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Green Supply Chain Integration and Technology Innovation Performance in SMEs: A Case Study in Indonesia

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Abstract

The purpose of the research to analyze SMEs' technological innovation performance in the Special Region of Yogyakarta based on green supply chains. This study's technology innovation performance is influenced by environmental management practices, green supply chain integration, and supply chain knowledge-sharing. This research is important because many SMEs are underdeveloped in terms of technology innovation performance. Technology innovation performance shows that innovation has a multi-dimensional ecological performance in organizations. Therefore, SMEs' sustainable supply chain could be achieved by managing operations, support, and information by focusing on environmental and social issues to maximize the entire chain. This study used primary data. The number of respondents in this study was 200 SMEs that have implemented green supply chain management practices. The data collection method used was a questionnaire. The data analysis technique tool used is a two-step approach to SEM-AMOS. The results of this study indicate that SMEs are willing to implement a green supply chain to increase their performance. The technological innovation performance model of this study is acceptable. The findings of this research suggest that companies must be encouraged to maintain and increase the implementation of green supply chain integration and better supply chain knowledge-sharing with improved technological innovation performance enhancements.

Keywords: Environmental Management Practices, Green Supply Chain Integration, Supply Chain Knowledge Sharing, Technology Innovation Performance

JEL Classification Code: M11, O32, Q50

1. Introduction

In recent decades, people try to find a balance between sustainable economic development and environmental damage (Do et al., 2020). There are numerous small- and medium-sized enterprises (SMEs), which are involved in an environmental product. It means that they use natural raw materials, and the production process is environmentally-friendly so that the product result is ecological or green. Sugandini et al. (2018) show environmental management has become a significant concern for SME businesses. The scarcity of natural resources forces business managers to change the supply chain strategy to be oriented toward an environmental perspective (Sugandini et al., 2020). Also, Lee and Ha (2020) said that a sustainable supply chain could be achieved by managing operations, support, and information by focusing on environmental and social issues to maximize the entire chain's benefits.

The world economy has developed rapidly over the past few decades. However, people only pay attention to the importance of economic development and ignore the ecological environment's protection. In developing countries, this situation is becoming more severe as natural resources are slowly being depleted and environmental problems increase (Ta et al., 2020). Green Supply Chain Collaborative Innovation (GSCCI) is increasing with growing popularity in organizations due to developments in information

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technology and the increasing globalization of the world economy. According to Gualandris and Kalchschmidt (2013) and Deng et al. (2019), GSCCI is a tipping point to address the emerging challenges of protecting environmental impacts and meeting changing consumer demands in the supply chain. In organizations, the focus of green supply chain management (GSCM) has an important role to play in developing a green-oriented lifestyle. According to Lin and Tseng (2016), community orientation toward a green lifestyle is carried out through environmental protection, innovation and collaboration. Some companies in this study are reluctant to implement environmental management programs, which can be seen from the research results that have been conducted on environmental management practices in various companies. The reason is the risk of being subject to sanctions and fines, which are increasingly strict. Environmental management practices can also improve environmental performance and its economy (Deng et al., 2019).

Changes in green lifestyle, rapid market developments and technological advances cause the business environment to become dynamic. According to Chesbrough (2003), Wang et al. (2015), West et al. (2014), to adapt to these changes to remain competitive, companies are trying to find a practical approach. According to Chesbrough (2003), the open innovation practice adoption approach encourages information/knowledge, a combination of external and internal market channels to exploit innovation. SMEs' ability to find innovations can respond to changes in the rate of information technology and new customers' tastes (Effendi et al., 2020). The flow of information/knowledge that crosses SMEs boundaries is the starting point for innovation's openness aspect (Bogers et al., 2018). Innovation can result in increased performance through innovation (IC) capabilities to be recognized as a fundamental competitive resource (Porter, 1996; Teece, 2018). IC can explore available resources in developing new ideas successfully (Francis & Bessant, 2005). Torabi et al. (2016) said many authors discussed that IC has a positive impact on business performance, but based on Saunila et al. (2014) the factors and circumstances that support or damage this relationship are not observed.

According to the resource-based view theory, the process of working together with supply chain partners, called green supply chain integration, can create networks between companies for the exchange of information and knowledge. The company's environmental management practices can reduce resource consumption and reduce negative environmental impacts (Wanger, 2008). Environmental management practices can also promote product innovation and process innovation through organizational learning. Voluntary environmental management practices significantly impact product innovation and process innovation (Rennings et al., 2006).

Some recent literature shows that more and more scholars are starting to examine the effects of green supply chain integration on innovation from a holistic supply chain approach. A collaboration of knowledge and supply chain integration (SCI) networks can not only improve service levels and product quality, but are also a major source of business innovation (Basole & Bellamy, 2014). Lee et al. (2014) found that SCI has a positive and significant effect on Malaysian manufacturing companies' innovation performance.

The influence of SCI on knowledge sharing is for product development. Green supply chain integration (GSCI) provides opportunities and suitable conditions for companies to acquire knowledge within the green supply chain's scope. Lee et al. (2014) also emphasized that the supply chain network is an essential source of companies' resources and knowledge. Nonaka (1991) states that knowledge sharing is the main phase of innovation. Knowledge sharing between organizations can increase innovation implementation and reduce development costs and reduce the difficulties of limited internal knowledge resources. Companies that share knowledge with supply chain partners can understand advanced, cutting-edge and timely technology in achieving technological innovation performance.

Cooperation, trust, and good communication are found among supply chain members in supply chain integration (SCI) (Cai & Zhou., 2014). The establishment of a collaborative supply chain network and learning between organizations is a direct impact of SCI. As a useful resource, SCI networks can promote organizational learning, collaboration, and knowledge sharing among supply chain partners. Thus, companies with a higher SCI level can gain more product life cycle knowledge and tacit knowledge of environmental management practices. SCI has more collaboration and learning opportunities between organizations to apply knowledge in technological innovation. Therefore, SCI is an additional important factor when exploring the relationship between technological innovation and environmental management practices.

2. Literature Review

2.1. Technology Innovation Performance

Chang et al. (2015) stated that technology innovation performance (TIP) is a comprehensive evaluation of organizational innovation activities consisting of innovation performance in a narrow sense and overall innovation performance (Hagedoorn & Cloodt, 2004). According to Freeman and Soete (1997), the focus of innovation performance in small minds refers to the value generated by innovation and innovation efficiency, including new product development, the speed of new equipment research, and new technology. Innovation performance in a broad sense concerns the entire process

of innovation and evaluation of innovation in organizations. TIP is concerned with management innovation and technological innovation (Szabo & Csontos, 2016). TIP shows that innovation has a multi-dimensional nature of performance in organizations. Chen et al. (2006) stated that the performance of green innovation in GSCM includes green process innovation and environmentally friendly product innovation. Technological innovation in green products is applying innovative design ideas and marketing new products that significantly encourage environmental sustainability (Wong, 2012). Green TIP is related to creative ways to reduce negative environmental impacts caused by the production process. Green TIP involves activities to reduce harmful emissions, reduce energy consumption and raw materials (Tseng et al., 2013).

2.2. Environmental Management Practices (EMPs)

Environmental management practices (EMPs) can provide a broad systems perspective on environmental problems (Shrivastave & Hart., 1995). EMPs cover all organizational activities from raw materials, production processes, and packaging to environmentally friendly waste disposal. Therefore, EMPs incorporates company activities aimed at improving waste treatment and reducing resource consumption. According to Bergmiller and McCright (2009), EMPs aim to improve environmental performance, shortening response times, increasing efficiency, reducing energy consumption, using toxic materials and reducing waste. Meanwhile, EMPs as a level of resources invested in skills development and activities that lead to pollution reduction, including applying environmental management system recycling efforts (e.g., ISO14001) to reduce waste (Hajmohammad et al. 2013).

Environmental management practices in companies can reduce the negative impact of resource consumption and the environment and encourage product innovation and process innovation through organizational learning (Wanger, 2008). Voluntary environmental management practices, including ISO14001 certification and life-cycle analysis, have a significant impact on process innovation and product innovation (Rennings et al., 2006). Environmental management practices such as investment recycling, environmental design, and internal environmental management have a positive impact on TIP (Lee et al., 2014). In some environmental management practices, life cycle knowledge and tacit knowledge can also enhance technological innovation performance.

H1: *Environmental management practices affect technology innovation performance.*

2.3. Green Supply Chain Integration (GSCI)

According to Flynn et al. (2010), technological innovation and green supply chain integration focusing on production methods, processes and commercial organizations. GSCI is committed to creating value for end customers. GSCI is a significant source of technological innovation in companies, supply chain members (including suppliers and customers), and knowledge and an essential source of ideas. Information sharing, mutual problem solving and mutual trust among members are crucial to GSCI to enhance indirect or direct interactions between companies and their supply chain partners. Things like this can generate different alternatives and new ideas, which are very important for innovation. Gemünden (1996), through his empirical study, found that involving suppliers for product innovation beforehand can evade expensive design changes. Technological innovation in supplier participation has a significant beneficial influence on innovative operational performance. Customer participation in new product growth can support companies to obtain request information. New product development can increase customer satisfaction at higher quality and lower costs. Customer request is an essential preceding of innovation to product design. Customer involvement in innovation definitely contributes to the innovation performance and quality of performance. The network resource augmented by GSCI for information and knowledge is a resource of corporate excellence. Networks can also facilitate problem-solving and mutual learning between companies in the supply chain. In doing so, it helps promote innovative performance and acquire innovative resources.

In consideration of the preceding material, networks can expedite knowledge sharing between companies in the supply chain. Basole and Bellamy (2014) emphasized that knowledge collaboration and supply chain integration networks not only can enhance service levels and product quality, but are also a significant source of innovation. GSCI offers its members with social communication opportunities. GSCI facilitates consensus building that contributes to effective use of tacit knowledge and open supply chain knowledge sharing. Lee et al. (2014) found that supply chain integration positively and significantly affects Malaysian manufacturing companies' innovation performance.

H2: *Green supply chain integration affects technology innovation performance.*

H3: *Green supply chain integration affects supply chain knowledge sharing.*

2.4. Supply Chain Knowledge Sharing (SCKS)

Organization innovation, based on theory of knowledge management, comes from the reintegration and knowledge

resources creativity. Supply chain knowledge sharing (SCKS) is a critical element for innovation. Sharing knowledge is the main stage of innovation (Nonaka, 1991). Knowledge cannot be created by an organization by itself. When the knowledge held by its personnel is analyzed, shared and discussed, the company or the organization will have the capability to innovate. Knowledge sharing between organizations not only alleviates the difficulties of restricted inside knowledge resources. Knowledge sharing not only increases the level of innovation implementation but also reduces development costs. SMEs can immediately understand advanced technology and the latest innovative achievements by sharing knowledge with supply chain partners (Li et al., 2017). Lim et al. (2017) also said that green knowledge sharing between companies in the green supply chain could break resource constraints in innovation, increase innovation speed, and improve the company's green products' quality to enhance company performance.

H4: *Supply chain knowledge sharing affects technology innovation performance.*

H5: *Supply chain knowledge sharing mediates the relationship between technology innovation performance and green supply chain integration.*

3. Research Methods

This is a survey research. Sekaran and Bougie (2013) state that a survey is a method for accumulating data from or about people to compare, explain, or describe their behavior, attitudes and knowledge. The approach used in this study is a quantitative approach and the data analysis tool used is a two-step approach to SEM-AMOS. The information utilized in this research are based on primary data obtained by distributing questionnaires to respondents. The number of samples utilized in this research was 200 green-oriented manufacturing SMEs in the Special Region of Yogyakarta. The results of the measurement model indicate that it provides valid and reliable indicators. The results of the structural model can be seen in the AMOS output.

4. Results

4.1. Respondent Characteristic

The descriptive analysis uses data from a questionnaire collected from 200 respondents and processed to describe respondents' characteristics and perceptions about the variables studied. The characteristics of the respondents in this study are described by descriptive statistical analysis carried out by the frequency distribution method in Table 1.

Table 1: Characteristic of Respondents

Characteristics	%
Length of Business	
One year to 5 years	0
>5 years to 10 years	3
>10 years	97
Number of Workers	
10 to 30 people	36
>30 to 50 people	32
>50 people	32

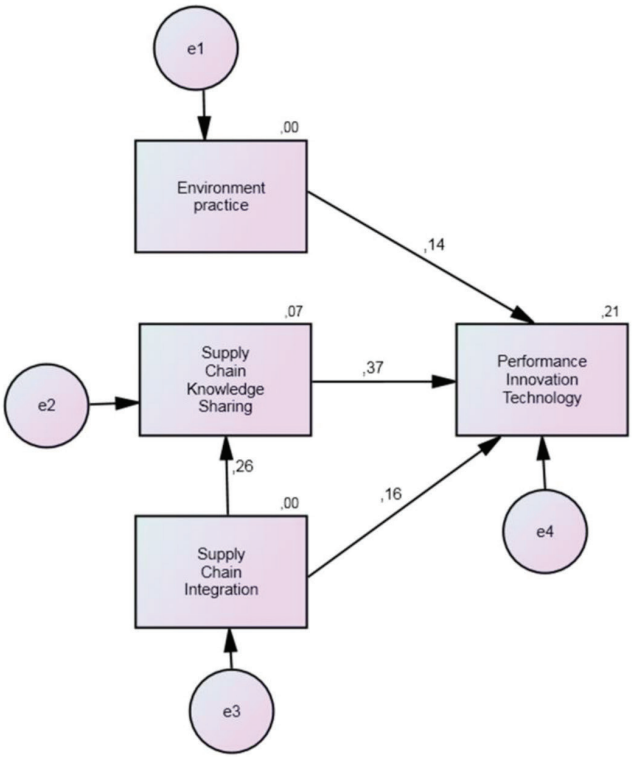

Figure 1: Model of Technology Innovation Performance

4.2. Quantitative Analysis of Respondents

Test results using structural equation models with the SEM-AMOS program can be seen in Figure 1. The analysis was carried out with a two-step approach in two stages: measurement models and structural models. The researcher's measurement model shows that all the indicators used are valid and reliable and have a relatively good fit model test

results. Testing the structural model after calculating the composite obtained the following results (see Figure 1).

From the proposed structural model (see Table 2), it turns out that most of the criteria used show good results, meaning that the model is suitable and does not need to be modified. To test the causal relationship hypothesis in the structural model of the following EMPs, see the path coefficient is presented in Table 3.

Hypothesis testing is done by comparing the probability (*p*) values, which is significant if the *p*-value is ≤0.05. With these criteria, it can be seen that all pathways are significant in the sense that EMPs have a (direct) significant effect on TIP. GSCI has a significant effect on the TIP. GSCI has a significant direct effect on SCKS. SKCS has a significant impact on TIP, and SCKS mediates the relationship between GSCI and TIP. When viewed from the direction, the influence of EMPs on TIP is positive, GSCI on TIP is positive, GSCI for SCKS is positive, SCKS on TIP is positive, and SCKS is positively mediating the relationship between GSCI and TIP.

From Table 3, it can be explained that there is a direct effect of EMPs on the TIP of 0.137, GSCI to TIP of 0.155, GSCI to SCKS of 0.257, SCKS of TIP of 0.366. The indirect impact of GSCI on TIP mediated by SCKS is 0.192. Thus, the direct effect of GSCI on TIP is greater than the indirect effect of GSCI on TIP that SCKS mediates. The five proposed hypotheses can be accepted by testing the significance of each variable and its indicators. Outline of hypothesis testing outcome can be seen in Table 4.

Table 2: Evaluation of Goodness of Fit Indices

Criteria	Results	Critical Value*	Evaluation of Model
C_{min}/DF	6.177	≤2.00	Moderate
Probability	0.103	≥0.05	Good
RMSEA	0.079	≤0.08	Good
TLI	0.934	≥0.95	Good
CFI	0.932	≥0.94	Good

5. Discussion

Hypothesis 1 shows that EMPs impacts on TIP are significant. This means that when the EMPs increase, the TIP will also increase. EMP in SMEs has reduced resource consumption and negative environmental impacts and promoted process innovation and promoted environmental product innovation through organizational learning. Therefore, with life-cycle knowledge and tacit knowledge embedded in several EMPs, it can improve the TIP for SMEs in the Special Region of Yogyakarta. This research supports results conducted by Lee et al. (2014), who also found that EMPs positively impact TIP.

Hypothesis 2 results are in line with Gemünden (1996) and Lee et al. (2014), who show that the GSCI is positively and significantly related to the TIP. This means that, if the GSCI increases, the TIP will also increase and

Table 3: Path Coefficient (Standardize Regression) Between Variables

Path	Estimate	Standardized Regression Weight	SE	CR	*P*
SCKS ← GSCI	0.291	0.257	0.084	3.463	***
TIP ← SCKS	0.659	0.366	0.129	5.124	***
TIP ← EMPs	0.612	0.137	0.25	2.45	0.014
TIP ← GSCI	0.316	0.155	0.098	3.223	0.001

Table 4: Summary of Hypothesis Testing

Hypothesis	Path	Results of Hypothesis Testing
H1	Environmental Management Practices to Technology Innovation Performance	Accepted
H2	Green Supply Chain Integration to Technology Innovation Performance	Accepted
H3	Green Supply Chain Integration to Supply Chain Knowledge Sharing	Accepted
H4	Supply Chain Knowledge Sharing on Technology Innovation Performance	Accepted
H5	Supply Chain Knowledge Sharing mediates the relationship between Green Supply Chain Integration and Technology Innovation Performance	Accepted

vice versa. Improving the GSCI makes relationships with customers through information networks, communicates with customers, increases the sharing of market information from customers, exchanges information with suppliers and customers, and participates with suppliers in procuring raw materials and improving TIP. The GSCI process can help improve product information on the market, determine what product innovations are happening and are needed by the market, and help companies maximize production and increase efficiency in the company. The implementation of the GSCI in SMEs in the Special Region of Yogyakarta can have an advantage in facing competition in selling products in the country.

Hypothesis 3 results are consistent with Basole and Bellamy (2014), which show that GSCI has a positive effect on SCKS. This means that, if the GSCI increases, the SCKS also increase, and if the GSCI decreases, the SCKS also decreases. The importance of the GSCI in SCKS is that the GSCI provides information about conditions and opportunities that are very suitable for companies to gain knowledge in the supply chain. GSCI brings SMEs closer to supply chain partners to stimulate information sharing or knowledge sharing, establish supply chain relationships both from within and outside the company, increase income and income, and increase cohesion to increase efficiency within the company. The implementation of the GSCI in SMEs in the Special Region of Yogyakarta can face very tight domestic competition and influence the company's level of sales.

Hypothesis 4 shows that SCKS has a positive effect on TIP. This means that, if the SCKS increases, the TIP will also increase and vice versa. For companies, innovation is the stem of integration and creativity from a source of knowledge. And knowledge is also the key to innovation. A SMEs can be successful in innovating if the whole series from upstream to downstream already understands and understands the knowledge provided. That way, the company's innovation will go hand in hand with the discussion and analysis so that the SCKS process can have a beneficial influence on TIP in improving performance and increasing SMEs' excellence in the Special Region of Yogyakarta. Based on the findings of Li et al. (2017), the findings are in line with this study.

Regarding Hypothesis 5, based on the multiplication results between the H2 and H3 pathways, the coefficient value shows a significant positive. The coefficient indicates that if SCKS implements the GSCI, it will better affect the TIP. This finding is in line with the research of Lim et al. (2017). This means that SCKS can mediate the influence of GSCI on TIP in manufacturing companies in the Special Region of Yogyakarta. The results of this study indicate that SCKS mediates GSCI against TIP. The GSCI has a direct implementation, which has been good to improve the GSCI to be implemented in companies. Then, the role of SCKS as mediation can make GSCI influence and play a more significant role in enhancing TIP. SCKS has a big role in improving communication and knowledge sharing on all matters related to its supply chain process. This means that SCKS has a positive and significant effect on GSCI on TIP if GSCI is through SCKS.

6. Conclusion and Limitations

The analysis and discussion results in this study lead to the following conclusions. First, important and positive consequences for technological innovation performance can be obtained from environmental management practices. Second, green supply chain integration has a positive and important impact on technology innovation performance. Third, a positive and significant influence on supply chain knowledge sharing can be obtained from green supply chain integration. Fourth, the positive and significant impact on technology innovation performance is influenced by the sharing of supply chain knowledge. Fifth, supply chain knowledge sharing mediates the influence of supply chain integration on technology innovation performance.

The results of the conclusions and discussion in this research suggest that SME managers in the Special Region of Yogyakarta should pay attention to environmental management practices around the company. Seeing the facts in the field that there are still many companies that have not implemented environmental management properly, this will not affect technology innovation performance. Companies are also encouraged to maintain and increase green supply chain integration and better supply chain knowledge sharing. There is a significant positive effect in improving technological innovation's performance by implementing supply chain knowledge sharing and the implementation of green supply chain integration. The competitive advantage of production companies in the Special Region of Yogyakarta will improve with good technological innovation performance and supply chain knowledge. Future researchers who use this research as a reference should develop a research model to find or prove new things from technology innovation performance, environmental management practices, supply chain integration, and supply chain knowledge sharing.

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