



DISCLOSURE INTEGRATION OF LEAN SIX SIGMA PRINCIPLES IN SUSTAINABLE SUPPLY CHAIN IN POULTRY INDUSTRY

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Abstract

The poultry industry has been in the spotlight for its enormous potential economic development. However, poultry industry is still not implementing the concept of sustainability properly. There are still many wastes that have not been managed properly and there are still many problems in the supply chain that require more systematic handling. Many studies have shown that the implementation of Lean Six Sigma (LSS) and sustainability has positive results on the company's bottom line performance. This research tried to integrate the application of LSS principles and sustainability along the supply chain in the poultry industry in Indonesia. Data were collected from 4 listed poultry firms in Indonesia. The research method used SEM PLS with SmartPLS software. The results showed that supply chain security management system disclosure as the principle of LSS had a positive effect on the collaboration of supply chain disclosure and collaboration of supply chain disclosure had a positive effect on sustainability. The results also showed that risk management disclosure had a negative effect on the collaboration of supply chain disclosure and economic sustainability had a negative effect on environmental sustainability, but social sustainability had a positive effect on environmental sustainability. Based on the results of this study, there is a need to improve supply chain security management system and supply chain collaboration in order to advance sustainable poultry industry.

Keywords: Integration, Lean Six Sigma, Poultry Industry, Supply Chain, Sustainability

INTRODUCTION

Indonesian poultry industry, grew rapidly in the 1990s with the support of government regulations that made it easier for foreign investment to enter poultry sector (Dagri, 2016). The Value of Foreign Investment (VFI) in the poultry sector is the highest source of investment compared to other livestock sectors, about US\$ 24.29 million in 2019. Domestic Investment Value (DIV) in the poultry sector is also the highest source of investment in other livestock sectors about IDR 875.76 billion in 2019 (Kementan, 2019b).

High investment value of the poultry sector has boosted the growth of poultry industry with composition of PT/CV/Firma of 97.75%, 1% of foundations, 0.75% of BUMN and 0.5% of cooperatives (BPS, 2020). The growth of the livestock business encourages increased production of broiler chickens which have a relatively faster growth rate. In 2015, Indonesian broiler chicken production has reached 3 million tons (Kementan, 2019b) which causes Indonesian broiler chicken supply exceed the total domestic consumption needs. This supply and demand imbalance occurs as a result of a lack of good coordination between supply chain actors. High production activity of broiler chickens has also resulted in other problems such as increased Green House Gasses (GHG) and waste in the form of feces and odors. The increase in GHG causes climate change in Indonesia and the world. Climate change has caused many regions to experience a crisis in the availability of clean water and resources.

Indonesian poultry industry has a great potential to be developed (Jamarizal et al., 2018; Saptana & Yofa, 2016). The high production of Indonesian broiler chicken meat has brought Indonesia to the 8th position as the largest chicken meat producer in the world (Kementan, 2019a), but Indonesian broiler chicken meat has not been able to compete with other countries products. The import value of Indonesian poultry input and output products is greater than the value of exports. It causes the importance of efficiency and systemic improvements in the supply chain of the poultry industry.

Currently, operational management development methods are developing rapidly with the application of Total Quality Management (TQM) such as Lean and Six Sigma (Garza-Reyes, 2015). Sustainability in the context of company management is also the focus of stakeholders where the company can have a positive impact on its economy,

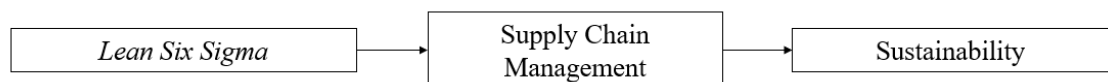
social and environment. Many empirical results showed that there was a positive impact in the application of Lean Six Sigma by organizations in various sectors and sizes (Dora & Gellynck, 2015; Drohomerecki et al., 2014; Sakumoto et al., 2019). Miller et al. (2010) suggested that LSS and sustainability had a positive impact on bottom line performance. Other studies have found that implementing sustainability can be achieved by implementing lean, six sigma and supply chain management (Cherrafi, Elfezazi, Chiarini, et al., 2016; Garza-Reyes, 2015; Narimissa et al., 2020). Supply chain management can be an effective way on implementing sustainability (Wijethilake, 2017) and is achieved by collaborative efforts and participatory governance (Varsei et al., 2014). Some researchers propose a new framework that integrates Lean, Six Sigma and Sustainability (Banawi & Bilec, 2014; Cherrafi, Elfezazi, Govindan, et al., 2016; Garza-Reyes, 2015). The integration of the three has more similarities than differences. Some scholars integrate lean, six sigma and ISO (Lalonde & Boiral, 2012; Marques et al., 2013; Marrugo et al., 2017; Sá et al., 2020; Wirkus & Chmielarz, 2018) which find compatibility between these three and can improve company's performance.

This study aims to analyze the factors that influence the disclosure of the integration of the LSS principles in the supply chain of the poultry industry to achieve sustainability with approach of annual report of poultry disclosure.

RESEARCH METHOD

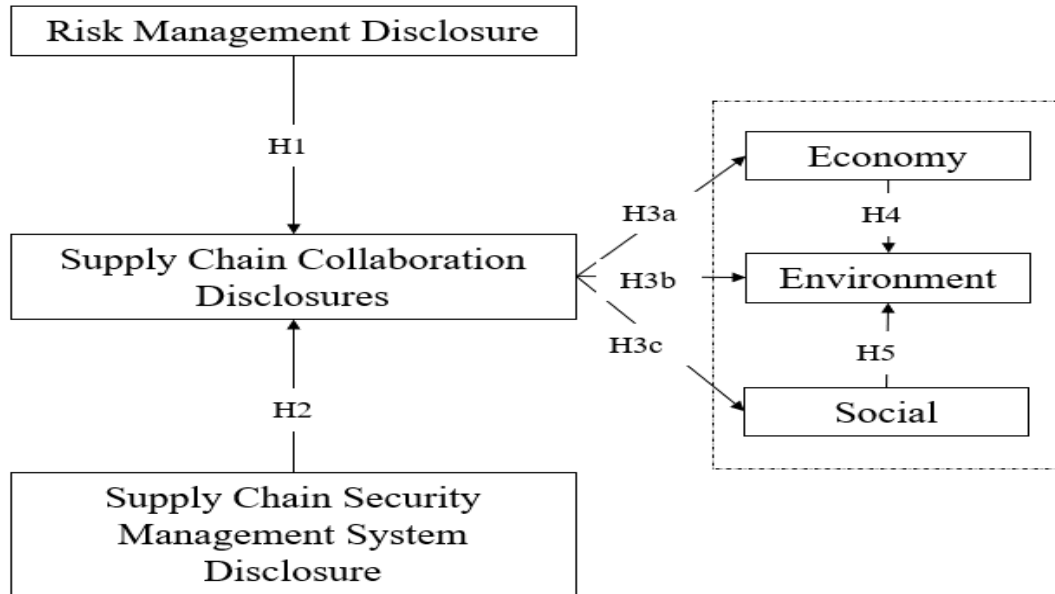
This study uses secondary data from poultry farm issuers in 2014-2019 obtained from the Indonesia Stock Exchange and livestock company websites. The data collected includes data related to risk management disclosures, disclosure of supply chain security management systems and company sustainability in economic, social and environmental aspects. Data collection is done by giving a binary scale of 0-1 on each indicator. A scale of 0 is given to the undisclosed indicator and a scale of 1 is given to the indicator that is disclosed.

Figure 1
Poultry Industry Research Model



This study refers to (Cherrafi, Elfezazi, Govindan, et al., 2016) which used integrated LSS and green framework to achieve sustainability. Waste reduction can affect financial performance while the integration of LSS and sustainability will improve the company's financial and operational performance. To get an effective result, the right method is needed. Sobral et al., (2013) found that companies implementing ISO 9001 on quality management systems and ISO 14000 on environmental management have a positive impact on the environment. The application of ISO 31000 on risk management will facilitate supply chain management. All issuers of poultry farming have ISO 9001: 2015 certification. For this reason, this study tries to integrate the application of LSS principles with supply chain management and sustainability as illustrated in Figure 1. This study then develops an existing model using risk management disclosure and supply chain security management system disclosure as variables that describe the implementation of LSS and integrate it with sustainability was measured using the SEM PLS method (Figure 2).

Figure 2
The Research Model Developed



Based on Figure 2, the hypotheses in this study are:

- H1 : There is an effect of risk management disclosure on supply chain collaboration disclosures.
- H2 There is an effect of supply chain security management system disclosure on supply chain collaboration disclosure.
- H3a There is an effect of supply chain collaboration disclosure on economic sustainability performance
- H3b There is an effect of supply chain collaboration disclosure on environmental sustainability performance.
- H3c There is an effect of supply chain collaboration disclosure on social sustainability performance.
- H4 There is an effect of disclosure of economic sustainability performance on environmental sustainability performance.
- H5 There is an effect of disclosure of social sustainability performance on environmental sustainability performance

The analysis was carried out by examining the influence between variables and analyzing the indicators that had a significant effect on each variable. The indicator used in the supply chain collaboration disclosure variable is supply chain collaboration which refers to the supplier development clause in the SNI Award 2020. The indicators contained in the 2020 SNI Award are similar indicators that are also used by other researchers (Jiang, 2009; Saptana & Yofa, 2016). Risk management disclosure variables use risk management indicators that refer to SNI ISO 31000: 2018. The variable of supply chain security management system disclosure uses supply chain security management system indicators that refer to SNI ISO 28000: 2009. The sustainability variable which consists of economic, social and environmental aspects uses reference indicators in the SNI Award 2020. Economic variables use indicators of NPM, ROA and ROE. Social variables use social indicators contained in social responsibility and knowledge management clauses. Environmental variables use environmental indicators contained in the work environment clause. The social and environmental sustainability variables also add to several other indicators used in sustainability research (Martens & Carvalho, 2016; Narimissa et al., 2020).

RESULTS AND DISCUSSION

SEM PLS is a widely used estimation method (Benitez et al., 2020) which is used in a complex research model, with many variables and construct indicators (Hair et al.,

2014). In addition, SEM PLS can be used for small sample sizes and abnormal data distribution (Hair et al., 2011). SEM PLS is carried out in 2 stages, namely measuring outer model and measuring inner model. The outer reflective measurement model is evaluated by measuring the reliability of indicators (loading) with a value greater than 0.70, measuring the internal consistency reliability (composite reliability and Cronbach's alpha) with a value greater than 0.70, and measuring convergent validity (AVE) with a higher value greater than 0.5 (Hair et al, 2014). AVE and CR values indicate the validity and reliability of the model testing. Inner model (structural model) is measured using the coefficient of determination (R square) with a value between 0 and 1 and the t statistic with a value greater than 1.96.

Figure 3
Research result

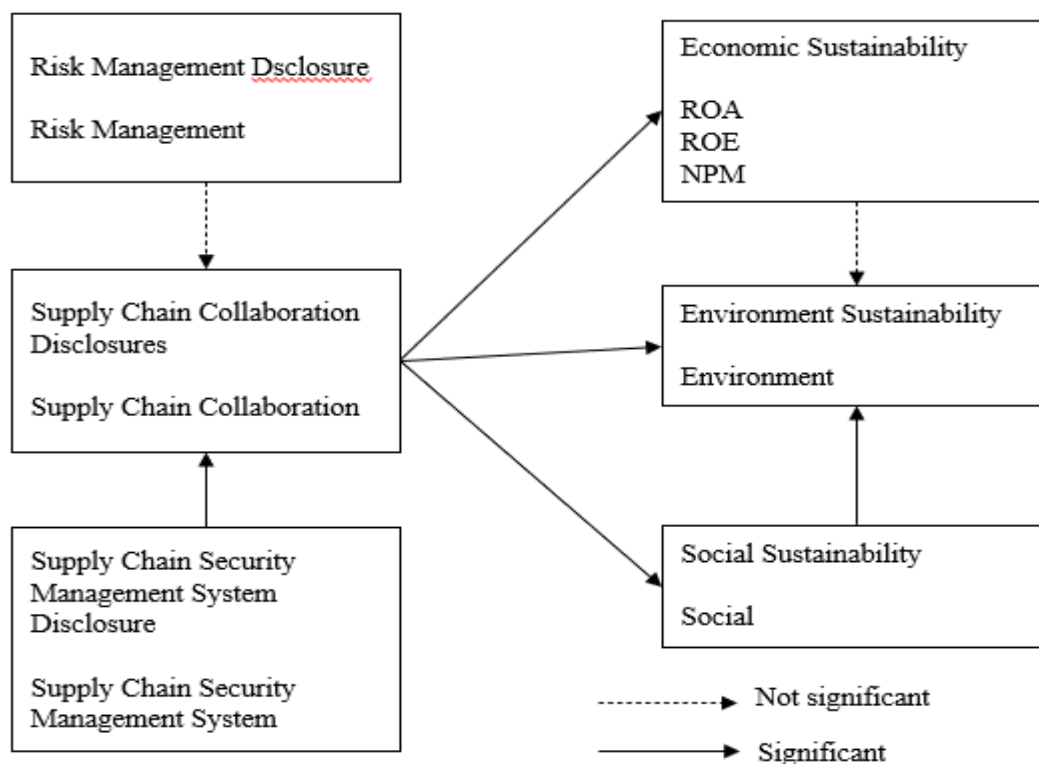


Table 1
Cross loading value

No	Variable	Indicator	Loading Factor	Conclusion
1	Risk management disclosure	Risk management	1.000	Valid
2	Supply chain security management system disclosure	Supply chain security management system	1.000	Valid
3	Supply chain collaboration disclosure	Supply chain collaboration	1.000	Valid
4	Environmental sustainability	Environment	1.000	Valid
5	Social sustainability	Social	1.000	Valid
6	Economic sustainability	NPM	0.996	Valid
		ROA	0.989	Valid
		ROE	0.993	Valid

Table 2
Outer model measurement

Variable	AVE	Composite Reliability	Cronbachs Alpha
Economic	0.98559	0.99515	0.99273
Supply chain security management system disclosure	1.00000	1.00000	1.00000
Risk management disclosure	1.00000	1.00000	1.00000
Supply chain collaboration disclosures	1.00000	1.00000	1.00000
Environment	1.00000	1.00000	1.00000
Social	1.00000	1.00000	1.00000

The evaluation results of the outer model showed that the loading factor value (Table 1) ranges from 0.98-1.00, greater than 0.70, which means that all indicators can be used. Composite reliability (CR) ranged from 0.99-1.00 exceeding the recommended number of 0.70 which indicates that the construct is reliable. Cronbach's alpha (Table 2) shows a reliable value because it is at a value of 0.99-1.00 which is above 0.70. The value of all AVE variables is above the number 0.50 which means that it is validly converging.

Thus, the measurement of the outer model is satisfactory because CR and Cronbach's alpha are all above 0.70 which indicates the consistency, reliability and validity of the model.

Tabel 3
Hypothesis Test

Path	Hypotesis	T Statistics	Coclusion
Risk management disclosures -> Supply chain collaboration disclosures	H1	1.214	Not significant
Supply chain security management system disclosure -> Supply chain collaboration disclosure	H2	29.532	Significant
Supply chain collaboration disclosures -> Economy	H3a	10.626	Significant
Supply chain collaboration disclosures -> Environment	H3b	5.815	Significant
Supply chain collaboration disclosures -> Social	H3c	7.864	Significant
Economy -> Environment	H4	1.758	Not significant
Social -> Environment	H5	16.072	Significant

Inner model evaluation is done by evaluating the significance of the path coefficient to test the hypothesis. Disclosure of risk management and disclosure of supply chain security management systems are tested for their effect on disclosure of supply chain collaboration. The results in Table 3 show that risk management disclosure has an insignificant negative effect on supply chain collaboration disclosures. The disclosure of the supply chain security management system has a significant positive effect on the disclosure of supply chain collaboration ($t > 1.96$), which means that H1 is rejected and H2 is accepted. The disclosure of supply chain collaboration has a significant positive effect on economic sustainability, social sustainability and environmental sustainability ($t > 1.96$) which means that H3a, H3b and H3c are accepted. Economic sustainability has no effect on environmental sustainability ($t < 1.96$), which means that H4 is rejected. Meanwhile, social sustainability has a significant positive effect on environmental sustainability ($t > 1.96$), which means that H5 is accepted. The value of R square for economic sustainability is 0.196, which means that the variation in economic sustainability that can be explained

by the model is 19.6%, while the rest is explained by other factors outside the model. The R square value of social sustainability and environmental sustainability which can be explained by the model is 13.3% and 37.6%, respectively. Meanwhile, the R square value for the disclosure of supply chain collaboration which can be explained by the model is 36.7%.

DISCUSSION

Hypothesis testing shows H1 is rejected where risk management disclosure does not affect supply chain collaboration. This is different from de Oliveira's (2017) research who found that ISO 31000 can be used as a model for managing risk in the supply chain. H2 accepted means that increased disclosure of the supply chain security management system will increase supply chain collaboration. The supply chain security management system based on SNI ISO 28000: 2009 aims to manage supply chain security by maintaining product quality and making continuous improvements. Good supply chain management will improve performance, coordination and communication along the supply chain, so that supply chain management can be more efficient. Good communication between supply chain actors will maximize the exchange of information along the supply chain. Thus, producers can predict well the amount of community demand for poultry products. Accurate forecasting is very useful to avoid over-supply of broiler chickens in the community. The three pillars of sustainability, namely economic, social and environmental, are strongly influenced by disclosure of supply chain collaboration (H3a, H3b, H3c). Good disclosure of supply chain collaboration will enhance cooperation not only for the exchange of information, but also the sharing of risks and benefits. This collaboration aims in the long term as an effort to maintain the economic, social and environmental sustainability of the related stakeholders.

Economic sustainability does not have a significant effect on environmental sustainability (H4). This is in line with research Younis & Chaudhary (2020) which mentions trade off in economic sustainability and environmental sustainability. Increasing the scale of production in order to achieve economic efficiency can lead to increased use of resources and energy. Increasing the scale of production in the form of high broiler population numbers will certainly increase the amount of waste which, if not managed

properly, will threaten environmental sustainability. Increasing social sustainability will increase environmental sustainability (H5). The company's efforts in implementing various corporate social responsibility (CSR) programs are carried out as part of maintaining environmental sustainability. Building public awareness of the importance of maintaining environmental sustainability will increase the sustainability of the environment itself.

CONCLUSION

Research on LSS integration and sustainability conducted in the poultry industry was investigated using the SEM PLS method. The variables used are risk management disclosure, supply chain security management system disclosure, supply chain collaboration disclosure and the three pillars of sustainability. The results show that the risk management disclosure variable has no effect on the supply chain collaboration disclosure. The disclosure of the supply chain security management system has a significant effect on supply chain collaboration. Supply chain collaboration has a significant effect on economic sustainability, social sustainability and environmental sustainability. Social sustainability has a significant effect on environmental sustainability, while economic sustainability has no significant effect on environmental sustainability. To achieve sustainability, companies need to focus on disclosure of supply chain collaboration and disclosure of supply chain management. The research results can be concluded as in Figure 3.

Based on the results, suggestions that can be given to improve the performance of the poultry farming industry are that the company needs to improve its supply chain security management system. This security management system will be easier to implement because all sample companies have been supported by ISO / SNI 9001: 2018 quality management certification. Companies need to strengthen communication and coordination of supply chain from upstream to downstream, to improve supply chain performance. Improving communication and listening to customer needs is an important aspect of quality management. The implementation of good quality management will be able to meet customer satisfaction and improve the sustainability of the company. Supply chain collaboration can be realized by sharing knowledge, product quality standards and

services along the supply chain so that the principle of sustainability can be applied throughout the supply chain flow.

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