

# Actors, Collaboration, and Interaction Mechanisms in Supply Chain for Circular Economy: A Literature Review

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**Abstract:** The loss of economic value from wastes of various industries can be prevented through the implementation of circular economy concepts, in which the wastes are processed to become resources for the same industry or other industries. From several existing cases, it is apparent that implementing the concepts of circular economy in supply chain processes could face several obstacles, especially in terms of supply chain actors, their collaboration, and their interaction. To find if other implementations meet similar obstacles, how they solve it and define possible research opportunities in this subject, this research sought to conduct a literature review on the existing research regarding implementation of circular economy concepts in the supply chain, from the perspective of supply chain actors along with their collaboration types and interaction mechanism. Several possible future research is identified from the conducted literature review: the importance of horizontal-type collaboration in supply chain implementing circular economy, the matter of actors and interaction in industry-specific context, and also the impact of cultural context on the behavior of actors and the impact to supply chain output.

## 1 INTRODUCTION

The matter of wastes has been the concern of various industries. In the agri-food industry, for example, there is the existence of inevitable by-products through the production processes, such as the cowhide and manure in the production of beef meat (van der Vorst et al., 2005). In the manufacturing industry, the wastes could come both from the production processes, in the form of production wastes such as water wastes and defective products, and also from consumption processes in the form of remains of the product after consumption, such as the packaging of the products. In the construction industry, the wastes come from the remains of construction processes, such as the stones, plaster, and other materials coming from the destruction and construction of buildings.

All the wastes that have mentioned above are generally immediately dispatched to the landfill. There are no other processes that could take them as resources for further functions. This situation can result in the loss of the possibility to gain economic value from the wastes. Said loss of possibility could be avoided through the implementation of circular economy concepts. Pearce and Tuner (1989),

described that in a circular economy system, the wastes would not be discarded directly but become resources for other processes instead (EM Foundation, 2012). In return, the wastes coming from these other processes would then provide resources for the original process, making the whole economy system follow the example of the feedback-rich living system. The wide possibility of this concept, along with the rising concern towards health and environment, encourages various research regarding its implementation.

Implementing the circular economy requires some changes to the existing economic system. Several research has been conducted in that matter. Smith-Gillespie (2017) and Lewandowski (2016) defined the changes of the business model when integrating the circular economy concepts using the business model canvas methodology. Moreno et al. (2016) defined the strategies which could be used to design businesses in a circular economy. In the term of performance measurements, Iacovidou et al. (2017) and Walker et al. (2018) defined the metrics and measures to evaluate the performance of businesses in regards to the dimensions of the circular economy concept. In the topic of supply chain management, Masi et al. (2017) have developed a systematic

literature review on the supply chain configuration in the circular economy system. In the article, the enablers and inhibitors of circular economy implementation are discussed, along with the types of supply chain configurations that could be implemented in a circular economy system.

However, there is a lack of literature review regarding the interaction between stakeholders and the behavior of the stakeholders in the supply chain implementing the circular economy. In the classification developed by Pomponi and Moncaster (2017), the relationship between stakeholders in the supply chain could be addressed as the societal aspect of the circular economy, while the behavior of stakeholders could be addressed as the behavioral aspect. Meanwhile, the stakeholders or actors within the supply chain, what they do, and the interaction between them are some of the most important factors to be regarded for the supply chain (Van der Vorst, 2005). This is because, in practice, the interaction of supply chain actors and behavior of each actor could affect the outcome of the supply chain. For example, in the research of Handayati et al. (2016), it is demonstrated that even in one location, there would be a variety of farmers' behavior in executing the standard operation procedure. The difference in executing standard operation procedure results in the difference of farming yield, in which farmers who comply with the standard operation procedure gain better yield both in quality and quantity than the ones who do not comply.

The importance of analyzing the interaction between supply chain actors and the behavior of these actors is also addressed in an existing systematic literature review conducted for the circular economy implementation in the supply chain. In Farooque et al. (2019), there is identified a large knowledge gap and very high importance regarding the collaboration and coordination in the supply chain implementing the circular economy. Several of the identified research opportunities are in identifying the incentives and strategic value alignment, collaboration and coordination mechanism, supply chain management, and knowledge management within the supply chain.

In relation to the implementation of circular economy in the supply chain, the importance of addressing the actors, their behavior, and their interaction is also shown in the recent preliminary study conducted to a company attempting to apply the concepts. The company, OrganicFe Co., produces organic fertilizer, which is processed from fruit and vegetable wastes by utilizing black soldier fly larvae. In trying to market their products to the farmers, they found several obstacles, mainly in their approach to

the farmers: farmers in some area would only buy the fertilizer if they had seen a successful usage conducted by neighbor, while farmers in other areas would not buy the fertilizer if they had seen their neighbor using it first—because they did not want to be seen as 'followers.' This difference in behavior requires the company to take different approaches in their interaction, and should they take the wrong approach, the farmers would not purchase the fertilizer. Farmers not purchasing the product result in the failure to implement circular economy concepts, as the produced fertilizer is not used and thus not having economic value.

Another case of failure to implement the circular economy in the supply chain comes from a company implementing holistic farming practices, EcoOrganic Co. There, the wastes from farming practices, including crops and fish farming, are processed by worms to create organic fertilizer. Similar to OrganicFe Co., while the production of fertilizer can happen, targeted customers of the fertilizer would not purchase it. In the case of EcoOrganic Co., their target market is the local residents around the company. The local residents would gladly accept the fertilizers if they gain it for free, but they would not purchase it. The implementation of the circular economy in this case also fails when the result of the circular economy process, the utilization of waste to become fertilizer, is not used in the system.

However, the implementation could successfully be done by IntegratedFood Co. IntegratedFood Co. can implement circular economy concepts in their integrated companies, in which the livestock sector and fruits production sector of the company are collaborating to handle their wastes. The goal of this company is to achieve “zero waste” in their processes, something that is currently achievable due to the fact that both sectors are located in the same area and that the sectors are within the same company, so the circular economy practices are implemented by actors under the same company.

With these examples of successful and not-yet-successful implementation of circular economy in the supply chain, it is suspected that the actors of these particular cases are the key: their behavior, their expectation of the supply chain practice, which affects their behavior, and their interaction with the other supply chain actors. The question is, does it happen too with other applications of circular economy in the supply chain? Do they find similar obstacles, or do they not try to address the actors of their supply chain in particular?

Thus, this research is conducted to find the current state-of-the-art in the research regarding the actors'

behavior and interaction in the implementation of the circular economy in the supply chain. First, the key concept of the circular economy and supply chain is discussed. Afterward, the methodology by which the literature review was conducted is defined. Then, the result of the literature review is presented, along with the possible research coming from the identified knowledge gap in the state-of-the-art. Finally, a conclusion and further research for this particular topic will also be discussed.

## 2 CIRCULAR ECONOMY AND SUPPLY CHAIN

### 2.1 Circular Economy

The circular economy concept is adapted from the living systems, which are called as feedback-rich systems (EM Foundation, 2012). The term feedback-rich is used to describe the living systems for naturally there are no wastes which would remain as wastes. In natural systems, when wastes return to nature, they would be further processed by the organism to become the resources for other living organisms. An example of this would be the lifecycle of animals. When animals defecate or die, their wastes or corpses would be processed by bacteria to become nutrients in soils. The nutrients are used by the plants to grow, and later the plants would become feedings for the animals. Such a concept is the goal of a circular economy, in which the wastes from one process should be utilized as much as possible to become resources for other processes. With this, the number of wastes that are really not useful and have to be disposed of to the landfill would be minimized. Other than decreasing the number of wastes, this system would also lead to a sustainable system, the final goal of the circular economy concept. A system is called sustainable when, by having a diversity of flowing materials and processes within the system, it could provide for itself indefinitely.

The workflow of the circular economy framework is illustrated in Figure 1. There are two possible cycles that could happen in the circular economy depend on the material type: biological cycle and technical cycle. The degradable, organic materials will go through the biological cycle, which consists of extraction and composting processes and resulting in biological nutrients. The technical cycle will take care of undegradable materials, in which said materials are processed through the recycling processes, which actually has many forms:

maintenance, reuse, refurbish, or actual recycle. These materials actually could come from any stages of the chain, including the manufacturing stages. The materials that cannot go through both cycles will be disposed to the landfill after going through the energy recovery processes.

There are also several principles for the circular economy, according to the EM Foundation (2012). The first one is to design out waste, in which the design of products should also consider whether the wastes of said product could be useful for other processes. This leads to the second principle: waste is food, in which these wastes should be considered as resources for the processes in the system. The next principle is to build resilience through diversity. As mentioned before, the sustainable system provides itself through the diversity of flowing materials and processes. In an economic system, this could be presented by enriching the system through the diversity of supply chains being connected to provide for each other. This also leads to the principle of thinking in systems, determining which parts of the systems should give feedback to the other parts; in this case, parts are the processes. The last principle for this system would be to rely on energy from renewable sources, as they are mostly more efficient and emit fewer wastes that cannot be processed than the unrenewable ones.

### 2.2 Supply Chain: Actors, Collaboration, and Interaction Mechanism

The actors of the supply chain differ for each case. However, they can usually be grouped based on the processes of the supply chain. Ayers (2006) defined the five supply chain processes: plan, source, make, deliver, and return. The *planning* process includes all planning activities for the other processes. The *source* process is the process encompassing all activities for procuring the sources used in manufacturing the products. The making process is the process for activities in product manufacturing. Afterward, the products are delivered to various receivers, such as the retailer and the consumers, through the delivery process. Finally, the return process is related to the activities involving returning the products to the manufacturer.

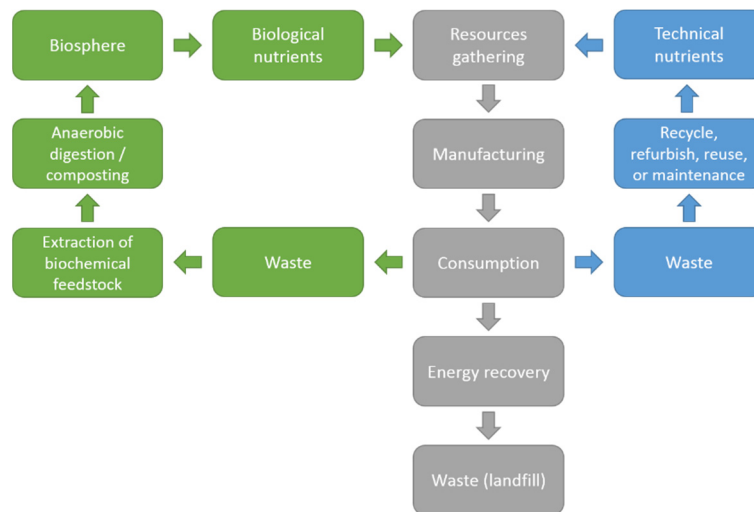


Figure 1: Workflow of the circular economy framework (EM Foundation, 2012)

Collaboration in the supply chain happens when there is a joint effort from two or more independent companies to achieve greater success in running the supply chain than both of them working separately (Simatupang and Sridharan, 2002). There are three types of collaboration in the supply chain: vertical, horizontal, and lateral (Simatupang and Sridharan, 2002; Barratt, 2004). Vertical collaboration happens inside a particular connected supply chain, between the suppliers, the manufacturing companies, delivery processes, and customers. Horizontal collaboration happens between companies, in which these companies are either unrelated or in a competing relationship. Finally, there is the lateral collaboration in the supply chain, which combines both vertical and horizontal collaboration. The kind of collaboration to be considered in a case, with the goal of achieving the best results in the supply chain, will depend on the strategic aims and capabilities of all the collaborating companies.

In supply chain collaboration, there are five elements to be considered (Simatupang and Sridharan, 2008). First is the collaborative performance system, which defines the metrics used to measure the performance of the supply chain along with the target for each metric. The target of these metrics is derived from the joint goal of the supply chain. Afterward, there is information sharing between the participating companies, in which they should communicate the necessary information concerning supply chain processes. Then, there should be decision synchronization between collaborating supply chain participants. This is to ensure that the performance of the supply chain can be measured by something they have agreed on, and

all participants have an idea of the final goal for the supply chain. Afterward, incentive alignment between supply chain actors is also something required to achieve supply chain collaboration. The incentive for supply chain actors should be assigned based on their performance in regards to the determined overall goal of the supply chain. And finally, there should be an innovative supply chain process, which can ensure the flow of goods and information without obstacles.

These five elements of collaboration in the supply chain can be derived to become the interaction mechanisms of supply chain actors (Sridharan and Simatupang, 2013). When there is a collaborative performance system, then there should be a mechanism to ensure that the metrics used in the performance system are agreed on and understood by the supply chain actors, which leads to the performance accountability mechanism. Then, for the information sharing to happen, there should be a willingness from participants to share, along with the availability of the means to share, such as the usage of technology. Decision synchronization is the next interaction mechanism, in which the supply chain actors work and discuss together as a team to make decisions for the supply chain activities, to achieve the overall supply chain goal. As for the innovative supply chain processes, to ensure that the flow of products and information is without obstacles, there should be the mechanism of process integration within the supply chain. And finally, to ensure that the supply chain actors can fulfill their individual interests as well as working to achieve the joint goal of the supply chain, an incentive alignment mechanism is also required.



### 3 METHODOLOGY

A search for research literature was conducted in the Scopus database. Scopus database was chosen because of the wide coverage, currently 36,377 titles from 11,678 publishers. The literature in Scopus is all peer-reviewed, establishing their trustworthiness. The search is conducted using the query of "circular economy" AND "supply chain," as this research focuses on the supply chain in the circular economy. This results in 305 articles. Through abstract screening, it was found that 25 of them were articles of systematic literature review, and they were analyzed to observe the subjects of existing literature reviews on circular economy and supply chain. The implementation of circular economy concepts have been researched quite thoroughly – from the configuration of supply chain to support circular economy, how the concepts are used in specific supply chains management function such as procurement and production, until the measurement tool of the circularity aspects in the supply chain and barriers to the implementation along with the possible drivers that might make industries switch to circular economy.

However, none of them specifically discusses the actors of the supply chain process and their interaction. While Corrado and Sala (2018) talk about the current issues about food waste in the supply chain, about how they were handled and the amount of several types of food waste, it is also mentioned that non-optimal coordination between supply chain actors might result in more food waste. The matter of supply chain coordination and collaboration in circular economy implementation is also highlighted as a very urgent research topic with a large knowledge gap in the currently available literature by Farooque et al. (2019). It also should be noted that Jabbour et al. (2019) discussed the human side of circular economy implementation. However, the research is more focused on adopting the aspects of green human resource management to firms' business models. While the human resource management in a firm is also important to be noted in the implementation of circular economy concepts, collaboration in the supply chain is more focused on the interaction between actors of each supply chain process, in which the actors of a process might be composed of more than one firm.

Thus, for this research, the actors of the supply chain implementing circular economy and their interaction become the focus. After excluding the literature review ones, the remaining 280 articles are

then also screened based on their abstract, whether they mention a case of implementing a circular economy in the supply chain or not. From the abstract screening, 155 papers remain, with some being literature review articles. These 155 papers are then get screened further for the existence of actors' characteristics and interaction in the supply chain implementing circular economy within the content of the articles. From the second screening process, 35 articles remained, and they will be further classified and analyzed.

The articles are reviewed based on these aspects:

1. The supply chain processes and the actors involved in each process. If there are other involved stakeholders who might not directly work as a part of the supply chain (such as the government body), it should also be analyzed.
2. Collaboration and interaction mechanism between actors. What kind of collaboration is conducted by the supply chain actors? What interaction mechanism exists between the actors?
3. Context of research, especially industry and area of application (continent). The circular economy activity conducted in each research will also be considered in this section.
4. The method used in the research and findings of the research. If there is a model, such as the mathematical model, what is the goal of the said model? How can the implementation of circular economy concepts be stated as being better than the current condition? In what aspects?

## 4 LITERATURE REVIEW RESULT AND DISCUSSION

### 4.1 Actors of Supply Chain Implementing Circular Economy

The existing research was also reviewed based on the actors involved in the supply chain defined in the research. Figure 2 illustrates the general model of actors in a supply chain implementing the circular economy. Basically, there are two stages involved: the usual linear supply chain actors, which consist of resource suppliers, manufacturers, distributors, and consumers; and the waste management actors, which consist of waste collectors, waste sorters, and waste processors.

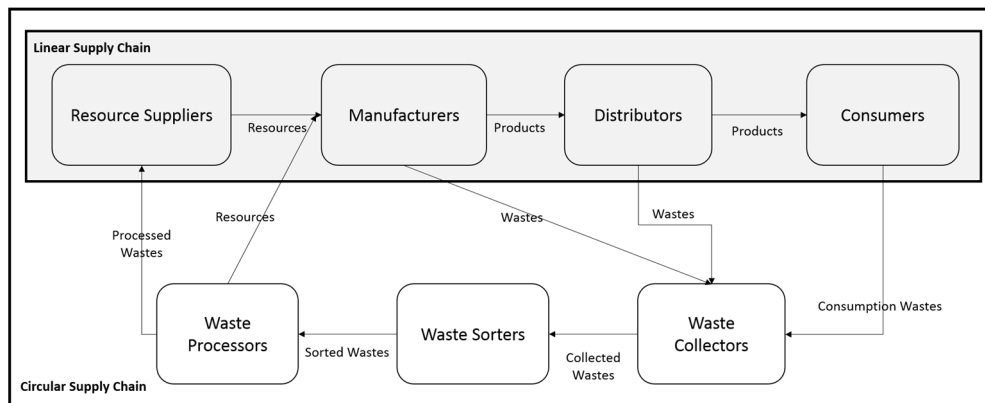


Figure 2: Actors of supply chain implementing circular economy

The resource suppliers are expected to gain the supply materials through the means agreed within the contracts with the manufacturers (de Oliveira, 2019). As for the manufacturers, the design of products should also consider the waste processing method for the product wastes, as well as the material, flows for the consumption wastes (Bernon et al., 2018; Tate et al., 2019; Franco, 2017). Distributors include the wholesalers and retailers involved in the distribution of the products, while the consumers are the end customers of the products.

It also should be noted that for each role, there could be more than one actor. The company in the research of Unal et al. (2019), for example, has more than one waste suppliers for their activities. It is also exhibited in the research of Batista et al. (2018) there waste collectors and recyclers working for one company can also be more than one. As for the waste collectors, there are also forms of both formal and informal associations, showing that the collectors are mostly individual agents.

There are various other stakeholders involved in the supply chain implementing the circular economy. The first one being mostly highlighted is the government, with their involvement in the supply chain, is mostly for establishing regulations that push for circular economy adaptation, as well as the bureaucracy for obtaining incentives for applying the circular economy. University and research centers are also mentioned, mostly for inventing products and introducing new processes for better circular economy implementation. Hogeboom et al. (2018) is the only research to focus on the investors, in which the research is introducing a framework that could be utilized by the investors to give insights for assessing companies to invest.

Through observing the overall distribution of supply chain actors in circular economy implementation, it is apparent that the most discussed

actors of the supply chain in implementing circular economy are the waste management actors, along with resource gathering actors. This should be due to the fact that the circular economy is highly concerned with how waste is managed, along with how they can be used as resources either by the original main process or the other processes. Manufacturing actors are concerned in the circular economy mostly because they handle the product design, and the product design should either utilize the resources gained from waste processing or devised to enable the product wastes to be processed by the waste management system.

#### 4.2 Collaboration Type and Interaction Mechanism in Supply Chain implementing Circular Economy

As previously defined in Section 2, there are three types of collaboration in the supply chain: vertical, horizontal, and lateral. From the review, it was found that most of the research, 24 out of 35 articles, consider the vertical collaboration in their supply chain. This is mostly caused by the fact that implementing the circular economy in the supply chain is mostly focused on the chain involving the flow of products and waste. Hence they are more focused on defining the vertical collaboration parts of the supply chain.

However, there is also research in which the supply chain considers lateral collaboration when implementing the circular economy concepts. The lateral collaboration, when being considered in research, can come in the form of collaboration between the main company and academic institutions or research centers (Batista et al., 2018; Bernon et al., 2018). This collaboration happens when the company seeks to research on developing new methods in

better implementing a circular economy. Other than with researching institutions, the lateral collaboration also considers government bodies, in which both the push and the support to implement the circular economy concept in supply chain practices might come from the government (Batista et al., 2018; de Oliveira, 2019; Lapko et al. 2018). The lack of regulation on circular economy implementation from the government might hinder the success of implementation, as it can also affect the aspect of incentives for the supply chain actors (Veleva & Bodkin, 2018). Both of the researching institutions and government bodies are part of the unrelated companies in horizontal collaboration. As for the collaboration between competing companies, none of the researched literature tries to consider this kind of collaboration.

Only one research considers horizontal collaboration, which is the research of Ali et al. (2019). In this research, the collaboration happens between automobile company and building construction company. The metal scrap wastes from an automobile company are to be used in building construction. As these companies should have been unrelated, their collaboration can be defined as fitting the horizontal collaboration type.

The research is also considered based on the interaction mechanism considered in the research: whether it is practiced in the research or highlighted as the necessary mechanism to ensure the success of circular economy implementation in the supply chain. Of the 35 research, the process integration mechanism and information sharing mechanism are mostly practiced or become a concern for the supply chain actors if they want to implement the circular economy implementation. For the process integration mechanism, it is caused by the fact that for the implementation to be successful, the wastes have to be processed to become resources, and the resources must be used either by the original processes or by other industries. This requires integration in both the waste management processes and resource procurement. As for the information sharing, it especially becomes a concern to increase the willingness of supply chain actors to participate in the supply chain, through sharing the information of circular economy implementation benefits, such as in the research of Patricio et al. (2018).

Incentive alignment comes as the third most discussed interaction mechanism. Other than the lack of information, the incentives which will be gained by the supply chain actors from the implementation are considered necessary for the supply chain success. This is because there is the possibility that the actors

would be unwilling to participate if they do not see the benefit of implementing supply chain concepts, especially because the implementation would require additional processes and efforts, which might possibly increase the cost of supply chain processes. Other than that, the research is generally not concerned with decision synchronization and performance accountability yet, as only 5 articles address the former, and 3 articles address the latter. This might be due to the fact that the other three interaction mechanisms are considered to be more important in the current state of circular economy implementation in the supply chain.

While there are only five interaction mechanisms defined for the base of literature review, apparently there is also interaction mechanism in the form of contracts (Batista et al., 2018; Fischer and Pascucci, 2017; Maab and Grundmann 2018). Contracts can be considered as encompassing several of the already defined interaction mechanism, as in the contract, the incentives for supply chain actors are defined, along with the agreement of the supply chain actors for the terms which could show the existence of decision synchronization aspect. In further analyzing the interaction between supply chain actors for implementing the circular economy concepts, this mechanism could become a key for better success.

### 4.3 Research Context

The majority of the research takes place in the countries of Europe and America (Northern and Southern America combined), with 19 research in Europe and 8 research in America. The high amount of research in Europe might be caused by the government's initiative to adopt a circular economy in Europe. As for in Asia, there is only two research, taking place in India and China. This shows that there is a research gap on research regarding actors' interaction in the supply chain implementing the circular economy in the context of Asia, especially in developing countries.

Regarding the industrial context, the amount of research in the agri-food industry is more or less the same amount as the manufacturing industry, with the former having 15 research and the latter having 16 research. Research with more than one industrial context is either having multiple case study methods in the research or the case study involve two industries to facilitate the implementation of circular economy concepts. An example of the latter is the case of Ali et al. (2019), in which the waste of the automotive industry is used in the construction industry.

Other than the industries, it is also important to determine the activities of processes that make the case adequate of being called "implementing the circular economy." The key to the circular economy concept is that the number of wastes discarded to the landfill should be minimized as much as possible. This results in the necessity to process wastes and use them as resources.

The most used activity for circular economy implementation is the reuse, remanufacturing, and recycling process. In this process, used products go through several processes (they might get repaired, remanufactured, disassembled, or recycled) to become resources in creating new products or the new products themselves. This activity is mostly used by the manufacturing industries. However, the agri-food industries involved with the processing of product packaging could also utilize this activity. The amount of research utilizing this activity is the highest: 23 of the 35 research contain the reuse, remanufacturing, and recycling process.

There are other activities that could be done to utilize wastes from other processes. The first one is composting organic wastes to become fertilizer (Borello et al., 2016; Borello et al., 2017; Chen et al., 2019; Noya et al., 2017; Patricio et al., 2018; Perey et al., 2018; Vlajic et al., 2018). The fertilizer could then be used in the farming processes, which could be done to either produce feeding for livestock farming or food sources for the plant-based food product supply chain. Feeding production from wastes is also a highly-used waste handling process in the agri-food industry, such as the utilization of wheat co-products for animal feed (Principato et al., 2019).

Another possible circular economy process is by giving the waste to other industries to be utilized, such as the utilization of pig blood and butter in Noya et al. (2017). There is also a method to resell the products without the whole remanufacturing processes (He et al., 2019). And finally, there is the sustainable use of resources through energy and resource recovery (Hogeboom et al., 2018; Vlajic et al., 2018). The amount of these other processes is far lower than the mostly used reuse-recycle-remanufacture processes.

As previously mentioned, for both the agri-food and manufacturing industries, there already exist several research regarding the circular economy implementation in their supply chain. However, in the research of Farooque et al. (2019), it should be noted that there is the possibility to find drivers and barriers for a specific industry, compared to a broad category such as agri-food and manufacturing. The drivers and barriers for implementation can also come in cultural

context, which is related to the country or continent context for the case study. This is highly important as the cultural context of the case affects the supply chain actors, which, as explained before, the behavior of supply chain actors could affect the implementation of circular economy concepts in the supply chain.

#### 4.4 Methods and Findings of the Research

The subject of circular economy implementation in the supply chain is still a growing body of knowledge which requires inputs from the empirical facts in the field. Thus, most of the research uses the case study method, whether it is the multi-case study or the single-case study. Generally, they are conducted in an exploratory manner with the goal of finding the insights from the current situation, either be it the perspectives from existing players, possible barriers and drivers for the implementation; also the possible benefits from the implementation though not yet applied. It is also interesting to note that while the specific method of which the materials will be processed varied on each case, there could be categorized back to either the reuse-remanufacture-recycle processes or agricultural resource gathering processes (composting for gaining fertilizers, processing to get animal feed).

Another popular goal in the research is to compare the result from several scenarios: the current condition and various implementations of the circular economy processes. For this comparison, they usually consider the best alternative to be the one with the least economic cost (investment, operating), least environmental effects (greenhouse gas emission, acidification of water), and most profitable, which sometimes can be attributed to the lower economic cost. A comparison of the scenarios generally uses data gathered through case study processes: an examination of already existing data and gathering information from key stakeholders. The data are then further processed by the chosen means of scoring the scenarios: lifecycle analysis, mathematical equations, analytic hierarchy process, discrete event simulation, system dynamic, an agent-based model.

In the matter of agent-based model, it is interesting to note that Moreno et al. (2018) argue that the methodology should be used when the research is focused on the people, or the actors, of the system. Thus, their research uses discrete event simulation to analyze the flow of products. However, in the research of Lieder et al. (2017), it is used to depict the material flow of washing machine products, in which



the agents are the washing machines, and the different characteristics for each machine are their score in their ability to be reused, recycled, or remanufactured. Actually, it is not that uncommon for the agent-based model to be used in the manufacturing industry to model the products, just as also shown by Nilsson and Darley (2006).

## 5 CONCLUSIONS

The circular economy is considered as one possible solution to the matter of waste management in various industries. However, the implementation of circular economy concepts in the supply chain can face several obstacles due to the behavior and interaction of actors within the supply chain. Several of the previously identified cases have shown this pattern, in which both the behavior and the interaction of actors can impact the actors' willingness to participate in the implementation, which also will affect the implementation success.

This literature review is thus conducted to find state of the art regarding the actors within the supply chain with the goal of implementing a circular economy, along with the collaboration type of the actors and the interaction mechanism they practice, or they should practice. From the literature review, it is apparent that the most important actors are the ones involved in the waste management processes: the waste collectors, waste sorters, and waste processors. The integration of these actors with the resource suppliers and manufacturers is also considered to be important, in order to ensure the flow of resources from processed wastes could be utilized by the original process or the other industries. As for the interaction mechanism, information sharing and process integration are most discussed by the literatures, considering that the current state of circular economy implementation in supply chain is mostly still in the stage of introducing circular economy to the actors and inquire their participation in the system, along with integrating the processes especially in the stage of waste processing and resource gathering.

There are several future research directions that can be taken for this subject. First, there seems to be a lack of horizontal collaboration in the supply chain implementing the circular economy. Further research can be conducted to find out whether this kind of collaboration is actually necessary for implementing a circular economy in the supply chain, or there is no impact of such collaboration for the implementation. The matter of collaboration between competitors can

also be further researched, especially if there is more than one company that conduct waste management processes. Other than that, there could be research in a specific context, both in the industries narrower than the agri-food or manufacturing umbrella and in the geographical context, which is not already majorly researched on. The latter can especially be conducted to compare the impact of different cultures on the actors' behavior, which will, in turn, also affect the success of circular economy implementation in the supply chain.

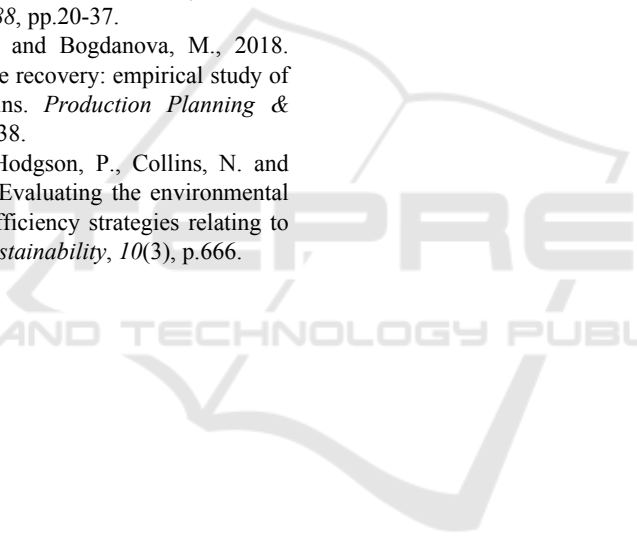
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