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ORIGINAL ARTICLE

EXTENDED ECO-EFFICIENT SUPPLY CHAIN INTEGRATION MANAGEMENT MODEL: A RESEARCH NOTE

Latifah Mohamed Naina[1], Yudi Fernando[1,*], Muhammad Shabir Shaharudin[1]

[1] Faculty of Industrial Management, Universiti Malaysia Pahang, Pahang, Malaysia

ABSTRACT – Manufacturing organizations must improve their environmental protection as this is the requirement of every stakeholder nowadays. At the same time, manufacturing organizations that pursue environmental protection goal should adopt eco-efficient supply chain integration as it has been known to improve environmental protection without sacrificing economic and operational performances. Nevertheless, there is a decline in integration among manufacturing organizations and their supply chain partners. Furthermore, investigations in the literature have been one-dimensional toward the relationship between practice and performance. It is obvious that current studies pointing toward energy-efficient practice to achieve eco-efficient supply chain integration but it is insufficient. Thus, this study objective is to investigate the impact of eco-efficient supply chain integration on environmental protection and proposing improvement for future research. This study has proposed an extended eco-efficient supply chain integration management model based on the gap in the literature and industry. This study elaborates on the importance of manufacturing organizations achieving environmental protection while understanding that organizations especially from developing countries cannot afford to move from economic and operational performances. The extended model proposed also underlines the improvement for eco-efficient supply chain integration management model and providing a breakthrough for future research to contribute to the organizational theory development and practical improvements.

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Eco-efficient supply chain integration; eco-efficiency; energy efficiency; supply chain integration; environmental protection; manufacturing

INTRODUCTION

Nowadays, environmental issues have become serious threat to the economy, society and environment. Issues such as climate change, Greenhouse gasses emissions, water and solid wastes (Klassen, 1993) have been the front issues that concern governments, societies and organizations (Rozar, Hasrulnizzam, Mahmood, & Ibrahim, 2015). These concerns are amplified in manufacturing industry as organizations in this industry produces high amount of Greenhouse gasses emissions and pollutions (Shaharudin & Fernando, 2017). Specifically, Malaysia that depends heavily on manufacturing industry due to its contribution to the GDP and export-oriented have also produces high emissions and pollutions. In fact, Malaysia was in the top 30 countries in the world that produces highest amount of carbon emissions (Shaharudin & Fernando, 2015). As a result, Malaysia and countries that depending on manufacturing industry for its economy have been the focus of stakeholders to improve its environmental protection.

Scholarly works have found that manufacturing organizations looking into environmental protection to offset and reduce emissions and pollutions due to pressure from government, customer, environmental non-government organization and competitor (Fernando, Wah, & Shaharudin, 2016). However, it is easier said than done as many manufacturing organizations have different objectives particularly to improve its economic performance and operational performance before focusing on environmental and social performances. Nevertheless, the reason for several manufacturing organizations focusing on economic performance and operational performance has been criticized as latest development in the literature has shown that manufacturing organizations that focus on environmental protection not only provide positive impact on the environment but also for manufacturing organizations' economic and operational performances. This is due to focusing on environmental protection leads to competitiveness among manufacturing organizations (Styles & Schoenberger, 2012). In addition, the competitiveness will also benefits the network of the supply chain for that manufacturing organization. Therefore, scholars have recommended that manufacturing organizations to practice environmental protection in its supply chain and operations (Acquaye, Mohammed, Genovese, Afrifa, Yamoah & Oppon, 2017).

The objective of environmental protection is to allows manufacturing organizations to focus on its economic and operational performances (Katiyar, Meena, Barua, Tibrewala, & Kumar, 2018). As the mentioned environmental protection is critical to manufacturing organizations, the underline practice requires manufacturing organizations to focus on energy consumption with economic growth as its objective without sacrificing environmental protection (Rahman, Noman, & Shahari, 2017). Both performances are critical to manufacturing organizations, government and society. This

*CORRESPONDING AUTHOR | Yudi Fernando | ✉ yudi@ump.edu.my

is because Colgan (2009) found that 38 percent of carbon emissions come from manufacturing organizations while these organizations produce goods and services for society.

Yet, the challenge is not only about environmental protection and practice of energy efficiency, but it is to help manufacturing organizations to adopt the practice throughout its supply chain network. Nowadays, the organization is no longer working alone but most organizations belong to several or large network of supply chain. As a result, adoption of environmental protection has become a challenge for manufacturing organizations and for scholars. This is due to the availability of data from manufacturing organizations is limited to designing efficient environmental supply chain framework.

Data limitation is not the only issues faces by scholars but manufacturing organizations also nowadays have complex and global supply chain processes. As the world is becoming more integrated due to globalization, the network of manufacturing organizations' supply chain are becoming more challenging to manage (Jin, Granda-marulanda, & Down, 2013). Thus, integration practice has been one of the key practice that manufacturing organization focuses on to ensure that the overall supply chain performance is achievable (Sezen, 2015). In the literature however, scholars have stressed that supply chain integration among organizations is advantages to the whole network of organizations to further improve its competitiveness and better performances. Yet, the benefits of the integration has not been well investigated with environmental protection due to complexity of investigating supply chain networks and specific supply chain processes that produce pollutions and emissions. As integration of the supply chain is to optimizes the operations of organizations in the network, and the objective of environmental protection is critical for manufacturing organizations (Trkman & Stemberger, 2007), the linkage between two concepts (supply chain integration & environmental protection) is regard as a tool or mean for manufacturing organizations to achieve sustainable development without sacrificing operational excellence (Govindan, Sarkis, Jabbour, Zhu, & Geng, 2014).

Therefore, this study is to provide an insight on how manufacturing organizations can achieve operational performance without sacrificing environmental protection while also meeting the operational objective. In order to do so, this study is focusing on the combination of supply chain integration concept with eco-efficient practice in order for manufacturing organizations to achieve environmental protection. This study allows the contribution to the literature as the combination of supply chain and operations and environmental science disciplines will further help scholars to theoretically contribute to the organizational theory development. As a result, scholars are able to understand more about organizations' environmental practices and performance. As business is becoming more complex, achieving all front in performances such as economic, social, operations and environment is inevitable. Thus, this study practically helps manufacturing organizations to achieve environmental protection without neglecting its core operations and supply chain performance.

LITERATURE REVIEW

This study's scope is focusing on manufacturing organizations in the Malaysian manufacturing industry as it is relevant to the investigation of eco-efficient supply chain integration towards environmental protection. In addition, Malaysia also realized that the manufacturing industry has contributed largely to the pollutions and emissions and that there is a need for manufacturing organizations to protect the environment (Mokhtar, Ta, & Murad, 2010). However, Malaysia as a developing country that its GDP is depending on the growth of manufacturing industry need to ensure that its economic growth is increasing and organizations' performance is performing well. Therefore, manufacturing organizations need to focus on operations and economic performances as well (Bekhet & Othman, 2017). Therefore, the key here is that Malaysian manufacturing organizations need to balance the performance by adopting eco-efficient supply chain integration practices to ensure that both operations and environmental protection can be achieved.

Currently, Malaysian manufacturing organizations are in dilemma as protecting the environment while achieving operational performance is considered as expensive for manufacturing organizations to focus on. Furthermore, many manufacturing organizations in Malaysian manufacturing industry are manufacturers for other manufacturing organizations or exporting the product to be assembled by other manufacturing organizations. As a result, decision to improve environmental protection while the manufacturing organization is expected to fulfil its operational objective is challenging and expensive. Nevertheless, with Malaysia moving for developed country status and trying to achieve vision 2020 by focusing on growth in economy, social and operations, environmental protection should not be neglected and the literature had shown that manufacturing organizations are moving towards that direction (Masud, Amin, Akhtar, Kari, Afroz, Rahman, & Rahman, 2015; Shah & Husin, 2013).

Environmental Protection

Environmental protection can be defined as the efforts to reduce emissions and pollutions by focusing on the land, air, solid waste and water resources (Mckinley et al., 2017; Perry & Singh, 2011). By improving environmental protection, manufacturing organizations are able to meet various requirements of its stakeholders (Machuca & Miras-rodríguez, 2018) particularly government that imposed stricter environmental regulations and customer pressuring organizations to take proactive roles in environmental management. In addition, manufacturing organizations are able to produce higher quality products and rebrand its products to cater to wider market (Vries, Tervel, Ellemers, & Daamen, 2015).

This is done through manufacturing organizations supply chain and operations processes where manufacturing organizations have to invest in green technology (Fernando, Shaharudin, & Wah, 2015), adopting practices for energy efficiency and to be more flexible and responsive in its operations. Green technology helps manufacturing organizations to reduce emissions particularly carbon emissions while energy efficiency will enable manufacturing organizations to

reduce wastages and pollutions. Moreover, flexibility and responsiveness of manufacturing organizations in its operations will improve the ability of organizations to remanufacture or realign the production process without additional process or materials or technology that will incur more costs, emissions and pollutions.

The importance of manufacturing organizations to achieve environmental protection cannot be denied any longer as rapid development and dependency on manufacturing industry have increase the emissions and pollutions. Moreover, that dependency and growth in manufacturing industry have increased the supply and demand of coal and fossil fuel energy (Mokhtar, Bin, Ta & Murad, 2010). This expectation has repercussion for Malaysian environmental protection goal. As such, scholars that investigate low carbon supply chain (Shaharudin, Fernando, Jabbour, Sroufe, & Jasmi, 2019) and green supply chain management (Fernando, Jasmi, & Shaharudin, 2019) have underlined that emissions and pollutions can be significantly reduced through energy management. Thus, in order for manufacturing organizations to protect the environment, energy efficiency and substituting current energy with renewable energy are recommended.

Figure 1 shows the determinants of energy efficiency for manufacturing organizations to achieve environmental protection. The critical driver of energy efficiency is of course related to energy management where manufacturing organizations need to reduce the energy without lowering the operational standards, quality and target (Ma, & Cai, 2018). On the other hand, services can be defined as the close relationship or integration between buyer and supplier to ensure that the environmental objectives can be delivered. Studies show that closer relationship with supplier will help manufacturing organizations to reduce the cost, ensuring quality, reducing error in inventory and reducing over extraction of resources (Wang, Wan, Zhang, Li, & Zhang, 2015; Nor, Bahari, Adnan, Kamal, & Ali, 2016). As such, when manufacturing organizations receives better services from its supply chain partners particularly suppliers, this will ensure that the energy used to run the production as well as the processing of materials kept at minimum. In addition, type of material used by manufacturing organizations to produce its products is also critical to protect the environment. While substituting to less carbon-intensive materials is one of the best way to reduce negative impact on environmental protection, manufacturing organizations is also able to achieve energy efficient when the materials are not complex and can be process with green technology (Wang, Zhang, & Zhu, 2017).

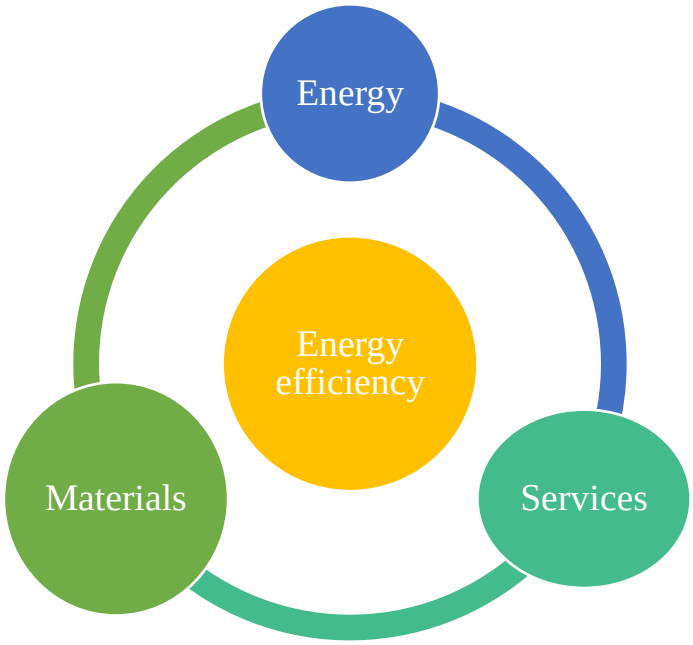

Figure 1: Determinants of energy efficiency

The concept of environmental protection serves as performance measurement for manufacturing organizations to show that organizations play an important role in reducing environmental degradation and organizations can take proactive responsibilities in ensuring the environment is protected. The indicators to support the claim are reduction of emissions and pollutions and reduction of wastages for land, water, air and solid waste.

Eco Efficient Supply Chain Integration

Eco efficient supply chain integration is a concept in which organizations in the supply chain network integrate its supply chain processes and operations by improving its information sharing and collaborating activities with its supply chain networks while addressing environmental management (Flynn, Huo, & Zhao, 2010)

It has become an important concept for manufacturing organizations to adopt as it helps organizations to produce products while reducing environmental costs (Gmelin & Seuring, 2014). The environmental costs here is referring to less energy used, less process used, less consumption of materials and less defects (Dormer, Finn, Ward, & Cullen, 2013). This is because as manufacturing organizations share its information and increase its collaboration, decisions and production of products are more efficient. While previously manufacturing organizations focus on efficient in operations

only, nowadays manufacturing organizations are required to reduce the impact to the environment, reducing the materials' extraction rate and reducing emissions and pollutions. Furthermore, organizations are not competing on its own but rather with its network of supply chain. As stakeholders such as government, customers and society have demanded manufacturing organizations to prevent environmental degradations, eco-efficient supply chain integration has becoming a popular concept among supply chain networks.

In the literature however showing supply chain integration as an established concept and well investigated. Yet, its impact on environmental protection has not concretely justified. This is due to scholars only look into practices of supply chain integration while neglecting environmental aspects. When scholars focus on environmental aspects such as eco-efficient supply chain integration, again the focus was on the practice alone. There is lack of synergy between practices, implementation and support for the overall organization and supply chain network. As such, Figure 2 shows the complete eco-efficient supply chain management framework that manufacturing organizations and its supply chain network should focus on. Practices such as collaboration and information sharing have been the primary practices for eco-efficient supply chain integration. But, the process in which manufacturing organizations streamlines with its supply chain network should also being regard as important. This is because process of supply chain integration not only able to helps manufacturing organizations achieving environmental protection but also improving the whole supply chain operations (Govindan, Sarkis, Jabbour, Zhu, & Geng, 2014). In addition, to tie the practice and process of eco-efficient supply chain integration, strategies of organizations also need to be supportive. Top management support and commitment for environmental protection will help the whole network to apply eco-efficient supply chain integration smoothly and effectively (Wong, Boon-Itt, & Wong, 2011). Yet, each element of eco-efficient supply chain integration should not be separated as it works in tandem. For example, manufacturing organizations that practice eco-efficient supply chain integration throughout its organization is not able to reap the benefits if the process is not integrated and strategy for integration is not robust.

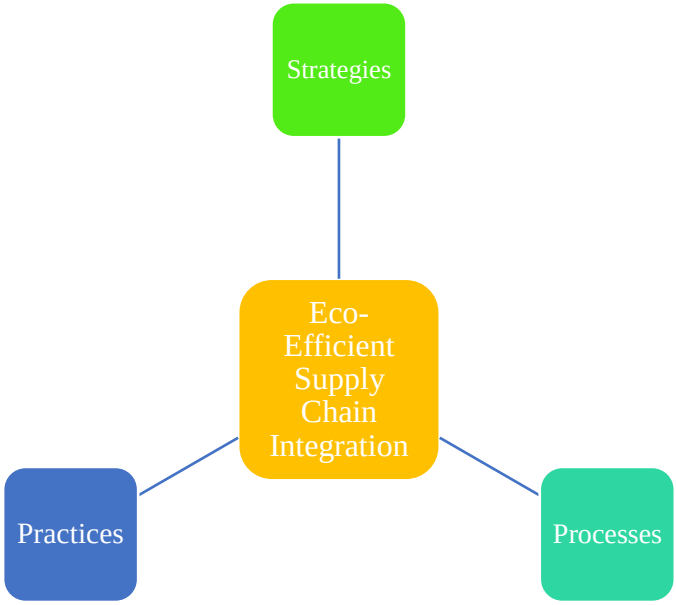

Figure 2: Design of eco-efficient supply chain integration management

On the other hand, organizational theory has pointed that customer is not only pressuring organizations but has specific requirements that need to be fulfilled. Eco-efficient supply chain integration does not integrate organizations with its supply chain network only but also with customer. This is advantageous for organizations in order to introduce new product to the market. However, it is still rare and limited in practice for organizations to integrate with customer. Even if it is limited in empirical evidence, management scholars have highly recommended and proposing a combination of eco-efficient supply chain integration management (Ferna & Capuz-rizo, 2010; He, Keung Lai, Sun, & Chen, 2014; Shrivastava, 1995). This is because the benefits include good reputation for organization, better performance and competitive advantage while also able to meet stakeholders' requirements.

This has called for organizations especially manufacturing organizations that produce emissions and pollutions at a larger scale to foresee its supply chain integration by practicing eco-efficient in both internal and external practices. Figure 3 shows the internal and external eco-efficient supply chain integration that has been designed to efficiently help manufacturing organizations to achieve environmental protection without neglecting operational and economic performances. The extended eco-efficient supply chain integration management is designed due to the current management model lacks of direction for collaboration and synchronization. While it is true that the current eco-efficient supply chain integration model has collaboration and information sharing as part of its practices, the attention to what constitute and how organizations can collaborate are not well-defined. On the other hand, supply chain nowadays are facing more complex business environment where the barriers to entry and life cycle of product have been a major issue

for organizations. On top of that, competition is not coming from local organizations but from abroad as well. Thus, achieving performance require better synchronization among supply chain partners (Denolf, Trienekens, Wognum, Vorst, & Omta, 2015). The result of this will ensure organizations to better manage its resources, increase in information sharing and innovation for new product development (Flynn, Huo, & Zhao, 2010).

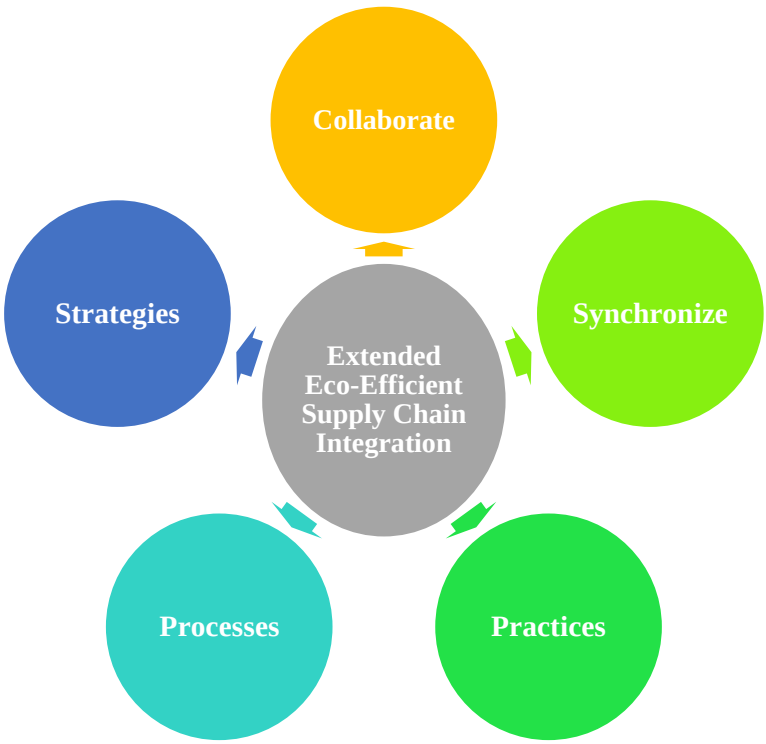

Figure 3: Design of extended eco-efficient supply chain integration management

Research Note

This paper has summarizes the important of achieving environmental protection for organizations especially those in manufacturing. This is because stakeholders are demanding manufacturing organizations to reduce emissions and pollutions cause by organizations. In order to do that, manufacturing organizations should practicing eco-efficient supply chain integration management. This management practice can be divided into three; practice, process and strategy. These three elements show that for manufacturing organizations to achieving environmental protection without failing to meet its operations and economic performances, they should practice information sharing and collaboration. Furthermore, manufacturing organizations also should make the process lean and adopting green technology so that organizations can protect the environment. Strategy also plays an important role in this concept. The main concern for eco-efficient supply chain integration is to achieving efficiency in resources management especially in regard to energy management. While energy efficiency is critical for eco-efficient supply chain integration, manufacturing organizations should also pay more attention to collaboration practice and strategy (Wang, Zhu, Zou, & Xu, 2017). This has highlights the weakness of current eco-efficient supply chain integration where collaboration is include as a practice and has not been specifically defined. Furthermore, synergy among supply chain partners should also be improved. As a result, this study has proposed an extended eco-efficient supply chain integration model that is able to improve manufacturing organizations environmental protection, economic performance and operational performance.

To further contribute to the literature and providing the guideline for further investigation for eco-efficient supply chain integration management model, this study has proposed Figure 4 conceptual model that will help scholars to contribute empirically and extending the organizational theory understanding. From the figure, it shows that environmental protection can be further investigated from the perspective of life cycle analysis for product, social responsibility and eco-efficient capability. In addition, as eco-efficient supply chain integration also helps manufacturing organizations to achieve operational performance, agility of manufacturing organizations in reducing manufacturing cost and inventory rate are area that management scholars can contribute.

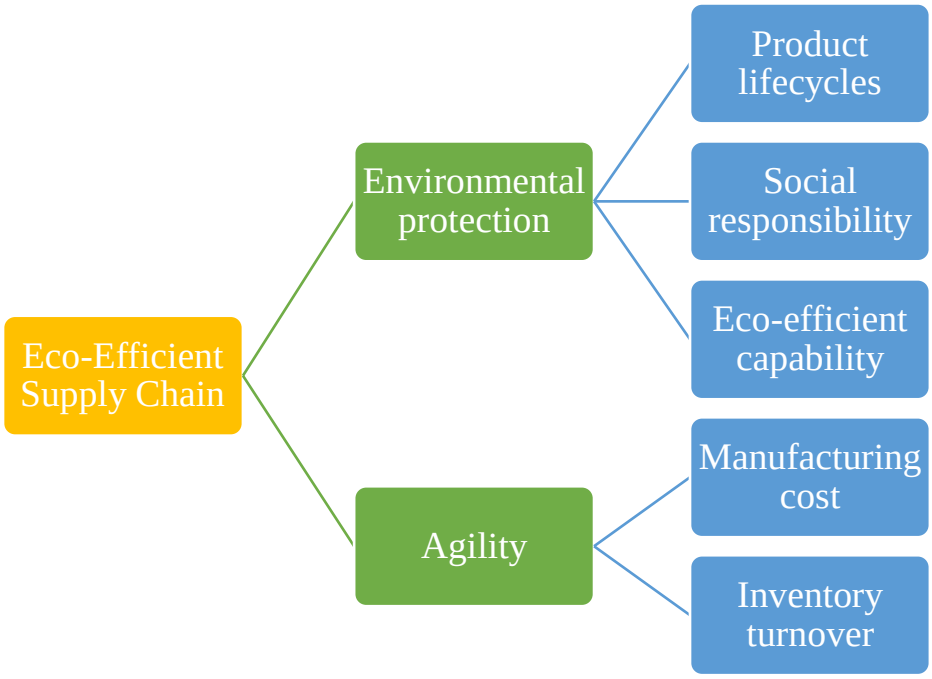

Figure 4: A conceptual model for future research

CONCLUSION

Environmental protection has become an important performance indicator for manufacturing organizations from the eye of government, customer, environmental non-government organization and society. But, developing countries that depend on manufacturing industry cannot allocate its resources to meet environmental protection goal while sacrificing economic and operational performances. Thus, scholars have proposed eco-efficient supply chain integration management concept to help organizations to achieving these goals. However, the current eco-efficient supply chain integration management model is not suitable for manufacturing organizations as it has a missing link. A better solution for better integration and achieving sustainable performance has been suggested and the future research that directs toward that will help scholars to contribute to the adoption of eco-efficient supply chain integration has been proposed.

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