Development of an Assessment Simulator and Directions for Improvement of Green Supply Chain Management Readiness Levels.

Traditionally, the measurement of company performance has only focused on the economic aspect. With increasing competition and demands for corporate social responsibility, companies are encouraged to pay more attention to non-financial aspects as a measure of their performance [2]. The demand for companies to pay attention to the impact of their business activities on the environment has made environmental performance measurement increasingly popular. Measurement of environmental performance has a strategic role because green management has been proven to increase the long-term competitiveness and economic performance of companies [3][4]. Furthermore, currently, competition between companies has shifted to competition between supply chains so that measuring performance including environmental performance cannot be carried out at the level of a single company anymore but requires a holistic approach that includes the supply chain [5]. The need for the development of suitable measuring tools to monitor the performance of green supply chain management has increased. Several organizations have developed in-house methods for assessing sustainable supply chain management performance through the SCOR framework which introduced a special section on environmental aspects in version 11 [4]. The development of a green supply chain management performance assessment model involving various procurement, manufacturing, distribution, and reverse logistics activities cannot be analysed with a single equation but can be approached with systems dynamics. Compared with operational approach models and econometric models, systems dynamics can describe the interaction of feedback relationships between activities in green supply chains comprehensively [7]. Mubiena and Ma'ruf (2018) have developed a sustainable supply chain assessment model through the SCOR framework and systems dynamics in the Batik Industry [8]. This research is important because it not only aims to develop a green supply chain assessment model but also assesses the readiness level of a green supply chain equipped with a simulator that can see its dynamic behaviour.

This research phase begins by identifying a simple supply chain system (Figure 1) and analyzing the activities that generate CO2 emissions. Six main activities generate CO2 emissions, namely (1) raw material distribution, (2) electricity use, (3) combustion engine, (4) distribution transport to customers, (5) return transport to suppliers, and (6) return transport to plants. To make a dynamic system modeling, the next step is to formulate a causal relationship between variables in the form of a causal loop diagram (CLD). The development of causal loop diagrams by accommodating six main activities which subsequently became six sub-models has been carried out (Figure 2). Currently, the development of the flow diagram is being carried out. After the model is declared valid, the development of an assessment simulator and the direction of improving the readiness level of green supply chain management can be carried out.

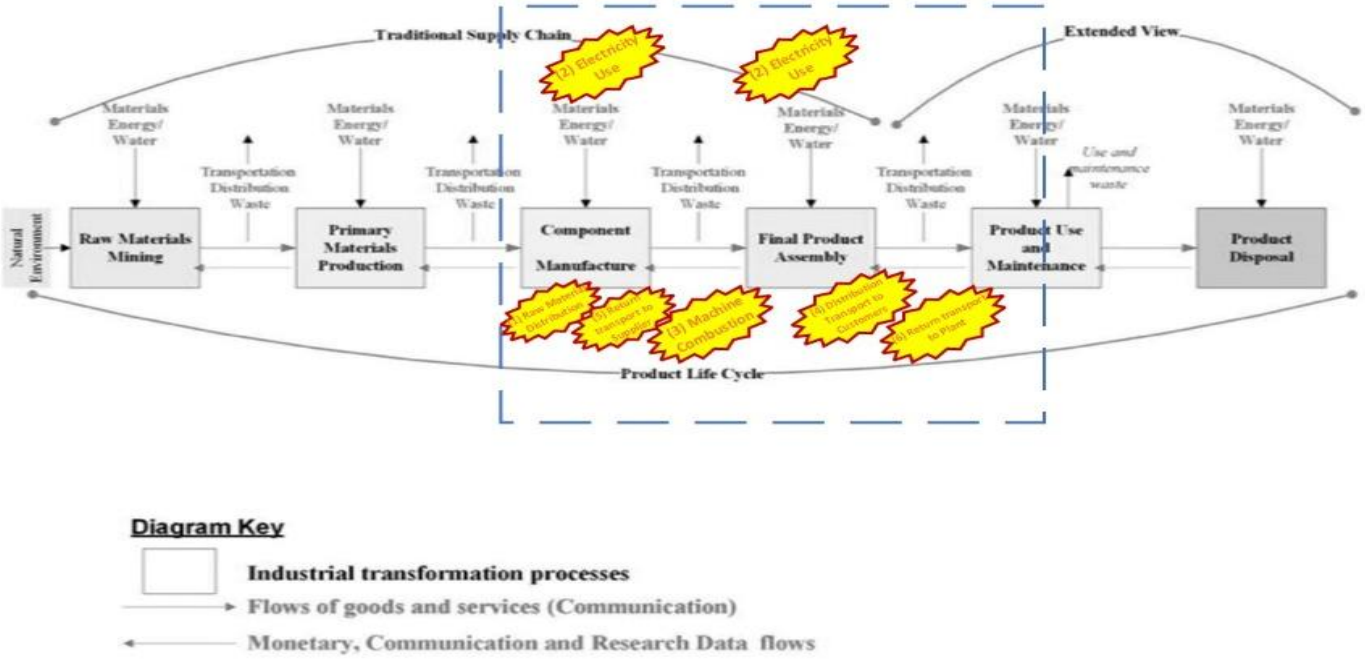

Figure 1. Identification of the company's supply chain activities

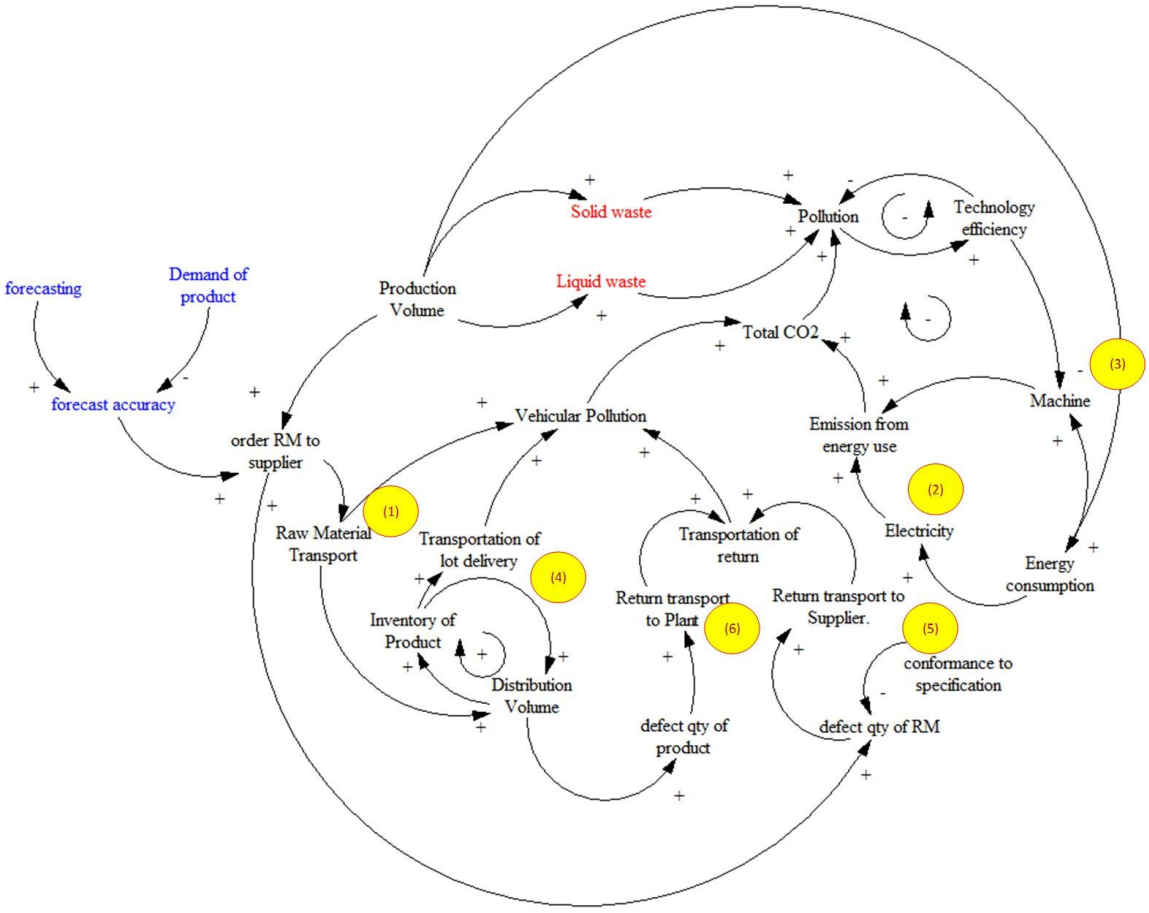

Figure 2. Causal Loop Diagram

References

1. Greenhouse Gas (GHG) Emissions | Climate Watch. (2021). Retrieved 20 *December 2021, from* https://www.climatewatchdata.org/ghg-emissions?end_year=2018&start_year=1990
2. Taticchi, P., Tonelli, F. and Pasqualino, R. (2013), “Performance measurement of sustainable supply chains: a literature review and a research agenda”, International Journal of Productivity and Performance Management, Vol. 62 No. 8, pp. 782-804.
3. Rao, P. and Holt, D. (2005), “Do green supply chains lead to competitiveness and economic performance?”, International Journal of Operations & Production Management, Vol. 25 No. 9, pp. 898-916.
4. Tuni, A., Rentizelas, A., and Duffy, A. (2018),”Environmental performance measurement for green supply chains; A systematic analysis and review of quantitative methods”, International Journal of Physical Distribution and Logistics Management, 02-2017-0062.
5. Cabral, I., Grilo, A. and Cruz-Machado, V. (2012), “A decision-making model for lean, Agile, resilient and green supply chain management”, International Journal of Production Research, Vol. 50 No. 17, pp. 4830-4845.
6. B. M. Beamon, Designing the green supply chain. Logistics information management. 12 (1999) 332-342.
7. Song, M., Cui, X., and Wang, S. (2018), ”Simulation of land green supply chain based on system dynamics and policy optimization”, International Journal of Production Economics, 0925-5273.
8. Mubiena, G.F., and Ma’ruf, A. (2018), ”Development of an assessment model for sustainable supply chain management in batik industry”, IOP Conference Series: Materials Science and Engineering 319, 012073.