The Role of Reverse Logistics and Forward Logistics Supply Chain Network in Supply Chain Business Performance: A moderating role of Environmental Issues

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Abstract: Environmental issues comprise the most crucial issue in most of the industries worldwide. Global warming is increasing due to the emissions of greenhouse gases (GHGs), here the logistic transportation has a crucial role. Logistic transportation causes to increases in $\text{CO}_2$ which has a negative effect on the environment. However, it can be handled through reverse logistics and forward logistic supply chain network. Therefore, the purpose of this study is to examine the effect of the reverse logistics supply chain and forward logistic supply chain network on logistics performance. Data were collected from employees of supply chain companies. PLS-SEM was utilised to analyse the data. It is found that reverse logistics supply chain and forward logistic supply chain network has a significant positive effect on supply chain business performance; however, environmental issues have a negative effect. The environmental issue as a moderating variable weakens the positive relationship of reverse logistics supply chain network and supply chain business performance.

Keywords: Reverse logistic, forward logistic, supply chain, business performance, environmental issues.

1. INTRODUCTION

The world population reached to more than seven billion individuals. With the expanding number of individuals, mankind has considerably affected the environment. Environmental issues comprise the most crucial problem worldwide (Haseeb, Hassan, Azam, & Suryanto, 2018). Global warming or in other words by the emissions of greenhouse gases (GHGs) is said to contribute to these environmental issues. In spite of the fact that there are numerous kinds of GHGs that affect the environment, for example, water vapor, carbon dioxide, methane, nitrous oxide, ozone and chlorofluorocarbon (CFC), this investigation based on the carbon dioxide emissions, which comprises the biggest part of gas emissions (Tahir et al., 2015; Zurina, 2013) through logistic transportation.

With the end goal to encourage the control of carbon outflow, environmental legislation has been expanded. Since the Kyoto Protocol in 1997, most nations around the globe have attempted to diminish their carbon emission. Based on the environmental issue, most of the countries are making policies to restrict logistic companies in such a way to save
the environment. These carbon emission policies have a significant role in logistic companies business (Jin, Granda-Marulanda, & Down, 2014). Transportation-related to logistic service increases the CO\textsubscript{2} which has negative consequences in the environment (Zanni & Bristow, 2010). Policies to reduce these issues decreases business performance. Indonesian logistics industry also facing various such type of issue. Due to which the performance is not satisfactory.

Table 1 shows the performance index of logistic by various countries. According to this performance index, Indonesia is ranked as 63 among 160 countries. As compared to the other countries such as Malaysia, India, China, Thailand, Singapore and Hong Kong the performance of Indonesian logistic is low which needs intention. Decreases in this performance has a negative consequence on the gross-domestic-product (GDP) of Indonesia. Polices against the various environmental issues is also one of the reasons of this low performance. Therefore, Indonesian logistic companies should work on different strategies to boost performance by decreasing environmental issues. These strategies include the proper implementation of reverse logistics supply chain and forward logistic supply chain network.

Reverse logistics is based on various operations related to the recycle of products as well as materials. It is one of the process which comprises of moving various goods/products from their ultimate end for the objective of capturing value, or proper disposal. On the other hand, traditional or forward logistics refer to the flow of goods from the plant to the end consumer. The includes the transportation from factory to consumer. The various types of forward logistic supply chain management process comprises direct order fulfilment, shipping, hub services and various pick-and-pack services (Zurina, 2013).

Various prior studies such as Browne and Allen (1998); Jin et al. (2014); Kannan, Diabat, Alrefaei, Govindan, and Yong (2012) and Gan, Liu, Chen, Yan, and Li (2018) carried out research about the logistic transportation, environmental issues and carbon emission, however, none of the researchers discussed with regards to business performance. Therefore, this study highlighted the issue of environment related to the logistics and supply chain performance, particularly in Indonesian companies. This study highlighted that how various strategies of reverse logistics supply chain and forward logistic supply chain network reduces the environmental issues and increases the business performance (Abidin, Bakar, & Haseeb, 2015; Abidin, Bakar, & Haseeb, 2014; Haseeb, Hartani, Bakar, Azam, & Hassan, 2014; Haseeb, Hassan, & Azam, 2017).

Therefore, the purpose of this study is to examine the effect of the reverse logistics supply chain and forward logistic supply chain network on logistics performance. Moreover, the moderating role of environmental issues are also described by this study. According to the best knowledge of author, this is one of the pioneer study which examined the role of reverse logistics supply chain and forward logistic supply chain network on logistics performance. Therefore, this study is beneficial for logistic companies to boost the performance by handling the environmental issues with the help of reverse logistics and forwards logistics supply chain management. Figure 1 shows the proposed framework of this study.

2. LITERATURE REVIEW

2.1 Reverse Logistics Supply Chain Network

According to Hu, Huang, Hou, Chen, and Bulycheva (2016), reverse logistics as a type of business procedure that includes planning, managing, as well as controlling the flow of waste for final disposal or reuse. It is a logistic structure of products
flow from users towards manufacturers. It turns out to be imperative since it gains value from utilised items as opposed to sending to landfill. From an environmental point of view, reverse logistics generally support practices in connection to different levels of item and materials reuse (Abidin & Haseeb, 2015, 2018; Abidin, Haseeb, Azam, & Islam, 2015; Hamzah, 2018; Haseeb, 2018; Haseeb et al., 2017; Meade & Sarkis, 2002).

Previously, when there were no regulations communicated by the public, most organisations did not assume any liability after their items were sold. Presently, in light of the developing problems from the public around the globe and control from the governments and agencies, reverse logistics is a decent method to manage this issue. Reverse logistics concerns those exercises related with the taking care and administration of hardware, items, segments, materials or even whole specialised frameworks to be improved (Brito, Flapper, & Dekker, 2002). Reverse logistics is a significant field to concentrate since it manages waste. By investigating reverse logistics, a few wastes can be recycling and can make less harm the environment. The reprocessed items will be brought once again into the market and redistributed to clients. Reverse logistics has turned into a key witness in an advanced inventory network (De Brito & Dekker, 2003). Although reverse logistics is a fine methodology in recyclable materials from the waste stream, not all items can be reprocessed or reused. Here, the risk management of enterprise (W.-U. Hameed, Hashmi, Ali, & Arif, 2017) to boost performance is also important.

Reverse logistics or product recovery can be divided into three classes; specifically, reuse, remanufacture and recycle (Fleischmann, Krikke, Dekker, & Flapper, 2000). Among the waste that can be reused are the materials that can be utilised constantly without earlier repair activities, for example, garments, household things and materials related to construction. Reusable parts can be extracted from the product sold in the second-hand market. The remanufacturing process is appropriate for materials that are exhausted or out of date. Auto parts (Cruz-Rivera & Ertel, 2009; Kumar & Putnam, 2008) and electronic items (Dat, Linh, Chou, & Vincent, 2012; Spengler, Ploog, & Schröter, 2003) are critical materials addressed in reverse logistics related with end-of-life items that fall under remanufacturing. All these benefits have significant effect on supply chain business performance. Electrical and electronic items present real concerns regarding the transfer of the items, particularly during the era of quick mechanical development where numerous electronic items end up out of date quicker than before. Some electronic products are dangerous to human wellbeing and eco-framework that are transferred to landfill on account of the substance, which contain harmful and unsafe substance. Therefore, these products must be legally allocated, prepared, arranged, remanufactured, recycled or reused. Otherwise, it will harm to the environment which causes to deal with strict government policies and ultimately decreases the business performance. A case of Waste of Electrical and Electronic Equipment (WEEE) is household appliances (Kumar & Putnam, 2008), machine instruments and cell phones (Chan, Chan, & Zhang, 2006; Hanafi, Kara, & Kaebernick, 2008). Figure 2 shows that how reverse logistics work.

Generally common product recycling and the materials that are frequently recycled are paper (Fleischmann et al., 2000), glass and metal (Gößling-Reisemann, 2008) and plastic (Pohlen & Theodore Farris, 1992). Moreover, sand recycling is investigated by Dekker et al. (1998) in the background of reuse in the operational perspective. Recycling of these materials has a relationship with business performance of supply chain companies.

Therefore, the waste from logistic companies or the emission of carbon from
logistic transport has negative impact on environment which causes environmental issues. It leads towards the government restriction on logistic companies. However, the implementation of reverse logistics can manage this issue.

**H₁**: Reverse logistics supply chain network has positive effect on supply chain business performance.

**H₂**: Environmental issues moderates the relationship between reverse logistics supply chain network and supply chain business performance.

### 2.2 Forward Logistics Supply Chain Network

Forward logistics defined as the management of the flow of different resources from one place to another. In a forward logistics supply chain network, the raw material is usually at the initial point of the network and ends with the end customer. Transportation is a noteworthy player in market reconciliation and turns into a key factor in economic prospective. However, it has negative effect on environment. Logistic operations has a major role in this aspect because logistic is heavily based on transportation (Zurina, 2013). Forward logistics supply chain network is shown in Figure 3.

With the increasing awareness of environmental effect, it might majorly affect the conventional supply chain plans. Universal freight transportation is to a great extent requested as the mechanism to send everywhere throughout the world. Truck, rail, ship and plane are normal methods of transportation. Various researches carried out the research on freight transportation network (Hasan, 2009; Southworth & Peterson, 2000; Yang, Low, & Tang, 2011) to highlight various issues related to supply chain. These resources of transportation have major role in supply chain performance.

Multimodal transportation was first electronically reported in 1988 (Macharis & Bontekoning, 2004). From that point onward, it was generally created in the 1990s. Multimodal or multi-purpose transport utilises through two methods of transportation in a single transport chain, without a change of container for the goods, with route travelled by rail and inland waterway with the shortest possible initial as well as final journeys by road (Macharis & Bontekoning, 2004). This transportation ultimately decreases the environmental pollution and increases business performance. The interest for multimodal transportation infrastructure climbed because of various components, for example, economic globalisation, spry manufacturing, speed-to-advertise conveyance, and supply chain administration. As transportation frameworks grow and turn out to be more influential, its effect on the physical environment will turn out to be more unpredictable (Rondinelli & Berry, 2000).

A few studies have been conducted regarding transportation management. Kim and Van Wee (2009) built up a model to compare the intermodal freight system and truck-only freight system. Their research presumed that regardless of the sort of train, the rail-based intermodal freight system emanates less carbon than the truck-only systems. In a customary supply chain, street transportation is broadly utilised for the greater part of the transportation procedure, in light of its adaptability. Therefore, Janic (2007) built up a model for contrasting the inner and outside cost of the street freight transport network. The finding from the investigation is that the costs of the street transport network are steady and the intermodal transport network decrease as the volume of units increases. With the end goal to kill the impact of higher costs, the administration frequencies in the medium-distance market must be increased. Moreover, the open-innovation strategies (W. Hameed, Basheer, Iqbal, Anwar, & Ahmad, 2018) can be beneficial to promote forward logistics.
Moreover, regarding the forward logistic network, optimisation models are broadly utilised in taking care of freight transportation issues. Advanced utilising simplex iteration has been finished by numerous researchers to build up an arranging model to limit redistribution utilising different methods of transportation. Yamada, Russ, Castro, and Taniguchi (2009) utilised a heuristic approach in proposing a model for key transport arranging in the freight terminal improvement and interregional freight transport network plan. Their investigation and heuristics approach decide a reasonable arrangement of activities from various conceivable activities, for example, enhancing the current infrastructure or setting up new roads, railways, sea links, and freight terminals.

Thus, forward logistic network has the ability to decrease various issues and increases the supply chain performance, regardless of political influence on business (Maqbool, Hameed, & Habib, 2018) and investment decision making (W.-U. Hameed, Sabir, Razzaq, & Humanyon, 2018). However, environmental issues such as emission of CO₂ due to transportation has negative consequences on supply chain management performance. Hence, below hypotheses are concluded:

\( H_3: \) Forward logistics supply chain network has positive effect on supply chain business performance.

\( H_4: \) Environmental issues moderates the relationship between forward logistics supply chain network and supply chain business performance.

Additionally,

\( H_5: \) Environmental issues have significant negative relationship with supply chain business performance.

3. RESEARCH METHODOLOGY

Research design is important to carried out any research study. Research design consistent with the nature of the study is important. In this study, the cross-sectional research design was used to carried out the whole research process. Moreover, this study relies on quantitative research rather than qualitative.

Furthermore, Polit Denise and Hungler Bernadette (1999) define a population as "the totality of all subjects that conform to a set of specifications, comprising the entire group of persons that is the interest to the researcher and to whom the research results can be generalised". In the present study, the population is the employees of logistic companies from Indonesia. Therefore, responses were gathered from logistic company employees.

A 5-point Likert scale were used for data collection. This is suitable scale to collect the data. Because 5-point Likert scale from strongly disagree to strongly agree decreases the frustration level of respondent and increases the reliability. Scale above 5-point has more option which confuses the respondent.

Moreover, the questionnaire was divided into four main sections. First section is based on the profile of respondents. Second section was based on the research items related to dependent variable, namely; supply chain business performance. Second section was based on the items related to independent variables, namely; reverse logistics supply chain network and forward logistics supply chain network. Finally, the fourth section was based on the items related to moderating variable, namely; environmental issues. Additionally, 500 questionnaires were distributed among the employees of logistic companies and 310 were returned.

4. RESEARCH ANALYSIS AND RESULTS

This study utilised PLS-SEM techniques. According to Henseler, Ringle, and Sinkovics (2009), PLS-SEM based on two main section. First is outer model assessment and second is inner model
assessment. Outer model assessment includes internal item reliability, external consistency and composite reliability. According to Hair, Black, Babin, Anderson, and Tatham (2010), factor loading must be higher than 0.5, composite reliability must be 0.7 and average variance extracted (AVE) 0.5 or above. Outer model assessment is shown in Figure 4 and results are shown in Table 2. Moreover, discriminant validity is shown through AVE square root in Table 2.

Inner model results are given in Table 4. According to these results, all the direct hypotheses has t-value higher than 1.96 and p-value less than 0.05. It indicates that all the hypotheses are supported by the results. The inner model assessment is shown in Figure 5 and results are shown in Table 4.

Moreover, moderation effect of environmental issues is shown in Table 5. It is clear that environmental issue is a moderating variable between reverse logistic supply chain network and supply chain business performance. However, moderation effect is not significant between forward logistic supply chain network and supply chain business performance. Moreover, results of the present study show that environmental issues have negative effect on business performance among Indonesian supply chain companies. As the relationship of the environmental issues and supply chain business performance found beta value -0.352. Increase in environmental issues decreases the supply chain business performance.

Additionally, the moderation effect shows that environmental issues moderates the relationship of reverse logistics supply chain network and supply chain business performance with t-value 4.059 and beta value -0.208. The Figure 6 portrays that environmental issues weaken the positive relationship of reverse logistics supply chain network and supply chain business performance. However, the moderation effect between forward logistic supply chain network and supply chain business performance is insignificant.

6. CONCLUSION

This study is based on Indonesian logistic companies. According to the world bank data, the ranking of logistic companies in Indonesia is decreased which ultimately affect the overall contribution in the gross domestic product. The present study is one
of the attempt to address this issue by considering the reverse logistics and forward logistic supply chain network.

Findings of the study depict that environmental issue is most crucial in the performance of logistics companies. Environmental issues decrease the performance of logistic companies due to the heavy transportation causes carbon emission. Thus, it decreases the supply chain business performance. On the other hand, reverse logistics supply chain network and forward logistic supply chain network have significant contribution in supply chain business performance. Reverse logistic supply chain network practices have the ability to decrease environmental issues and enhance business performance. Therefore, it is recommended to the logistic companies to focus on reverse and forward logistics supply chain network.

REFERENCES


Polit Denise, F., & Hungler Bernadette, P. (1999). Nursing research principles and
methods: Philadelphia: Lippincott Williams and Wilkins.


**Table 1. Logistic Performance Index**

<table>
<thead>
<tr>
<th>Country</th>
<th>LPI rank</th>
<th>LPI score</th>
<th>Custom</th>
<th>Infrastructure</th>
<th>International Shipments</th>
<th>Logistic Competence</th>
<th>Tracking &amp; Trace</th>
<th>Timeline</th>
</tr>
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<tbody>
<tr>
<td>Singapore</td>
<td>5</td>
<td>4.14</td>
<td>4.18</td>
<td>4.20</td>
<td>3.96</td>
<td>4.09</td>
<td>4.05</td>
<td>4.40</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>9</td>
<td>4.07</td>
<td>3.94</td>
<td>4.10</td>
<td>4.05</td>
<td>4.00</td>
<td>4.03</td>
<td>4.29</td>
</tr>
<tr>
<td>China</td>
<td>27</td>
<td>3.66</td>
<td>3.32</td>
<td>3.75</td>
<td>3.70</td>
<td>3.62</td>
<td>3.68</td>
<td>3.90</td>
</tr>
<tr>
<td>Malaysia</td>
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<td>3.43</td>
<td>3.17</td>
<td>3.45</td>
<td>3.48</td>
<td>3.34</td>
<td>3.46</td>
<td>3.65</td>
</tr>
<tr>
<td>India</td>
<td>35</td>
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<td>3.17</td>
<td>3.34</td>
<td>3.36</td>
<td>3.39</td>
<td>3.52</td>
<td>3.74</td>
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<td>2.90</td>
<td>3.00</td>
<td>3.19</td>
<td>3.46</td>
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<tr>
<td></td>
<td>(53)</td>
<td>(3.08)</td>
<td>(2.87)</td>
<td>(2.92)</td>
<td>(2.87)</td>
<td>(3.21)</td>
<td>(3.11)</td>
<td>(3.53)</td>
</tr>
<tr>
<td>Vietnam</td>
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<td>2.98</td>
<td>2.75</td>
<td>2.70</td>
<td>3.12</td>
<td>2.88</td>
<td>2.84</td>
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<td>3.01</td>
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<td>2.86</td>
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<td>2.10</td>
<td>1.76</td>
<td>2.68</td>
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</table>


**Figure 1. Proposed framework of the current study**
Figure 2. Reverse Logistic Network Design
Source: Alshamsi and Diabat (2015)

Figure 3. Forward Logistics Supply Chain Network
**Figure 4.** Outer Model Assessment

**Table 2.** Outer Model Results

<table>
<thead>
<tr>
<th></th>
<th>Cronbach's Alpha</th>
<th>rho_A</th>
<th>Composite Reliability</th>
<th>Average Variance Extracted (AVE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EI</td>
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<td>0.946</td>
<td>0.961</td>
<td>0.860</td>
</tr>
<tr>
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<td>0.929</td>
<td>0.948</td>
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</tr>
<tr>
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<td>0.932</td>
<td>0.952</td>
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<td>SCBP</td>
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<td>0.934</td>
<td>0.940</td>
<td>0.760</td>
</tr>
</tbody>
</table>

**Note**

EI = Environmental Issues, FL = Forward logistic supply chain network
RL = Reverse logistic supply chain network, SCBP = Supply chain business performance
Table 3. Cross-Loadings

<table>
<thead>
<tr>
<th></th>
<th>EI</th>
<th>FL</th>
<th>RL</th>
<th>SCBP</th>
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</thead>
<tbody>
<tr>
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<td>0.894</td>
<td>0.836</td>
<td>0.871</td>
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<td>0.865</td>
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<td>0.830</td>
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<td>EI3</td>
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<td>0.596</td>
<td>0.615</td>
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Figure 5. Inner Model Assessment
Table 4. Inner Model Results

|                  | Original Sample (O) | Standard Deviation (STDEV) | T Statistics (|O/STDEV|) | P Values | \( r^2 \) | Decision |
|------------------|---------------------|----------------------------|----------------|----------|--------|----------|
| EI -> SCBP       | -0.352              | 0.079                      | 4.435          | 0.000    | 0.880  | Supported|
| FL -> SCBP       | 0.328               | 0.09                       | 3.643          | 0.000    | 0.561  | Supported|
| RL -> SCBP       | 0.298               | 0.079                      | 3.781          | 0.000    | 0.258  | Supported|

Table 5. Moderation effect

|                  | Original Sample (O) | Standard Deviation (STDEV) | T Statistics (|O/STDEV|) | P Values | Decision |
|------------------|---------------------|----------------------------|----------------|----------|----------|
| FL* EI -> SCBP   | 0.227               | 0.130                      | 1.739          | 0.061    | No       |
| RL* EI -> SCBP   | -0.208              | 0.051                      | 4.059          | 0.000    | Moderation|

Figure 6. Moderating effect of environmental issues between reserve logistic supply chain network and supply chain business performance