D attempts to solve or at least reduce the environmental and social issues by implementing a number of sustainable manufacturing practices such as cleaner production, eco-efficiency, employee-oriented sustainable practices, supplier-oriented sustainable practices, and customer-oriented sustainable practices. Adopting cleaner production concept, Firm D continuously tries to prevent pollution at source rather than remove or treat it after it was created. Various initiatives has taken such as substitute hazardous materials to an environmental friendly materials. Since majority of the products manufactured will be applied and use in electrical and electronic industries, Firm D must use materials that pass RoHS (Restriction of Hazardous Substances) and REACH (Registration, Evaluation, Authorization and Restriction of Chemicals) compliance. Firm D also optimize the manufacturing processes to reduce solid waste and emissions, design the tools and processes with an aim to reduce energy and materials consumption, as well as conduct good housekeeping practices. Though the firm did not acquire new clean or green technology to use in manufactured products, Firm D modified or upgraded the existing machines and equipment to become greener which more economic and environmental friendly.

Adopting eco-efficiency concept, Firm D extended the implementation of environmental friendly and socially responsible practices to a wider context to include every department in the firm. Cross-functional cooperation being conducted for managing environmental problems. Having total quality environmental management system, Firm D continuously ensure that the firm comply with environmental and other relevant regulations. The firm employed 3R approach in its business operations such as reuse of its products and components as well as recycle waste or materials especially packaging materials.

Apart from adopting cleaner production and eco-efficiency in daily operations, Firm D has also undertaken its responsibility to ensure the safety, health and welfare of the employees as well as protecting others such as customers from the safety and health hazards arising from the business activities. The firm's efforts in relation to the occupational safety and health issues have met the safety legislations which enforced and annually audited by Department of Safety and Health, Malaysia. Among the employee-oriented sustainable initiatives and practices carried out by the firm are fair payment of employees (met the minimum wages in Malaysia), and supporting work-life balance by providing facilities to the employees such as basic pantry and prayer rooms.

Caring for the wellbeing of both suppliers and customers, Firm D implemented various sustainable initiatives and practices including

choose suppliers based on the environmental criteria, share knowledge and problems with suppliers and customers for improving environmental sustainability, implemented environmentally friendly waste management especially for both solid and liquid waste (chemical), improve the packaging of products by considering the environment such as used reusable packaging, and met the customer requirements for supplying environmental-friendly products. Since its customers are industrial (manufacturers) and many of them are large firms from various industries (e.g. external hard drives and computer, radio communication, automotive accessories, consumer electronics, and industrial engineering) in which are very concern with environmental issues, Firm D need to verify that both its products supplied and processes (ways of making products) are sustainable for ensuring long-term business relationship.

Firm D also showed some efforts on improving communal performance such as providing donation or sponsorship to the events organized by higher education institute and involving in certain CSR projects related to the community. However, such efforts were ad hoc and not in a regular basis.

5. Discussion & Conclusion

As a conclusion, this study has explored the sustainable manufacturing practices in four Malaysian SMEs. An analysis has led to the identification of the five sustainable practices which are being applied in the firms studied such as cleaner production, eco-efficiency, employee-oriented sustainable practices, supplier-oriented sustainable practices, and customer-oriented sustainable practices.

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