Lean Management and Green Supply Chain Management Implementation on the Manufacturing and Logistics Industry at an Indonesia

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ABSTRACT

This research is on the manufacturing and logistics industry in Indonesia in improving environmental performance. This study aims to implementation of lean management and green supply chain management to environmental performance. The methodology used in this study is primary data, 150 respondents from logistics professionals. This study uses SEM-PLS. The results showed that lean management had no significant effect on environmental performance. The implications of this study are focused on geography and small samples. Green supply chain management is oriented towards the environment in making supply chain decisions to improve environmental performance.

Keywords: Lean Management; Green Supply Chain Management; Environmental Performance.

INTRODUCTION

Firms are required to apply competitive tactics to produce quality goods or services, as well as implement emission reductions in the industrial sector at affordable prices for consumers. Consumers want environmentally friendly products and services (Green et al., 2015; Ramli, 2020; Ramli and Mariam, 2020), manufacturing companies must adapt to be environmentally friendly (Mulyadi et al, 2020; Ghazmahadi et al, 2020; Armanda et al., 2020; Mariam and Ramli, 2019b). Manufacturing companies have a significant relationship to the environment (Cherrafi et al., 2018; Mariam and Ramli, 2019a). Firms and communities implement green sustainable supply chain management oriented to the environment (Walker and Jones, 2012; Takaya et al, 2019; Chandra et al., 2019).
Research by Hussain et al., (2019) lean techniques do not have a significant effect on environmental performance. Cherrafi et al., (2018) lean techniques have a significant effect on green supply chain management performance. This study is related to whether lean management has an influence on environmental performance in Indonesia with green supply chain management as an intermediary.

**Hypothesis**

The influence of lean management on green supply chain management.

Lean integrates management practices to improve organizational performance and the overall supply chain (Beske, 2012), taking into account economic, environmental and social dimensions.

Green purchasing to the supply chain is integrated with suppliers, manufacturers, customers, and reverse logistics (Zhu et al., 2004). Lean and green supply chain management related to the environment (Srivastava, 2007) eliminates non-value-adding activities so that product delivery to consumers is faster, more efficient, and profitable.

**H₁:** There is an effect of lean management on green supply chain management.

The effect of green supply chain management on environmental performance. Supply chain management has become an important component in world trade and globalization. Supply chain management focuses on environmentally friendly and competitive advantages (Seeman et al., 2012).

**H₂:** There is an effect of Green supply chain management on environmental performance.

Lean management is designed to reduce waste, reduce time inefficiencies, improve environmental performance and reduce costs. Lean eliminates activities that do not add value to continuous improvement (Gasperz, 2007). Lean management has a positive effect on environmental performance (Zailani et al., 2012; Ulubeyli, 2013).

**H₃:** There is an influence of lean management on environmental performance.
The influence of Lean management on environmental performance is mediated by green supply chain management. Environmental is a company's strategic role in managing its impact on the environment (Walls et al., 2012). Lean focuses on reducing waste and maximizing added value in company effectiveness (Martínez-Jurado and Moyano-Fuentes, 2014; Shurrab et al., 2018). Lean helps organizations in reducing toxic materials (Eltayeb et al., 2011) and reducing environmental accidents.

**H4:** There is an influence of lean management on environmental performance mediated by green supply chain management.

**Picture 1:** Conceptual Framework

**METHODS**

SmartPLS version 3.3.2 with a significance level of 0.05. By using two-tailed hypothesis testing, the T statistical value is above 1.96. The Goodness of Fit (GoF) test in PLS-SEM is carried out through two analyzes, namely: testing the relationship between variables (R2). This test shows the determination of the independent variable on the dependent variable. The greater the R2 value means the better the level of determination. The relationship between variables can be categorized into three categories, which classify the amount of influence on the R2 value: 0.19 (weak), 0.33 (moderate), and 0.67 (Chin et al., 2008).

**RESULT AND DISCUSSION**

**Validity test**
There are several criteria for measuring convergent validity, namely by looking at the value of outer loading and average extracted variance (AVE). The first test of the convergent validity test is outer loading. A variable is said to be valid if it has an outer loading value of more than 0.5. The results of outer loading are described in table 1 as follows.

**Table 1: Outer Loading Results**

| Outer Loading | GSCM | LM | EP |
|---------------|------|----|----|
| CWC1          | 0.957|     |    |
| CWC4          | 0.567|     |    |
| ED3           | 0.957|     |    |
| EP3           |      | 1.00|    |
| GP1           | 0.567|     |    |
| GP5           | 0.957|     |    |
| JIT1          | 0.811|     |    |
| JIT2          | 0.810|     |    |
| KZ1           | 0.811|     |    |
| PM2           | 0.810|     |    |

From table 1 it can be seen the results of the validity test carried out through SmartPLS on three variables. The construct reaches the validity value of the suggested value, which is above 0.5. Therefore, Lean Management, Green Supply Chain Management, and Environmental Performance are declared valid and can be continued for further research. The next test for convergent validity is to look at the value *average variance extracted* (AVE). AVE is the result of measuring the amount of variance that can be captured from the construct compared to the variance generated due to measurement error. AVE is obtained from the calculation technique with the PLS algorithm. A variable is said to be valid if it has an AVE value of more than 0.5. The results of the average variance extracted (AVE) calculation are described in table 2 below.

**Table 2: Average Variance Extracted Results**

| AVE  | Validity Evaluation |
|------|---------------------|
| CWC  | 0.642               | GOOD               |
For the AVE criteria, the indicator reaches the limit criterion of 0.5. The results of Table 2 show that all variables are said to be valid because they have succeeded in achieving the criteria for AVE value and the commonality of each variable is more than 0.5.

**Reliability Test**

The reliability test is known from the Cronbach's alpha score and Composite reliability. Cronbach's alpha score is required to be at least 0.6 while the minimum score for composite reliability is 0.7 (Sekaran, 2013).

Similar to the validity test above, the reliability test is also carried out using the PLS algorithm technique.

**Table 3: Internal Consistency Results**

| Internal Consistency | Composite Reliability | Cronbach's Alpha |
|----------------------|------------------------|------------------|
| CWC                  | 0.779                  | 0.468            |
| ED                   | 1.000                  | 1.000            |
| GP                   | 0.779                  | 0.468            |
| GSCM                 | 0.909                  | 0.875            |
| JIT                  | 0.793                  | 0.479            |
| KZ                   | 1.000                  | 1.000            |
| PM                   | 1.000                  | 1.000            |
From table 3 it can be seen that the reliability test results of all variables show that Cronbachs Alpha and Composite Reliability (CR) simultaneously indicate that the entire construct has reached the recommended reliability value, which is above the value of 0.6. Even though the Cronbach's Alpha value of CWC, GP, and JIT is less than 0.60, if you look at the Composite Reliability value, all latent variables in the study have fairly good reliability (Composite Reliability value > 0.60).

R-Square Analysis (R2)

R2 is obtained from calculating the PLS algorithm in the SmartPLS software. R2 exists only in latent variables which are influenced by other latent variables. The latent variable affected is also called the endogenous latent variable (Hussein, 2015). In this study, three endogenous latent variables have a calculation of R2, namely digital innovation, and sustainability. According to (Chin et al., 2008), the R2 value is considered weak, moderate, and strong if it shows 0.19, 0.33, and 0.67 respectively (Ghozali, 2014). The results of R2 in this study are shown in table 4 below.

Table 4: Result R²

|       | R²   |
|-------|------|
| EP    | 0.917|
| GSCM  | 0.002|
| LM    |      |

From table 4 it can be seen that the value of R2 varies, with the R2 value of the Environmental Performance variable of 0.917, this shows that 91.7% is influenced by the Green Supply Chain Management variable. The value of R2 on this variable is categorized as strong referring to the criteria (high, moderate, low). It means, the variables in the model have a greater influence on the affected variables than other factors that come from outside the model. The R2 value of the Green Supply Chain Management variable is 0.002, this shows that 0.2% is influenced by the Lean Management variable. The R2 value on this variable is categorized as low according to
the criteria (high, moderate, low). It means, the variables in the model have less influence on the affected variables than other factors that come from outside the model.

**Q-Square Analysis (Q2)**

Model evaluation in PLS-SEM is different from the evaluation of the SEM model because the basis of processing between PLS-SEM and SEM is different. SEM uses a covariance or correlation matrix as the basis for processing, while PLS-SEM uses a variance matrix as the basis for processing.

A criterion that is usually used to see the prediction accuracy of the SEM PLS model in Q2.

\[ Q^2 = 1 - \frac{\text{SSE}}{\text{SSO}} \]

If \( Q^2 < 0 \), it means that the model is very bad, the independent variables cannot explain the dependent variable (no predictive relevance). If \( Q^2 > 0 \), it means that the model is good, the independent variables can explain the dependent variable.

**Table 5: Predictive Relevance Results**

| Variable | \( Q^2 \) |
|----------|-----------|
| CWC      | 0.612846  |
| ED       | 0.909132  |
| EP       | 0.905136  |
| GP       | 0.602920  |
| GSCM     | 0.000628  |
| JIT      | 0.713146  |
| KZ       | 0.638186  |
| LM       | 0.410751  |
| PM       | 0.651016  |

In table 5, it can be seen that all latent variables have a value of \( Q^2 > 0 \). This means that all exogenous constructs have good relevance in predicting endogenous constructs in the model. This can illustrate the suitability of the proposed model (Goodness of Fit).

**Table 6: SEM-PLS Path Coefficients Calculation Results**
### Table

| H1: LM -> GSCM  | Coefficients | Standard Deviation | Standard Error | T Statistics | pvalue |
|----------------|--------------|--------------------|----------------|--------------|--------|
| 0.0451         | 0.0645       | 0.0645             | 0.6984         | 0.4854       |

### H1: There is an influence of lean management on green supply chain management.

The P values for lean management on green supply chain management are 0.4854 <; This means that lean management has no significant effect on green supply chain management. PLS calculation results show that lean management has no significant effect on green supply chain management. H1 was declared rejected.

### H2: There is an effect of green supply chain management on environmental performance.

The P values for green supply chain management on environmental performance are 0.000 <; This means that green supply chain management has a significant effect on environmental performance. PLS calculation results show that green supply chain management is proven to have a significant effect on environmental performance. H2 is declared accepted.

### H3: There is an effect of lean management on environmental performance.

The P values for lean management on environmental performance are 0.2961 <; This means that lean management has no significant effect on environmental performance. The PLS calculation results show that lean management has no significant effect on environmental performance. H3 was declared rejected.

### H4: There is an influence of lean management on environmental performance mediated by green supply chain management.

The P values for lean management on environmental performance through green supply chain management are 0.4850 <; This means that green supply chain management does not significantly mediate lean management on environmental performance.
RESULT, DISCUSSION, AND IMPLIKASI MANAGERIAL

The results showed that green supply chain management did not significantly mediate lean management on environmental performance. Lean focuses on increasing efficiency and reducing waste in production. Green supply chain management collaborates with customers to reduce product waste. Customers realize the importance of a green supply chain applied to manufacturing companies in creating environmentally friendly products so that they can improve environmental performance.

Implication Managerial
Green supply chain management is the pre-production stage, namely holding seminars with suppliers regarding environmental awareness. Guide suppliers for setting up environmental programs. Hold seminars with all suppliers to share knowledge and problems. Provide information about suppliers to achieve the benefits of environmentally friendly production and technology. Provide understanding to suppliers to take action based on the environment. Selecting suppliers according to criteria based on the environment. At the production stage, namely the selection of environmentally friendly raw materials, the use of environmentally friendly technology to save energy, water, and waste. The post-production stage is to provide information to customers that the product and its production process are environmentally friendly. Use of environmentally friendly transportation and minimal gas emissions.

Suggestion
Further research is recommended to apply variables such as total quality management and just-in-time as well as kaizen so that lean management affects company performance. In further research, it can be carried out outside the territory of Indonesia.

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