DESIGNING A COLLABORATIVE MODEL FOR THE RAW MATERIAL PROCUREMENT PROCESS TO ELEVATE THE FURNITURE INDUSTRY COMPETITIVENESS

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Abstract

The furniture industry is a non-oil and gas sector that can be developed aggressively due to the abundant natural resources provided by Indonesia's forests. However, there are several issues in the wooden furniture industry, starting on the upstream supply chain, especially in the raw material procurement process. The increasing product cost because of high procurement costs could make this industry hard to compete or grow. Thus, this study proposes an improvement of raw material procurement by developing a collaborative model to minimize the total circular procurement cost in the wooden furniture industry supply chain. Adopting the collaborative model is expected to reduce the raw material procurement costs of all parties involved in the supply chain by shortening the supply chain. In addition, this study built a dynamic system model with an implementation circular supply chain concept, which focuses on regenerating the wood raw material toward zero waste. The finding is that a collaborative model could reduce the total circular procurement cost by 25% to 35% compared to the base model. A recommendation for building the terminal comes from the collaborative model. The result of this study provides a solution to elevate the furniture industry's competitiveness through cost reduction.

Keywords: *circular economy; circular procurement cost; collaborative procurement; furniture industry; supply chain*

1. Introduction

Indonesia's furniture industry has shown its great potential to be explored by being one of the top five industries with the highest growth for the non-oil and gas sector in 2021 and is growing by 4.36% in the first quarter of 2022 (Kemenperin, 2022). Focusing on its raw material, the most significant export value of Indonesia's furniture is wooden furniture which contributed as much as 69% of the total export in 2021 (Kemenperin, 2022). It is also supported by having a forest area of about 50.9% of Indonesia's total area as of 2020 (Dihni, 2022). Despite the condition above, Indonesia ranked twenty-first in the world with a percentage of 1.02% in 2020, was far behind Vietnam as the top fourth (5.16%), and even China as the leading furniture exporter (39%) (Observatory of Economic Complexity (OEC), n.d.) (Simoes & Hidalgo, 2011). Thankfully, Indonesia's rank increased to seventeenth in 2021 with a market share of 1.19% (Kemenperin, 2022). Due to the circumstances, Indonesia's furniture industry needs to be evaluated to improve its competitiveness.

The common problem in wooden furniture is the continuity and stability of supplying the raw material, which ironically caused the industries to be controlled by the supplier, not either way (PERMAPSI, 2020). Several factors influencing raw material scarcity are illegal logging, mainly from Indonesia's forests to competitor countries, and deforestation (Salim & Munadi, 2017). Other issues that must be considered are the expensive wood materials, high technology machines, and labor costs (Ministry of Trade of The Republic of Indonesia, 2008). Additional issues in the furniture industry are the increasing trend of imported furniture, the U.S.-China Trade War, relatively high prices on supported parts, lack of support for marketing and competitiveness in the global market, high logistics cost, limitation of appropriate machinery, limitation of skillful and standardized human resources, and lack of support for infrastructure and funding policy (Kemenperin, 2022). Moreover, the mean wastage rate of 37.4% from processing the logs to the final production could be a

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potential environmental issue if there is no further application of its waste (Sofuoğlu & Kurtoğlu, 2012).

It is shown that the wooden furniture industry problems have occurred starting from the upstream supply chain. Thus, this study tries to further analyze the upstream situation, especially on the raw material procurement system, because it greatly influences the next chain. It is based on the consideration that procurement spends more than 50% of the total product/service cost (Monczka et al., 2016). Meanwhile, procuring the wooden furniture industry's raw material is highly dependent on natural resources because the wood obtained for furniture, such as teak, can be harvested after 5 to 40 years (Damayanti et al., 2018). Thus, its raw material procurement should consider sustainability by cutting trees and then planning the replantation. Moreover, if the issue of raw material scarcity cannot be solved, it could affect the furniture industry's competitiveness because of higher procurement costs.

The UN Environment Programme has also provided sustainable procurement guidelines (UNEP, 2021). Sustainable procurement also can be linked to a circular economy concept because it focuses on designing out waste within the business model and overcoming the risk of resource depletion (Ellen MacArthur Foundation, 2013). As mentioned, it is suitable for the furniture industry's characteristics that produce high waste. Moreover, based on the biological and technical cycle in the circular economy, the wooden furniture industry has features that can apply those cycles in the circular economy (Ellen MacArthur Foundation, 2019). Then, the benefit of this concept can be used to improve the wooden furniture industry. For example, applying a circular economy in the wood production chain can significantly reduce the total net carbon emission (Do et al., 2023). In addition, importing raw materials on wooden furniture could increase the impact of $CO2$ emission by 39% to 45% based on the life cycle assessment (LCA) result (Coloma-Jiménez et al., 2022). It means adopting the circular economy could reduce the environmental impact in the wooden furniture industry.

Based on our knowledge, there need to be more scientific manuscripts solving the wooden furniture industry problem by integrating the circular economy into the procurement strategy in its supply chain. Hence, there is room for improvement in solving the problems in the wooden furniture industry by adopting a circular economy, considering all those advantages combined with the procurement strategy in its supply chain. Differentiating from the previous study evaluating Green Public Procurement (GPP) criteria and its weight in the furniture sector (Braulio-Gonzalo & Bovea, 2020), this study focuses on assessing the total circular procurement cost in the wooden furniture industry. Furthermore, this study applies a collaborative strategy in the raw material circular procurement practice, primarily through multi-stakeholders involvement (Xu et al., 2022). The design of the collaborative model will be simulated and then evaluated compared to the base model (current condition). The collaborative approach can provide a fair proportional margin over the wooden furniture industry supply chain that could keep this industry profitable and lower the upstream's operational cost. This collaborative model implies that reducing the total circular procurement cost could improve the upstream wooden furniture industry, making the procurement system more manageable and in control to improve the continuity and stability of the raw material. This study uses the total circular procurement cost as a measurement indicator of the model designed. This research aims to minimize the total circular procurement cost so the industry can realize the improved continuity and stability of the raw material. Finally, the result of this study becomes the input for stakeholders to assess and plan the improvements in the upstream wooden furniture industry.

2. Research Method

This study is a causal explanatory study with a quantitative approach. This causal explanatory study describes the relationship among variables for building the total circular procurement cost in the furniture industry. Besides that, the quantitative approach in the study is for modeling the total circular procurement cost in the furniture industry and developing it for a collaborative strategy with multi-stakeholder involvement. The study applies dynamic system modeling to represent the actual case condition and obtain the advantage of the ease of model development. The methodology of this study starts from the initial research, data collection, system modeling for the current condition, designing a collaborative model, analysis, and conclusion.

2.1. Data collection

This study's objects are PERMAPSI, located in Ngemplak, Boyolali, Central Java, and the Department of Environment and Forestry, Central Java Province, located in Banyumanik, Semarang, Central Java. PERMAPSI (Non-Governmental Organization of Indonesian Social Forestry Association) is an association of independent and integrated social forestry observers and managers responsible for the social forest's existence and sustainability (PERMAPSI, n.d.). Surveys and observations were conducted to obtain information on the current condition. The interview questions consist of the current state of the furniture industry, including questions to explore the wood supply for production, cost elements and its amount for raw material procurement, and the furniture industry's supply chain. The study was conducted in December 2020. Besides survey and observation, the data type required for this study also referred from the literature review. The data of variable cost is essential as the input for building the simulation model. This study's critical variables for total circular procurement cost are wood stand price, the number of participants, additional cost, mark-up, and wastage (Sachan et al., 2005).

2.2. The supply chain

Effendi (2011) stated that the actors in the wood supply chain are the forest owner, first collector

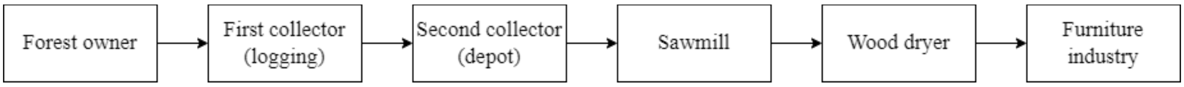

Figure 1. Wood Supply Chain (Effendi, 2011)

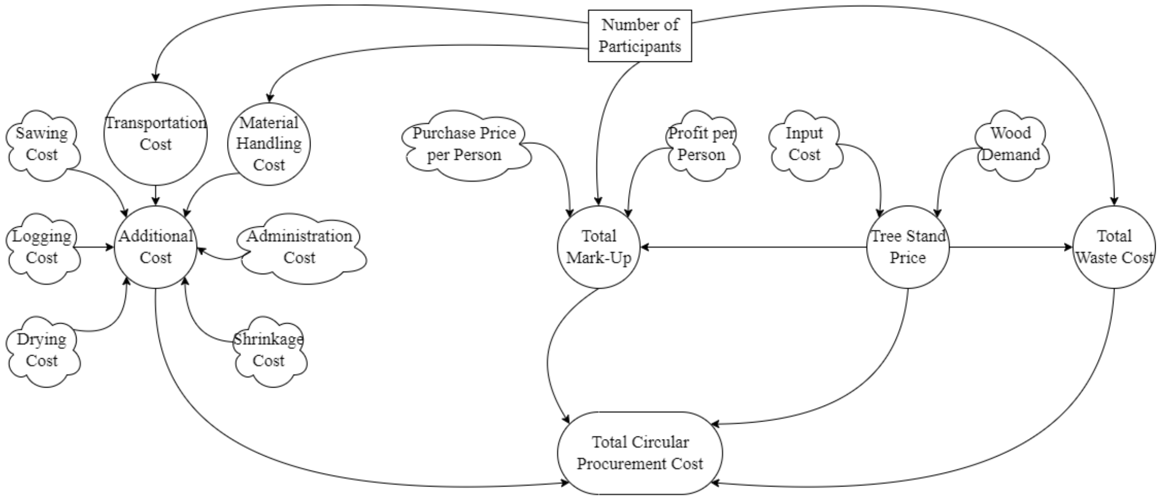

Figure 2. Influence Diagram

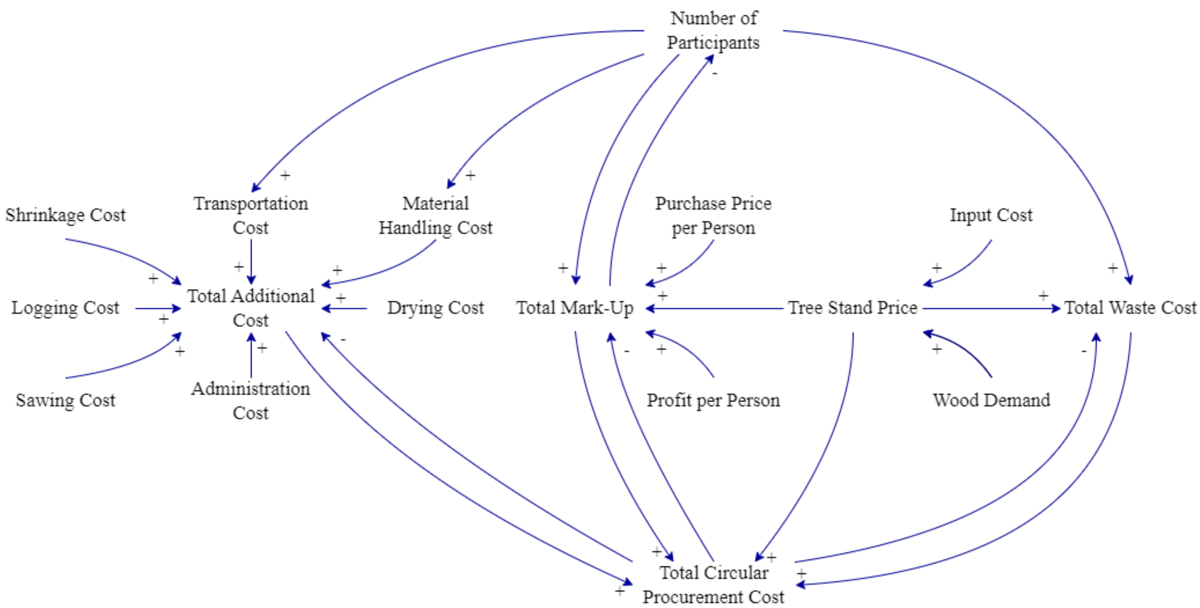

Figure 3. Causal Loop Diagram

(logging), second collector (Depot), sawmill, and wood dryer and furniture industry. The forest owner can be community forest farmers and forestry companies. The first collector (logging) is the actor who purchases tree stands directly from the forest owner. The second collector (Depot) is a collector of wood from the first collector (logging) without any added value. The sawmill acts as a wood processor from logs into sawn timber. The wood dryer is responsible for drying out the wood from the sawmill. The furniture industry is the supply chain's end customer or downstream wood processing industry. The wood supply chain configuration is illustrated in **Figure 1**.

2.3. System model

After collecting the data and understanding the wood supply chain, the stage in this study is designing the system model for the current condition or base model. At first, the data collected is transformed into the influence diagram shown in **Figure 2**. Based on this influence diagram, all elements forming the total circular procurement cost have been constructed based on their relationship. The output from this diagram is the total circular procurement cost. The control input (decision, decision rule) is the number of participants. The uncontrollable inputs are drying cost, logging cost, saving cost, administration cost, shrinkage cost, purchase price per person, profit per person, input cost, and wood demand. Lastly, the system variables are an additional cost, transportation cost, material handling cost, total mark-up, tree stand price, and total waste cost.

The next stage is to build the causal loop diagram. The causal loop diagram in **Figure 3** describes the main factors influencing total circular

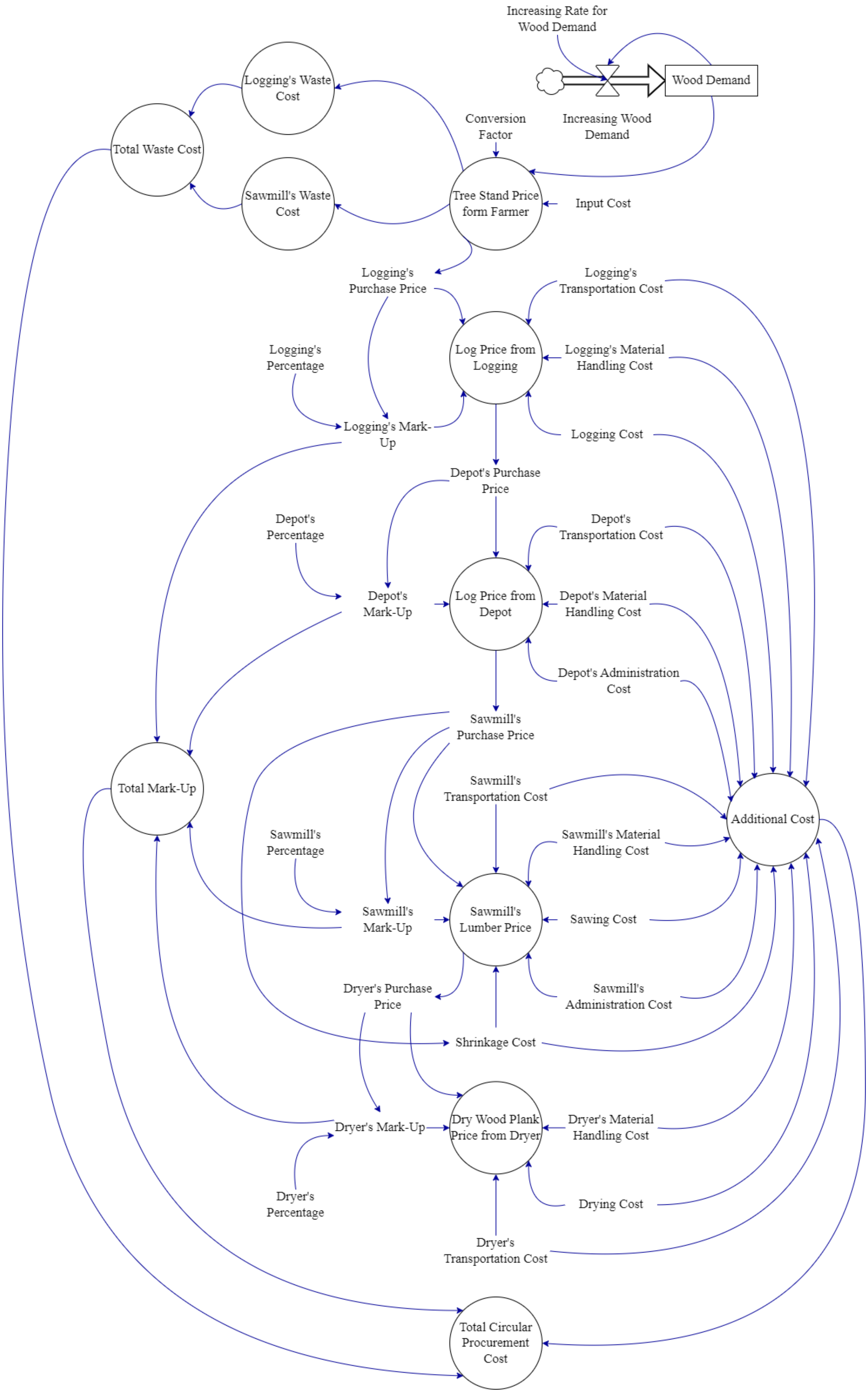

Figure 4. Stock Flow Diagram–Base Model

procurement cost based on the current condition. Furthermore, any elements that construct the cost in the total circular procurement cost are identified as having a positive or negative impact based on the interview result and literature review.

Based on the causal loop diagram, a stock-flow diagram is constructed to describe and simulate the flow of forming total circular procurement cost. The data acquired for building a stock-flow diagram with the programming language is supported by Ventana Simulation (Vensim) software. Vensim is a simulation software for helping the dynamic system model (continuous simulation), event-discrete system, agent-based modeling, and many more to achieve performance improvement of the system (Ventana Systems, Inc., n.d.). The whole stock flow diagram for the furniture industry's total circular procurement cost based on the current condition (base model) is shown in **Figure 4**.

The detailed information according to this stock-flow diagram is as follows. The increasing rate for wood demand is the accumulation from wood demand in Central Java as much as 14.2% based on the historical data. The initial wood demand in this study is based on the information on wood demand for furniture production in Central Java in 2013, with a value of 1,600,000 m^3. The increasing wood demand is in the form of an integer number and calculated based on the initial wood demand and increasing rate for wood demand. The Depot's mark-up percentage is 5%. Meanwhile, the mark-up percentage taken by the sawmill and dryer are 10% and 5%, respectively. The equations for all sub-model of total circular procurement cost can be seen in **Table 1**.

The verification stage is done by running the Vensim to check whether there is an error. When there is no error, it means the model is verified. Before verifying the model, the time boundaries should be set with the period from the year 2013 to the year 2019. The next step is to validate the model. A behavior validity test does the model validation to check whether the behavior output can be accepted. The validation calculation results that pass the requirements are a mean comparison value of less than 5% and an error variance value of less than 30%. All submodels in the model, i.e., wood demand, log price from the Depot, sawmill's lumber price, and dry wood plank price from the dryer, have been validated.

2.4. Collaborative Model

The designed scenario for the collaborative model is that the Depot, sawmill, and dryer would be changed into the terminal. The terminal responsibilities are providing ready-to-use raw materials with the consideration of quality and quantity and guaranteeing a stable price for the furniture industry. The work in the terminal starts from wood collection until the drying process, and it is managed by one party. It also means that the terminal acts as the integrated system of the Depot, sawmill, and dryer. Hence, it will cut the previous raw material procurement flow process. This terminal's yearly production capacity must also cover the wood demand data trend in Central Java.

Furthermore, information sharing by every stakeholder involved in the raw material procurement process is crucial. Hence, an integrated information system is required to share any information, i.e., wood demand from industry, and wood availability in the logging, to shorten the order cycle time. The terminal party must also collaborate with the PERMAPSI to gather information about the logging. It would help the

Table 1. Sub-Model Equations for Total Circular Procurement Cost

Variable	Equation
Total Circular Procurement Cost	Total Additional Cost + Total Mark-Up + Total Waste Cost + Tree Stand Price from Farmer
Total Additional Cost	Depot's Administration Cost + Sawmill's Administration Cost + Depot's Material Handling Cost + Logging's Material Handling Cost + Dryer's Material Handling Cost + Sawmill's Material Handling Cost + Sawing Cost + Dryer Cost + Logging Cost + Shrinkage Cost + Depot's Transportation Cost + Logging's Transportation Cost + Sawmill's Transportation Cost + Dryer's Transportation Cost
Tree Stand Price from Farmer	(Wood Demand/Conversion Factor) x Input Cost
Total Mark-Up	Logging's Mark-Up + Depot's Mark-Up + Dryer's Mark-Up + Sawmill's Mark-Up
Total Waste Cost	Logging's Waste Cost + Sawmill's Waste Cost
Increasing Wood Demand	Wood Demand x Increasing Rate for Wood Demand
Depot's Mark-Up	Depot's Mark-Up Percentage x Depot's Purchase Price
Log Price from Depot	Depot's Transportation Cost + Depot's Material Handling Cost + Depot's Administration Cost + Depot's Mark-Up + Depot's Purchase Price
Shrinkage Cost	Sawmill's Purchase Price x 0.5
Sawmill's Mark-Up	Sawmill's Mark-Up Percentage x Sawmill's Purchase Price
Sawmill's Lumber Price	Sawmill's Transportation Cost + Sawmill's Material Handling Cost + Sawmill's Administration Cost + Sawing Cost + Shrinkage Cost + Sawmill's Mark-Up + Sawmill's Purchase Price
Dryer's Mark-Up	Dryer's Mark-Up Percentage x Dryer's Purchase Price
Dry Wood Plank Price from Dryer	Dryer's Transportation Cost + Dryer's Material Handling Cost + Drying Cost + Dryer's Mark-Up + Dryer's Purchase Price

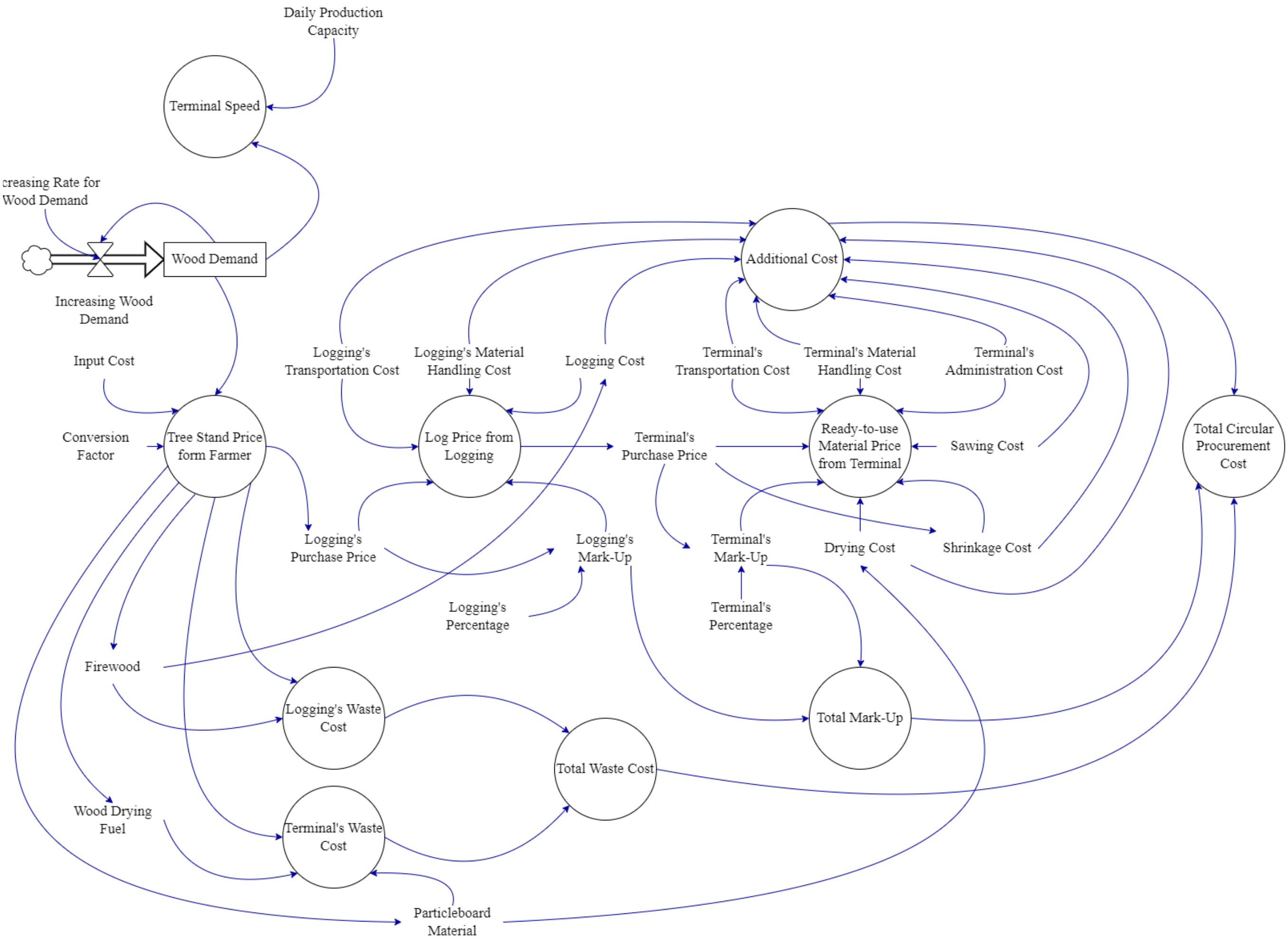

Figure 5. Stock-Flow Diagram–Collaborative Model

Table 2. Sub-Model Equations for Collaborative Model

Variable	Equation
Shrinkage Cost	Terminal's Purchase Price x 0.5
Terminal's Mark-Up	Terminal's Mark-Up Percentage x Terminal's Purchase Price
Logging's Waste Cost	(0.17 x Tree Stand Price from Farmer) – Firewood
Terminal's Waste Cost	(0.3 x Tree Stand Price from Farmer) – Wood Drying Fuel – Particle Board Material

terminal to obtain wood logs sold by logging under PERMAPSI. The stock-flow diagram for a collaborative model can be checked in **Figure 5**.

Different elements included in the collaborative model based on **Figure 5** are daily production capacity, terminal speed, firewood, wood drying fuel, particle board material, terminal's waste cost, terminal's purchase price, ready-to-use material price from the terminal, terminal's transportation cost, terminal's material handling cost, terminal's mark-up, terminal's percentage, and terminal's administration cost. The terminal's mark-up percentage is 25%. The different equations applied in the collaborative model are shown in **Table 2**.

3. Result and Discussion

The simulation model has been designed for both the base and collaborative models. As previously mentioned, the base model is built based on the current condition. Meanwhile, the collaborative model is made by changing three stakeholders, i.e., the Depot, sawmill, and dryer, into one stakeholder, the terminal, and considering waste reduction from the tree stands into firewood, wood drying fuel, and particle board material. This terminal is an integrated stakeholder that does all the Depot, sawmill, and dryer processes. The base and collaborative models' simulation run from 2013 to 2026. The performance of the models is evaluated based on the total circular procurement cost. The results are shown in **Table 3** and **Figure 6**, including their differences.

The results from **Table 3** and **Figure 6** indicate that the collaborative model has lower total circular procurement cost, and the gap between the two models tends to get bigger over time. These results also show that the collaborative model reduces the total circular procurement cost by 20% to 35%. As shown in **Figure 5**, the key variables influencing the total circular procurement cost in **Table 3** are (1) additional cost; Depot, sawmill, and dryer processes are collaborated into one party, the terminal, with lower transportation, material handling, and administration cost in total, (2) total mark-up cost; its cost has reduced from logging, Depot, dryer, and sawmill mark-up into logging and

Table 3. Total Circular Procurement Cost Comparison

Year	Base Model	Collaborative Model	Difference
2013	Rp2,035,480	Rp1,540,810	Rp494,670
2014	Rp1,989,920	Rp1,524,860	Rp465,060
2015	Rp2,076,420	Rp1,517,210	Rp559,210
2016	Rp2,144,150	Rp1,595,810	Rp548,340
2017	Rp2,128,010	Rp1,692,090	Rp435,920
2018	Rp2,350,140	Rp1,626,940	Rp723,200
2019	Rp2,467,770	Rp1,706,080	Rp761,690
2020	Rp2,383,230	Rp1,781,900	Rp601,330
2021	Rp2,450,700	Rp1,830,800	Rp619,900
2022	Rp2,536,330	Rp1,746,890	Rp789,440
2023	Rp2,692,110	Rp1,819,310	Rp872,800
2024	Rp2,923,610	Rp1,954,380	Rp969,230
2025	Rp3,048,010	Rp1,991,200	Rp1,056,810
2026	Rp3,071,620	Rp2,038,360	Rp1,033,260

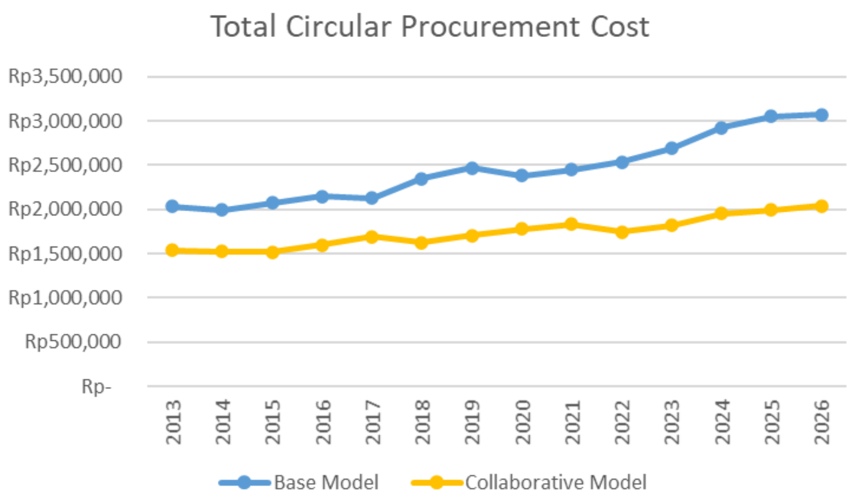

Figure 6. Total Circular Procurement Cost for Base Model and Collaborative Model

terminal mark-up only, (3) total waste cost; its cost has reduced from logging, and sawmill waste cost into logging and terminal waste cost and it got lower from firewood, wood drying fuel, and particle board material. It is also supported by Hald et al. (2021) that collaboration among stakeholders as their sustainable procurement initiatives can benefit from an efficient process, time-saving, and time resource cost trade-off. Implementing collaborative procurement also can minimize the system-wide cost along with the cost allocation (Oner & Kuyzu, 2021).

This constructed collaborative model has considered adopting the circular economy concept in the system. It utilizes the waste in the system into material for other processes in the supply chain, reducing the waste cost. It is supported by a study that the practice of various stakeholders' involvement, especially the suppliers, also could encourage the circular economy implementation (Pinheiro et al., 2022). Thus, the study has identified three ideas for the practice of circular economy adoption by utilizing the wood waste from the furniture industry supply chain, i.e., firewood, drying wood fuel, or particle board material, as shown in **Figure 5**. At first, the wood waste produced from the logging process is categorized as whether it can be used. The remaining wood waste is utilized as firewood. The logging party earns additional income by selling the firewood to other customers. The medium and big-sized wood waste collected from the sawing process in the terminal has been utilized for wood drying fuel. Optimizing the waste for wood-drying fuel gains the benefit of reducing the operational cost, specifically the drying cost that requires much wood fuel for the oven. Recycled wood waste is also considered an alternative raw material for producing particleboards with similar or even better mechanical properties than conventional ones and reducing the environmental footprint (Lee et al., 2022). Hence, the more negligible-sized wood waste, i.e., sawdust or other wood waste type, can be utilized as particle board material and sold to the particle board manufacturing company to earn additional income from the wood waste.

Applying a collaborative model in this supply chain produced better transparency of information sharing, more accessible ways for obtaining ready-to-use material, and a lower environmental impact of wood waste to yield lower raw material procurement costs. However, this model has several drawbacks that need to be considered, i.e., it requires long-term planning and high investment for implementation, collaboration, and coordination from upstream to downstream parties to be involved and design the rules and policies for managing this model.

4. Conclusion

Based on this study, it can be concluded that applying a collaborative strategy combined with the furniture industry's circular economy concept reduces the total circular procurement cost. The benefits from the collaborative model are not only in terms of cost but also operational, as it shortens the supply chain, reduces the environmental impact by utilizing wood waste, and better transparency on information sharing. Moreover, applying dynamic system modeling in this system is very helpful in simulating the performance achieved when using different models or scenarios. Considering all the benefits that can be gained through the implementation of this model, the furniture industry will have a better opportunity to compete in the global market with higher competitive advantages.

For future research, this study can be developed further in several aspects, i.e., designing the terminal system for its integrated process, adding the downstream parties up to the end customer, and adding several KPIs to evaluate the supply chain performances. Assessing the distribution system in this furniture industry supply chain with circular economy adoption also can be an alternative for research development in this area.

5. References

Braulio-Gonzalo, M., & Bovea, M. D. (2020). Criteria analysis of green public procurement in the Spanish furniture sector. *Journal of Cleaner Production*, 258. https://doi.org/10.1016/j.jclepro.2020.120704

Coloma-Jiménez, M., Akizu-Gardoki, O., & Lizundia, E. (2022). Beyond ecodesign, internationalized markets enhance the global warming potential in the wood furniture sector. *Journal of Cleaner Production*, 379(2), 134795. https://doi.org/10.1016/j.jclepro.2022.134795

Damayanti, R., Ozarska, B., Pandit, I. K. N., Febrianto, F., & Pari, G. (2018). Wood Properties of 5-year-old Fast Grown Teak. *Wood Research*, 9(2), 29-34.

Dihni, V. A. (2022). Berapa Luas Lahan Berhutan Indonesia pada 2020? https://databoks.katadata.co.id/datapublish/2022/02/07/berapa-luas-lahan-berhutan-indonesia-pada-2020

Do, T. T. H., Ly, T. B. T., Hoang, N. T., & Tran, V. T. (2023). A new integrated circular economy index and a combined method for optimization of wood production chain considering carbon neutrality. *Chemosphere*, 311(2), 137029. https://doi.org/10.1016/j.chemosphere.2022.137029

Effendi, R. (2011). Kajian Tata Niaga Kayu Rakyat di Pulau Jawa bagian Barat. *Jurnal Penelitian Hutan Tanaman*, 8(4), 251-258. https://doi.org/10.20886/jpht.2011.8.4.251-258

MacArthur, E. (2013). Towards the circular economy, economic and business rationale for an accelerated transition. *Ellen MacArthur Foundation: Cowes, UK*, 21-34.

Ellen MacArthur Foundation. (2019, February). Circular economy systems diagram. https://ellenmacarthurfoundation.org

Hald, K. S., Wiik, S., & Larssen, A. (2021). Sustainable procurement initiatives and their risk-related costs: A framework and a case study application. *Measuring Business Excellence*, 25(2), 230-243.

Kemenperin, P. (2022). Buku Analisis Pembangunan Industri 2022: Peran Strategis dan Potensi Penguatan Industri Furnitur Terhadap Perekonomian Nasional. https://kemenperin.go.id/download/28134/Buku-Analisis-Industri-Furnitur-2022

Lee, S. H., Lum, W. C., Boon, J. G., Kristak, L., Antov, P., Pe̜dzik, M., Rogozinski, T., Taghiyari, H. R., Lubis, M. A. R., Fatriasari, W., Yadav, S. M., Chotikhun, A., & Pizzi, A. (2022). Particleboard from agricultural biomass and recycled wood waste: A review. *Journal of Material Research and Technology*, 20, 4630–4658. https://doi.org/10.1016/j.jmrt.2022.08.166

Ministry of Trade of The Republic of Indonesia. (2008). Handbook of Commodity Profile “Indonesian Furniture: Creativity in Woods.” Trade Research and Development Agency, Ministry of Trade, Republic of Indonesia.

Monczka, R. M., Handfield, R. B., Giunipero, L. C., & Patterson, J. L. (2016). *Purchasing and Supply Chain Management (Sixth)*. Cengage Learning.

Observatory of Economic Complexity (OEC). (n.d.). Furniture. Retrieved November 30, 2022, from https://oec.world/en/profile/hs/furniture-bedding-mattresses-mattress-supports-cushions-and-similar-stuffed-furnishings-lamps-and-lighting-fittings-nes-illuminated-signs-illuminated-name-plates-and-the-like-prefabricated-buildings

Öner, N., & Kuyzu, G. (2021). Core stable coalition selection in collaborative truckload transportation procurement. *Transportation Research Part E: Logistics and Transportation Review*, 154, 102447.

PERMAPSI. (n.d.). Profile PERMAPSI. Retrieved December 2, 2022, from https://www.permapsi.com/profile-permapsi/

PERMAPSI. (2020, February 25). PERMAPSI – ILWA JALIN KERJASAMA UNTUK KEJAYAAN & KEMANDIRIAN INDUSTRI KAYU NASIONAL. https://www.permapsi.com/kegiatan-kerja/permapsi-ilwa-jalin-kerjasama-untuk-kejayaan-kemandirian-industri-kayu-nasional/

Pinheiro, M. A. P., Jugend, D., Jabbour, A. B. L. de S., Jabbour, C. J. C., & Latan, H. (2022). Circular economy-based new products and company performance: The role of stakeholders and Industry 4.0 technologies. *Business Strategy and the Environment*, 31, 483–499.

Sachan, A., Sahay, B. S., & Sharma, D. (2005). Developing Indian grain supply chain cost model: A system dynamics approach. *International Journal of Productivity and Performance Management*, 54(3), 187–205. https://doi.org/10.1108/17410400510584901

Salim, Z., & Munadi, E. (2017). Info Komoditi Furnitur. Badan Pengkajian dan Pengembangan Perdagangan Kementerian Perdagangan Republik Indonesia.

Simoes, A., & Hidalgo, C. (2011). The Economic Complexity Observatory: An Analytical Tool for Understanding the Dynamics of Economic Development. Scalable Integration of Analytics and Visualization. *Workshops at the Twenty-Fifth AAAI Conference on Artificial Intelligence*.

Sofuoğlu, S. D., & Kurtoğlu, A. (2012). A Survey for Determination of Wastage Rates at Massive Wood Materials Processing. *Wood Research*, 57(2), 297–308.

UNEP. (2021). Sustainable Public Procurement: How to Wake the Sleeping Giant! Introducing the United Nations Environment Programme's Approach. UNESCO.

Ventana Systems, Inc. (n.d.). Vensim. Retrieved December 5, 2022, from https://vensim.com/

Xu, L., Jia, F., Yan, F., & Chen, L. (2022). Circular procurement: A systematic literature review. *Journal of Cleaner Production*, 365.