Conference Paper

Research Note on Eco-Efficient Supply Chain Integration

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Abstract

Manufacturing must strictly improve environmental protection as this will able to triggers eco-efficient based innovation. At the same time, it will lead manufacturing to achieve the optimum level of environment protection and improve business performance. Currently, environmental improvement still a lack of pressure given for industry to implement environmentally friendly management practices even though the improvements in energy efficiency are obvious. Eco-efficiency has been expanded through green and lean initiatives; there is a decline in the level of integration for eco-efficiency in the supply chain to balance in both environmental and economic aspects. Thus, the objective of this study is to determine the impact of eco-efficient supply chain integration in environmental manufacturing protection improvement. The paper elaborates the importance of eco-efficient supply chain integration in environmental manufacturing protection to indicate of their improvement. The application and mechanics of eco-efficient supply chain integration discussed related to the implementation of the current practices of environmental manufacturing protection improvement.

Keywords: eco-efficient supply chain integration, environmental manufacturing protection.

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1. Introduction

Government, business organizations, and societies have deep concerns about environmental issues such as solid pollution, global warming, air pollution, and ozone depletion. Issues in environmental have become measured for most of the industry for their environmental problem (Rozar, Hasrulnizzam, Mahmood, & Ibrahim, 2015). In Malaysia, the manufacturing sector is its economic development driven by export-oriented, that makes Malaysia one of the potential choices for an investor in a foreign country to invest in the manufacturing sector. Moreover, the manufacturing industry in Malaysia is one of the key industries that contribute to Malaysia economic growth. Unfortunately, manufacturing industry triggered a decline in environmental because manufacturing produces more emissions compared to other industry when manufacturing build order to fulfill customer's demands and needs (Yusuf, Mahmood, Salleh & Rahman, 2015).

On the other hand, there is a negative impact from manufacturing in terms of environmental in a different way, where manufacturing generated liquid, gaseous, and solid waste products that can cause to the pollution of our natural resources (Klassen, 1993). Firms encouraged to align their operations towards a sustainable supply chain. The firm needs to measure environmental protection in its operation by achieving transition in the sustainable supply chain (Acquaye, Mohamed, Genovese, Afrifa, Yamoah & Oppon, 2018).

The awareness of environmental impact towards transportation of goods, production processes and sourcing of raw material should be escalating not only for the manufacturers but the pressure should also be given to upstream and downstream supply chain partners. (Katiyar, Meena, Barua, Tibrewala, & Kumar, 2018). According to Rahman, Noman, and Shahari (2017), energy consumption and economic growth have the highest impact on environmental pollution in Malaysia. Environmental protection would require essential changes in manufacturing industry activities and their business patterns. According to Colgan (2009), the manufacturing industry in worldwide has contributed 38% of carbon dioxide (CO_2) emissions, and this has an impact on the environment such as changes in weather patterns, air pollution, global warming and potential to expand disrupting the natural balance of the ecosystem and human health. It is essential for manufacturing to reduce CO_2 emissions, and change is needed to gain trust from business and customer.

Due to globalization, the supply chain distribution networks of goods and services have become more complex, and it has increased the carbon emission across the supply chain (Jin, Granda-marulanda, & Down, 2014). Govindan, Sarkis, Jabbour, Zhu and Geng (2014) claimed that eco-efficient is a tool that will give sustainable growth and increased attention to practitioners and researchers as eco-efficient has given important benefits to firm's operational performance but with having eco-efficient supply chain integration (EESCI) is a closed-loop alignment and collaboration including coordination in supply chain including internally and externally. The level of integration (Sezen, 2008); (Trkman & Stemberger, 2007) between the supply chain members has become a necessity. EESCI is a tool for manufacturing to work for hand on hand among supply chain partners to look at overall problems that manufacturing facing and collaborate to resolve the issues.

2. Literature Review

Malaysia emphasized environmental protection when realizing the country has increased in industrialization, and this will reduce threats to the national environment

(Mokhtar, Ta, & Murad, 2010). Thus, the Malaysian government has put priority to provide good quality and modest environment for the urban area as these important towards economic growth and investment center for Malaysia (Bekhet & Othman, 2017).

Mehedi Masud et al. (2015) claimed the environmental problems have created by activities designed to improve human life. One of the Malaysia vision in 2020 is to become a developed country, with the rapid growth in the nation and climate change burden it is a threatened to environmental improvement (Mehedi Masud et al., 2015). However, there is an inherent conflict of interest between protecting the environment and promoting economic growth (Shah & Husin, 2013).

2.1. Environmental Manufacturing Protection Improvement

The development in the manufacturing sector has increased rapidly, and the population in the industries area has been boosted. The land has expanded to occupied by the population. Consequently, the negative impact is on the quality of the environment because of economic growth and has caused air pollution and industrial emissions (Mokhtar et al., 2010). According to Ma and Cai (2018), manufacturing industry caused serious damage to the environmental by consumes a lot of limited material, energy, and services. Global warming and environmental pollution are severe because of the impact of industrial production. Therefore, the manufacturing industry must implement processes with high-level flexibility and efficiency at the same time, support by consuming low energy and cost (Wang, Wan, Zhang, Li, & Zhang, 2016). On the other hand, products with environmentally friendly are higher price, customer that have environment-sensitive will support environmental protection and willing to pay high prices but some customers will have some price concern and will expect to get lower price and their care on environmental protection level is lower (Wang, Zhang, & Zhu, 2017). Figure 1 shows the determinants of low energy efficiency in the manufacturing context.

2.2. Eco-efficient supply chain integration

Eco-efficiency has become critical for a manufacturer to implement in their products (Gmelin & Seuring, 2014) and (Dormer, Finn, Ward, & Cullen, 2013). There is still a lack of integration for eco-efficiency in the supply chain to balance in both economic and environmental aspects. Contingency factors such as product complexity, the complexity of business conditions in supply chain integration are uncertainty (Wong, Boon-Itt, & Wong, 2011). Even though there is a different opinion in research, limited study has

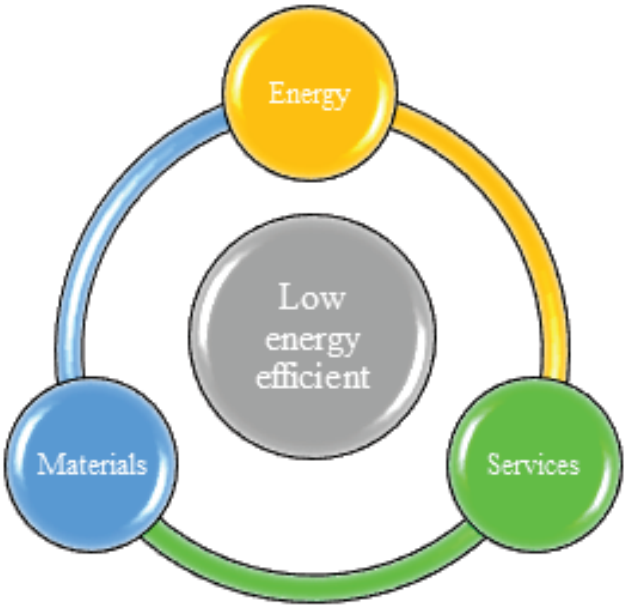

Figure 1: Determinants of Low Energy Efficiency.

agreed that the impact of the eco-efficiency-based supply chain to firm improvement process (Govindan, Sarkis, Jabbour, Zhu, & Geng, 2014). The connection between customer and supplier integration in new product development is still very limited. This is an opportunity to improve supply chain integration (He, Keung Lai, Sun, & Chen, 2014). Many studies have stressed that manufacturing will gain benefits if they successfully implement eco-efficient, the benefits they will achieve will be greater, the benefits categorized in workforce productivity, better firm image, improved in social responsibility, expand to the new green market and enhance eco-efficient capability ((Shrivastava, 1995). Hence, EESCI can be implemented to increase improvements in services, processes, and services along the product value chain (Ferna & Capuz-rizo, 2010). EESCI can be viewed as the manufacturer requires good coordination and collaboration among supply chain to work together with internal and external supply chain to improve supply chain process internally among the supply chain and externally with supplier and customer to protect and improve in environmental. There are two major groups in supply chain integration; there is internal integration which manufacturers create own organization strategies, processes and practices to collaborates and synchronized so that can interact with supply chain partners such as upstream supply chain and satisfied downstream supply chain requirement (Flynn, Huo, & Zhao, 2010). Figure 2 shows the design of internal integration in supply chain management. Whereas for

external integration, manufacturers work with supply chain partners to creates inter-organization strategies, creates processes, and implement practices to collaborate and synchronized from both sites (Flynn, Huo, & Zhao, 2010).

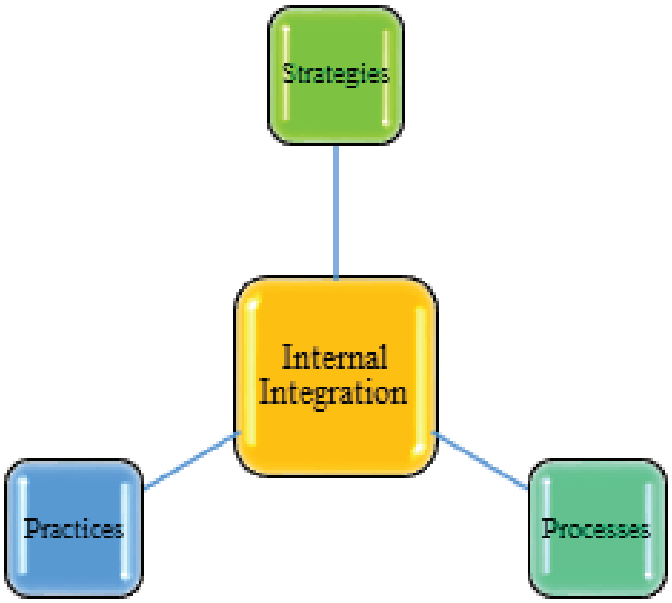

Figure 2: Design of Internal Integration in Supply Chain Management.

Figure 3 shows the design of the external side of supply chain integration. However, different objective among the supply chain partner will cause failure in communication and collaboration (Denolf, Trienekens, Wognum, Vorst, & Omta, 2015). Manufacturing that implements the eco-efficient able to reduce negative impacts on the environment during the production process (Fernando, Xin, & Wah, 2017). Eco-efficient combines both environmental demands and economic, and at the same time, eco-efficiency will be used to identify a solution that will not increase the level of damage in environmental unless if the costs also get impacted that will lead to increase in cost (Neto, 2009).

3. Research Note

This paper summarizes the implementation of EESCI in environmental manufacturing protection improvement. EESCI able to play an important role to improve environmental protection in the manufacturing industry. According to *(Wang, Zhu, Zou, & Xu, 2017)*, integrate between supplier and customer may reduce manufacturing cost, increased inventory turnover, and increase in labor. Information sharing and collaboration are part of the key contribution of EESCI. Manufacturing adapts to collaboration in networks among the supply chain partners can reduce unpredictable issues arise in

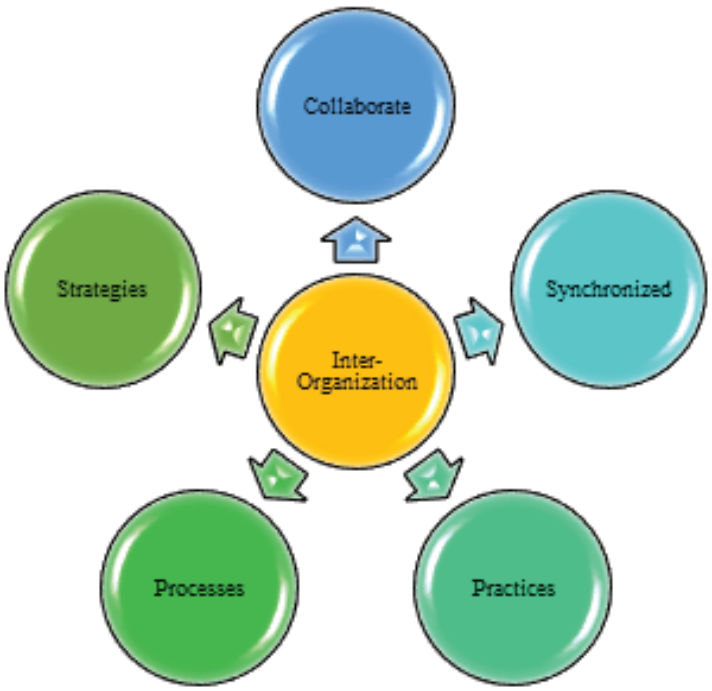

Figure 3: Design of External Integration in Supply Chain Management.

markets and reduce the product lifecycles with increasing the agility *(Perspective, Brettel, Friederichsen, Keller, & Rosenberg, 2014)*. Based on the review on eco-efficient supply chain integration, this study is proposed a conceptual model for future research. The conceptual model is presented in Figure 4.

4. Concluding Remarks

Improving the enforcement of environmental protection of the manufacturing industry is essential and a key task to increase environmental performance. Environmental manufacturing protection improvement would require essential changes in manufacturing industry activities and their business patterns. EESCI able to add value to environmental protection such as purchasing environmentally-friendly facilities, conducting low carbon training to employees and so on, which may increase costs but high-quality products (Mao, Zhang, & Li, 2017). For EESCI to succeed, supply chain partners must implement good teamwork and coordination among them. Although technological advancement is essential and playing a big role in making EESCI success, the integration in technologies among supply chain partners does not confirm that the supply chain actions will integrate automatically after implementing such technology, this is because EESCI needs a greater transformation in engaging supply chain partners. Firms also required

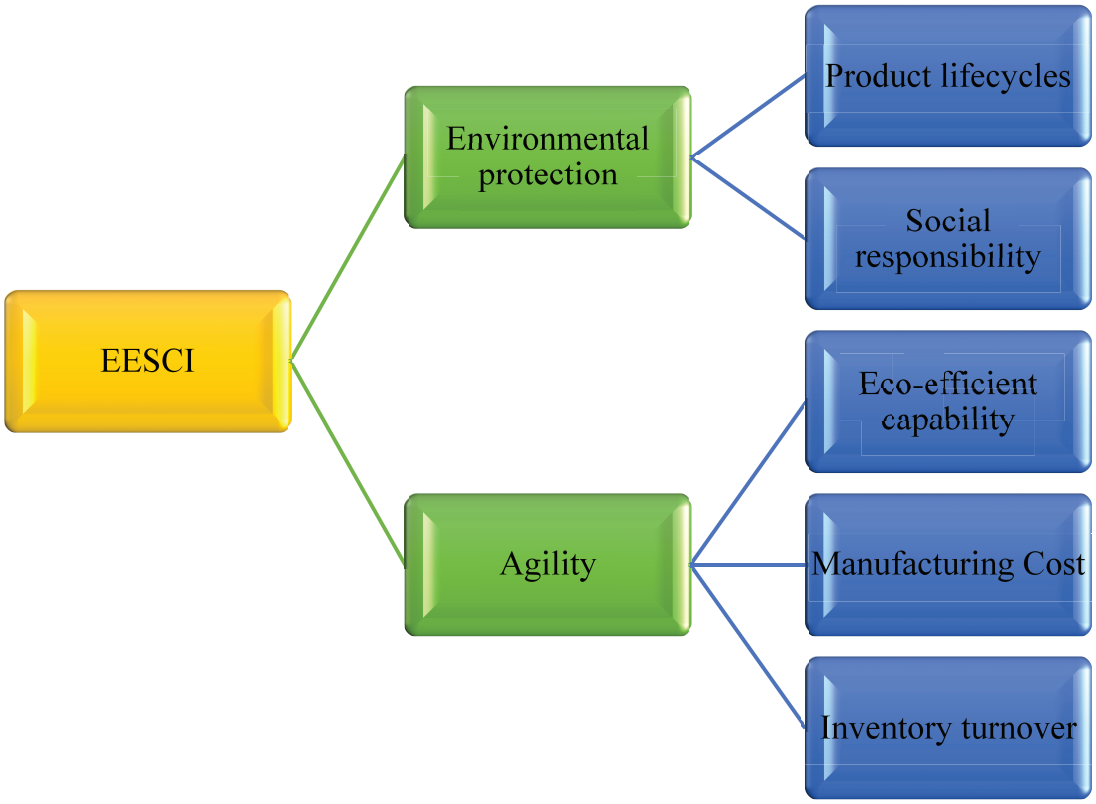

Figure 4: A Conceptual Model for Future Research.

to change to integrate all the procedures and product flow to become more effective and efficient (Huang, Yen, & Liu, 2014).

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