

Promoting Industrial Symbiosis at Supply Chain

Yunita Ismail¹

¹Environmental Engineering Study Program, President University, Indonesia

Abstract. In running the business, efforts to always improve efficiency is a must. For the company efficiency not only on production activities but also on all chain in their supply chain. Collaboration is a must on a supply chain in order to achieve the common goals of companies in the supply chain. On the other hand, industrial symbiosis is an environmental management approach that also requires collaboration in its implementation. Collaboration and synergy are two important things in the early stages of symbiosis industry formation. Therefore this paper sees the opportunity of application of symbiosis industry in supply chain. As an example, use dare earch about model of collaboration utilization and synergy of supply chain to apply symbiosis industry in component automotive supply chain.

1 Introduction

The contribution of the industrial sector to Indonesian GDP (Gross Domestic Product) still occupies the highest position (20.91 percent in the period 2013-2016; Figure 1) [2]. This large contribution to GDP has consequences for environmental destruction. Environmental destruction by the activities of this industry should be addressed, so the benefits of the industrial sector can be enjoyed while maintaining environmental conditions. Consumers can push producer pay attention to environment aspect through the market in addition to economic aspects [7]. For industry, consider about environment gave consequences to expenses. Therefore if the environmental management conducted jointly between several companies, then the costs can be shared.

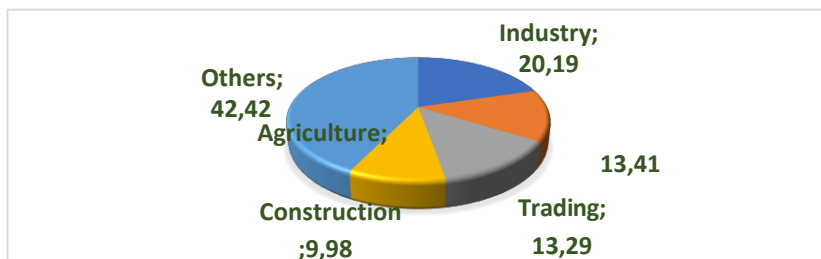


Fig. 1. GDP base on Sector for Indonesia, 2013 – 2016 (BPS, 2017)

Environmental management approach that involves many companies to reduce environmental impact, improve economic efficiency and enhance the company's competitive advantage is called industrial ecology approach [8]. Industrial ecology

approach analogy industry activities with nature activities. In the industrial ecology approach, the development of industry is seen as a systemic change, namely industrial system which follows the natural system [15].

Industrial ecology has principles of three pillars, social, economic, and environmental. The economic goal is to produce more goods from the same resource, so that the waste and the by-product produced are reused as materials for other products[9]. From the environmental side, industrial ecology will make resource use more efficient and waste into nature becomes less [3], [13] and [11]. From a social perspective, industrial ecology emphasizes the role of local communities, and working comparatively with other industries and governmental bodies to contribute to regional economic development[1].

One of the methods of environmental management in industrial ecology is symbiosis industry. Symbiosis industry known as mutualism symbiosis in the natural system. Industrial symbiosis according [5] is a part of industry ecology- related ecological cooperation among industry, to enhance the comparative advantages through a joint approach, the exchange of materials, energy, water and byproducts. According to [14], symbiotic industry is the environmental management measures implemented by many companies that provide environmental management impacts better, than if done individually.

The implementation of these industrial symbiosis approaches need to have two think, namely collaboration and synergy. Collaboration and synergy among different companies that may occur due to the proximity of the location [6]. Establishment of industrial symbiosis is planned on an industrial estate. As is known formation of industrial symbiosis requires synergy and collaboration. Synergy and collaboration is highly possible to occur between companies that are at the same location. Industrial symbiosis that occurs in Kalunborg an example of the symbiosis that occurs between industries that are at the same location. This has happened in Kalunborg optimizing the utilization of energy, heat, water and byproducts. So it becomes more efficient resource utilization and occur along the approach to achieve sustainability of the industry [11].

However, according [16], the collaboration and the synergy between the companies are not only available because of the proximity of the location, but also occurred in the supply chain, such as the automotive supply chain. Keywords collaboration is not the only thing that counts derived from the proximity of the location of industries. However, collaboration is more determined by the way the industry related to each other [13]. In addition to the close proximity is more analogous to the impact of transportation and mental closeness between industries[14].

In this study wanted to see the potential for using industrial symbiosis approach that occurs between some of the industries in supply chain. Potential industrial symbiosis that occurs not only seen from the flow of matter, energy, water and waste, but also see the flow of information that occurs.

If look at the definition of industrial symbiosis according [5], said that the collaboration and synergy occurs hence the proximity. However, according to [14], industrial symbiosis is not only determined by the proximity of the location. The distance between the company did not correlate significantly with the value of there source. At companies that are located in a specific industry network may be possible for the industry symbiosis. Geographical proximity associated with the transport costs directly caused by distance, but transportation costs will be less than the benefit sof the synergy that occurs between companies [14]. Hence the importance of geographical proximity economically determined but not typical for the application of industrial symbiosis [6]. Proximity is considered to be a guarantee for the collaboration and synergy among the company, the experience of the construction industry in the area of industrial symbiosis is not always the case.

2 Results and Discussions

2.1 Industrial Symbiosis at Automotive Supply Chain

Based on [10] industrial symbiosis model at automotive supply chain, collaboration among component automotive companies have correlation with by product and water exchange, but no correlation with material and energy exchange. Material exchange in supply chain actually as the main relationship, but no correlation with collaboration.

The exchange of material in the formation of an industrial symbiosis requires the commitment and voluntary participation of the cooperating parties. In the formation of industrial symbiosis either through self organizing or through planning requires a long period of time, so collaboration that is limited only by short (1 year) contract periods (like in automotive supply chain) is difficult to establish an industrial symbiosis.

In research about industrial symbiosis model at automotive supply chain [10], test about relationship between material, energy, by product and water exchange with sustainability show just water exchange related. The exchange of materials, energy and by products occurring in the automotive supply chain, is not related to sustainability. These tests provide findings that the exchange that occurs by leveraging collaboration and synergies, is not directly an exchange that will shape the industrial symbiosis. Model of industrial symbiosis in the automotive supply chain shows that environmental management by companies of automotive components is done by conservation and utilization of water savings both for production and for other supporting activities. If this model will be applied in the automotive supply chain collaboration and synergy that occurs should take into account the social and environmental aspects in addition to economic aspects. Exchange of material, energy, byproducts, and water should be implemented by making all parties to maximize the utilization of natural resources, suppress the waste generated, utilizing byproducts produced.

Collaboration between companies leads to integrated planning, coordination and integration processes [10]. This integrated planning makes the company strive for mutual benefits. In business activities, profits are the main objectives and strive to continue to be improved. The desire to share profits is something that needs to be tested for years to work. The better collaboration is happening the more side product use occurs. For the exchange of by-products is the company's most popular strategy, in addition to having a good impact on environmental management, also provides additional economic benefits [7]. In the automotive supply chain, automotive component companies have sold scrap left over. This scrap is purchased by a third party who is the collect or of there maining steel. This steel scrap collector sells there mainder of this steel to the steel company to be re-melted and re-steeled. Collaboration to deal with scrap between automotive component companies with scrap collectors has occurred and mutually beneficial. In the handling of the environment, especially with industrial symbiosis, this collaboration has not had the maximum impact for the environment. This is because the amount of energy used (eg energy needed to melt scrap) than if the collaboration handling of these by- products occurs among automotive component companies. Automotive component companies in tier 2 can still utilize the remaining steel sheets from automotive component companies in tier 1. Tier 2 or 3 tiered automotive parts usually buy scrap steel from tier to scrap collectors. Collaboration between automotive component companies this increase the exchange of side products that occur. Utilization of by products requires well-tested research.

2.2 Industrial Symbiosis: Environmental Approach at Supply Chain

Collaboration between automotive component companies and also with principal companies in automotive supply chain occurs with a business relationship to meet the needs of raw materials production. Cooperation built on business relationship laden with rules that calculate profit and loss and fulfilment of production needs. This cooperation is stated in the cooperation contract which is valid for 1 year or less. Period this time for fast moving component suppliers whose large number of suppliers and manufactured components require high precision.

According to [1] collaboration that occurs between companies raises social relationships among companies. Social relationships between companies in the automotive supply chain should be able to develop into a joint relationship in environmental management. To maintain the quality of products supplied by the automotive component company, the principal company conducts coaching mainly to carry out the production process. The coaching is done more based on

The transfer of production knowledge, because the quality of the supplier's product affects the final product. This coaching has not been on the guidance of environmental management in this case to exchange material between automotive component companies in the same tier or not the same.

In supply chain, the effort made by companies to get sustainable supply chain. Companies collaborate to achieve several goals, such as developing processes, sharing the cost of investments, mitigating the risk, etc. According to [9], supply chain distinguish is hot supply chain integration and coordination as collaborative practices. Integration build relation between companies, whereas coordination purposes to making partnership working together effectively and efficiently.

3 Conclusion

From the analysis it can be concluded that the model of industrial symbiosis derived from the automotive supply chain for raw material of steel in fast moving components, is a model that only considers the exchange of water. Exchange of matter, energy and by-products do not contribute to this management model. In more detail can be summarized as follows: 1) the exchange of material, energy, and by-products do not contribute to environmental management using industry symbiosis. Which determines the exchange of water environmental management in the automotive supply chain, 2) the model of industrial symbiosis in the automotive supply chain occurs in the presence of water exchange. This model shows that the management of the environment by industrial symbiosis in the automotive supply chain is indicated by the exchange of water, and 3) industrial symbiosis approach can develop in supply chain

References

1. Baas, L. W., Boons, F. A. J. of *Cleaner Production* **12** (2004)
2. Badan Pusat Statistik, *Produk domestik bruto indonesia triwulan*, (ISSN: 1907-4557, Direktorat Neraca Produksi, Jakarta, 2017)
3. Chertow, M. *Industrial symbiosis: literatur and taxonomy* (Annual Review of Energy and the Environment, 2000)
4. Chertow, M. J. of *Industrial Ecology* **11** 1 (2007)

5. Chertow, M. *Industrial symbiosis*, (Encyclope him of Earth, July 26, 2008)
6. Cote, R. P. and E Cohen-Rosenthal. *J. of Cleaner Production* **6** (1998)
7. Djajadiningrat, ST., and Melia F, *Environmental industrial zone (eco industrial park)*. (Engineering Science, Bandung, 2004)
8. Garner, A and Gregory A Keoleian, *Industrial ecology: an introduction*. (National Pollution Prevention for Higher Education, The University of Michigan, 1995)
9. Herczeg, G, Renzo A and MZ Hauschild. *J. of Cleaner Production* (2017)
10. Ismail, Y. *Model Simbiosis Industri pada Rantai Pasok Otomotif yang Berkelanjutan (Kajian Rantai Pasok Material Baja Pada Komponen Fast moving)*. (Disertasi. Program Studi Ilmu Lingkungan, Universitas Indonesia, Jakarta, 2015)
11. Jacobsen, NB. *J. of Industrial Ecology* **10**, 1 (2006)
12. Leigh. M and Xiaohonh Li. *J. of Cleaner Production* (2014)
13. Lombardi, R and Peter Laybourn. *J. of Industrial Ecology* **16**, 1 (2012)
14. Lombardi et al. *J. of Industrial Ecology* **16**, 1 (2012)
15. Tibbs, H. *Industrial ecology*, (An Environmental Agenda for Industry, Global Business Network, 1993)
16. Van Berkel, R. Comparability of Industrial Symbiosis. *J. of Industrial Ecology* **13**, 4 (2006)