Analysis of the Application of Circular Supply Chain in Beverage Packaging Industry

Zahrah Aulianti
Industrial Engineering Department, Faculty of Engineering,
Bina Nusantara University, 11480 Jakarta, Indonesia
zahrah.aulianti@binus.ac.id

Taufik Roni Sahroni
Industrial Engineering Department, Faculty of Engineering,
Bina Nusantara University, 11480 Jakarta, Indonesia
taufik@binus.edu

Abstract

Sustainability is one of the issues currently facing the industry. The increase in food packaging waste is an obstacle to achieve sustainability. In this study, a food packaging company was selected to apply the circular supply chain in the production of its beverage packaging. The purpose of this research is to analyze the application of circular supply chain in beverage packaging industry based on circular supply chain methodology. Beverage packaging process, recycling process, circular supply chain process and SCOR (Supply Chain Operation Reference) were analyzed in this research. The results showed that the company uses the recycling method for Used Beverage Cartons (UBC) in the application of circular supply chain for the production of its beverage packaging and made it into various kinds of products that can be used by the community. It can be concluded that the company has contributed to reducing food packaging waste by implementing a recycling process for its UBC.

Keywords
Circular supply chain, beverage packaging production.

1. Introduction
The concept of sustainability is the study of how natural processes work, remain diverse, and provide everything an ecosystem needs to maintain balance. The increase in food packaging waste is one of the environmental issues that we are facing. Disposing of packaging waste freely into the environment or final disposal site, will cause pollution with different levels. One way to support sustainability, especially in food packaging, is by implementing a circular supply chain in today's industry. Circular supply chain systematically updates technical materials and regenerates biological materials towards a “zero-waste” vision.

The company is a food and beverage packaging company that has taken the initiative to build integrated and sustainable solid waste management. The circular supply chain approach to realizing a circular economy allows used materials to have a circular phase in order to maintain their value. The company also contributes by using recyclable basic materials for beverage packaging, so that waste from consumable beverage packaging can be managed responsibly. In this research, the author conducted an analysis to determine the application of a circular supply chain in beverage packaging production. The research was conducted using qualitative methods with secondary data and document studies from the one of the beverage packaging industries in Indonesia. After that, the data that has been collected is analyzed. The main objective of this study is to analyze and measure the application of circular supply chain in beverage packaging industry.

2. Literature Review
Circular supply chain management is an integration of circular thinking into supply chain management and the industrial ecosystem and nature around it. Circular supply chain systematically updates technical materials and regenerates biological materials towards a “zero-waste” vision. Circular supply chain recover value from waste by

collaborating with other organizations in the same or different industrial sectors (Farooque, Zhang, Thürer, Qu, & Huisingh, 2019).

Supply chains in a circular economy (CE) stimulate significant growth for supply chain organizations, this is due to environmental awareness, energy conservation and global competition (Manavalan & Jayakrishna, 2019). Recycling is the strategy most often referred to, accompanied by remanufacturing, repair, and reuse (Schöggl, Stumpf, & Baumgartner, 2020). The main objective of various businesses is to contribute to sustainable development by implementing changes, including the CE program, into their business processes (Kravchenko, McAlone, & Pigosso, 2019). A sustainable CE must not only apply an environmental perspective, but economic and social performance must also be taken into account (Haupt & Hellweg, 2019).

Sustainability has become a core issue in manufacturing motivated by awareness of global environmental degradation, emissions, and scarcity of natural resources. In general, a circular economy (CE) and closed supply chains are seen as important means of achieving more environmentally friendly production and industrial goods (Brunoe, Andersen, & Nielsen, 2019). One way to create a circular supply chain in the production process is with the help of digital technology. In addition, data analytics can serve as a method for estimating product health and wear, reducing downtime or downtime in production, scheduling maintenance, ordering parts, and minimizing energy use. These examples show that a number of circular techniques and business processes are involved in the contribution of digital technology to the circular supply chain, from recycling to reuse, and creation of new methods to maintenance management (Kristoffersen, Blomsma, Mikalef, & Li, 2020).

There are several things that need to be considered in additive manufacturing, such as the assessment of materials after use, recycling of materials being used, and environmental aspects in relation to the manufacturing of these additives. These aspects can be applied not only to the additive manufacturing process, but also to other manufacturing processes to create an optimal circular supply chain (Colorado, Gutierrez Velasquez, & Monteiro, 2020).

Although the environmental and social aspects of sustainability have so far attracted less attention than the economic dimension, the circular supply chain in a circular economy (CE) is about resource scarcity, environmental impact, and economic returns (Niero & Hauschild, 2017). Exploring the synergy between the two ends of the supply chain allows meaningful improvements to be made in order to improve commodity quality, productivity and sustainability (Hahladakis & Iacovidou, 2018).

A study on the use of chemical recycling methods to reduce plastic packaging waste shows that all chemical recycling pathways can reduce the impact of global warming, and depletion of fossil resources when using unsorted plastic waste, otherwise processed in municipal solid waste treatment plants (Meys, et al., 2020). The idea of changing or innovating green business models is relevant in exploring how a company's circular supply chain approach can be applied to business and its environmental relevance (Stewart, Niero, Murdock, & Olsena, 2018).

Several companies have targets to reduce production waste. Particularly in the beverage sector, product distribution to consumers involves packaging (Niero & Hauschild, 2017). To achieve the goal of a circular supply chain, reuse of packaging is recommended, but for food packaging, reuse is only commercially viable for clean, refillable containers. Only by integrating such initiatives, considering competing priorities and including all stakeholders, includingfood and packaging producers, recyclers, decision makers, civil society and customers, sustainable food packaging ina circular supply chain can be achieved (Geueke, Groh, & Muncke, 2018).
The strategy suggested facilitates inclusion in the design and process of selecting key topics, such as circular supply chains and life cycle thinking, which should be taken into account with technological success when designing and selecting new food packaging solutions (Rivera, Leadley, Potter, & Azapagic, 2019). Reusable packaging can be seen as a product service system, where instead of just selling products, services are also provided to consumers. By using reusable packaging, it can reduce costs and price incentives such as discounts for reuse, increased variety and adjustment, ease of delivery and collection, and reduced waste (Coelho, Corona, Klooster, & Worrell, 2020).

Packaging is the art of product presentation. Lately, the development of new food packaging not only increases the shelf life of food, but also improves food safety and quality, along with increasing convenience for consumers. The following are some of the types of packaging (Sarkar, 2020).

1. Primary Packaging

Primary packaging is a material that is in direct contact with the contents of the package. This section covers the product and holds it in place. Usually, it is the smallest unit of distribution or use. An example is a packet of chips.

2. Secondary Packaging
   Secondary packaging is a material that is outside the primary packaging. This section is also used to group the main packages together. Examples include cereal cartons, cartons, or beverage cans.
3. Tertiary Packaging
   Tertiary packaging is a material that holds secondary packaging. These parts are used for bulk packaging for easy handling, transportation, distribution, shipping, or storage. Examples are wooden and cardboard crates.

In determining the shelf life of a food product, packaging materials play an important role. There are several types of materials for food packaging, including the following (Sarkar, 2020).

1. Paper and Cardboard
   Almost all paper used for food packaging is usually made of cellulose fibers that come from wood. The first step of making paper or cardboard is pulping which is done by mechanically grinding wood. Paper made from this type of pulp is relatively weak compared to chemical pulps.
2. Glass
   Packaging with glass material is impervious to moisture, gas, odors, vapors, and micro-organisms so that it keeps the product fresh for a long time without sacrificing taste or safety.
3. Metal
   Metal is the most versatile of all forms of packaging and plays a very important role in the packaging, preservation and storage of food. Metals offer excellent physical protection and barrier properties. Its shape and printability, recyclability, and consumer acceptance make it a multifaceted material.
4. Plastic
   Plastics are so malleable that they can be molded into different solids. This material is used in many products at different scales because of its low cost, ease of manufacture and resistance to water.
5. Wood
   Wood is widely used to package fresh produce, although its use is limited when handling processed food. The wood is strong and provides better protection against damage and impact than a cardboard box. However, wood is heavier and more expensive. Wooden containers can be made light-proof and leak-proof.

Food packaging has evolved from just carrying food containers into something that can play an active role in today's food quality. By offering protection from environmental, chemical, and physical threats, packaging today plays an important role in the quality of food products. Some of the food and beverage packaging technologies are as follows (Nura, 2018).

1. Smart Packaging
   The innovation in smart and active packaging, also known as new packaging, is the result of customer demand for easy, ready-to-eat, minimally processed food. This packaging system can repair small holes or tears, respond to environmental factors such as changes in temperature and humidity, and alert consumers if food is contaminated.
2. Nano Technology
   Nanotechnology involves the manipulation of matter on a very small scale, generally between 1 and 100 nanometers. A nano sensor is a very small device that can bind to anything it wants to detect and send a signal back. Nano sensors can offer solutions to packaging problems when applied to food packaging because they can detect the presence of gases, odors, chemical contaminants, pathogens, and even changes in environmental conditions.
3. Antimicrobial packaging
   The three basic categories of antimicrobial packaging systems include incorporation of the antimicrobial agent into sachets connected to the package where the volatile bioactive substances are released during further storage; direct incorporation of the antimicrobial agent into the packaging film; and coating packaging with a matrix that acts as a carrier for antimicrobial agents.
4. Consumable Packaging Films and Coatings
   Edible films and coatings are thin layers of edible materials and act as a barrier to the movement of moisture, oxygen and solutes for food. The growing interest in edible coatings is due to factors such as environmental concerns, new storage techniques and developing markets for underutilized agricultural commodities.
5. Sustainable Packaging

Sustainable and eco-friendly protocols recommend the use of biodegradable and environmentally friendly materials for food packaging because many packaging materials produce waste. Three important issues that must be considered in evaluating the sustainability of packaging are the entire life cycle of packaging from raw materials to final disposal to avoid problems being transferred from one part of the life cycle to another, the interaction between packaging and the products it contains so that the environmental impact of the product packaging system is minimized overall, and also consider the 'triple bottom line' impact of packaging: on business, on people and on the natural environment.

To reduce packaging waste, the first step taken is to encourage reducing the use of packaging as much as possible or reusing packaging (Gurlich, Hummelberger, Kladnik, & Tacker, 2020). Exploration of materials is expected to find materials that are more sustainable without sacrificing economic and social functions. There are several recommendations that can be done, namely by using biodegradable paper, using environmentally friendly plastics, using glass, using aluminum, using recycled materials, and using other alternative materials (Setiadi, 2018).

The emergence of Smart Packaging systems has contributed to a significant change in the existing perceptions of packaging, as they transformed the traditional communication function of packaging into intelligent communication. The transport phase also does not imply a high environmental impact. This shows that by adding a bypass system to the package the environmental load is removed, bypassing the transport phase to the smart system (Cabot, Luque, Heras, & Aguayo, 2019).

3. Methods

Figure 1 shows the research methodology and generally describe the steps were taken to carry out the current problem in beverage packaging industry.

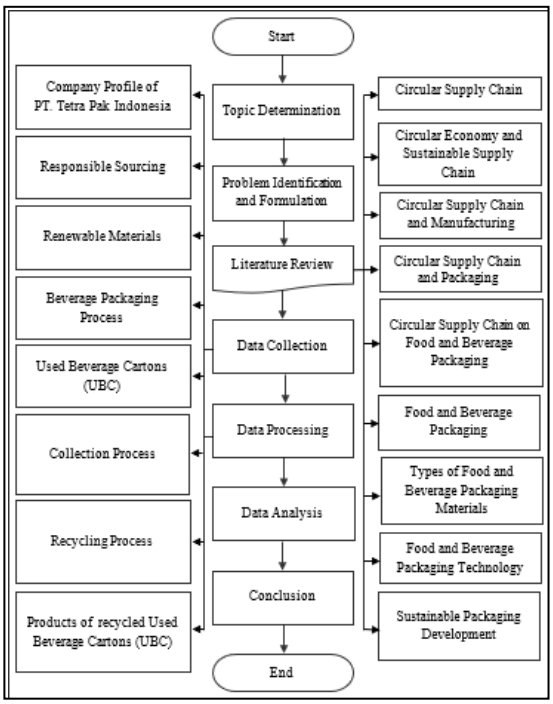

Figure 1. Research Methodology

4. Data Collection

Data collection was carried out by identifying secondary data and studying documents through the website of several beverage packaging industry in Indonesia. The data collected includes beverage packaging processes from beginning to end of use, recycling processes, and recycled products. Based on the data that has been collected, the author got some information about the beverage packaging process by company. Figure 2 shows a diagram of the beverage packaging process.

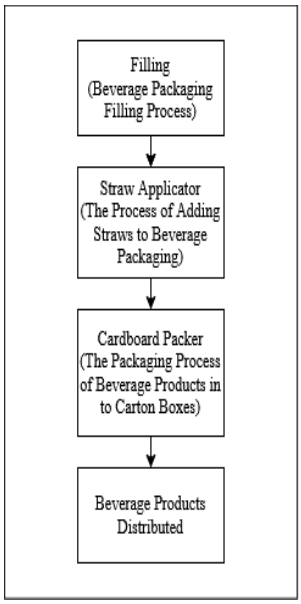

Figure 2. Beverage Packaging Process

After the beverage product is distributed and consumed by consumers, the beverage packaging will be discarded. Used drinking cartons or UBC (Used Beverage Cartons) will be collected and carried out into the recycling process. Based on the data that has been collected, the following Figure 3 is a diagram of recycling process for UBC (Used Beverage Cartons).

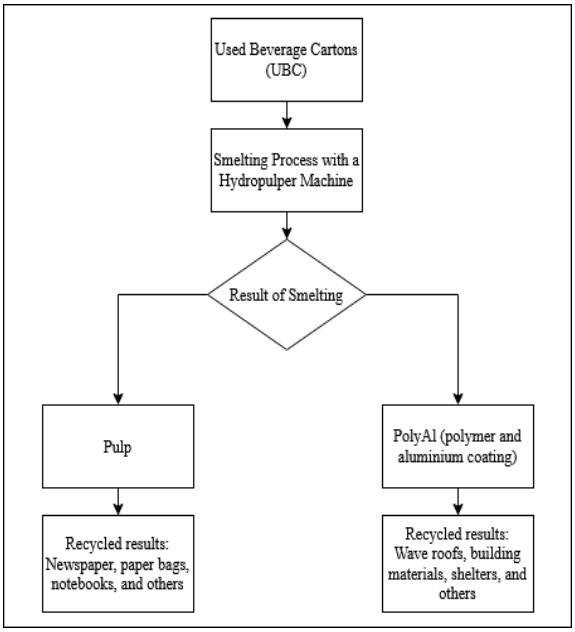

Figure 3. Recycling Process for UBC (Used Beverage Cartons)

5. Results and Discussions

Based on the data that has been collected, there are several stages in the circular supply chain process at company. The following is a design of the circular supply chain process as shown in Figure 4.

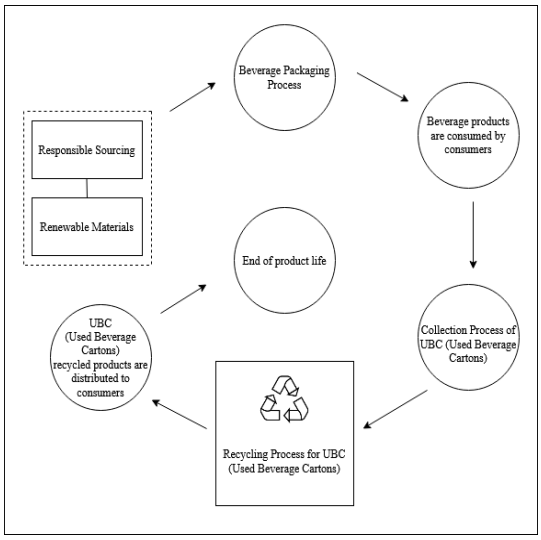

Figure 4. Circular Supply Chain Process

The next step is to define the SCOR (Supply Chain Operation Reference) model is a system of processes for the supply chain, metrics and success expectations, best practices, and skills. SCOR continues to evolve through adaptation to the changing needs of its users from suppliers, production and delivered to customers. Performance metrics based on sustainable supply chain management are included in the new issue of SCOR and it is applicable to represents for its company supply chain. (Vegter, Hillegersberg, & Olthaar, 2020). In this research, the author used SCOR as a method to determine the performance of circular supply chain in the production of beverage packaging company.

Based on the data that had been collected, the author designed a layout as a suggestion for the recycling process of UBC (Used Beverage Cartons), which was one of the steps in the sequence of circular supply chain in company. Figure 5 shows the proposed layout to fulfil for the recycling process of UBC.

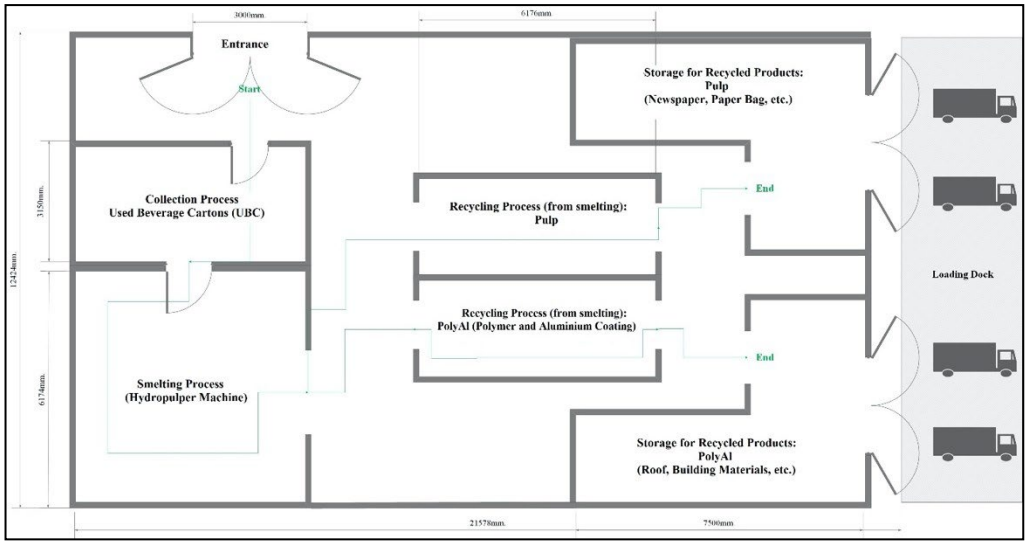

Figure 5. Proposed Layout for the Recycling Process of UBC

Beverage carton packaging of company consists of 75% cardboard layers, 21% polymer layers, and 4% aluminum layers. The main material used is paperboard produced from wood fibers and comes from certified sustainable forests. company uses renewable ingredients without sacrificing food quality and safety. The beverage packaging process at company begins with a filling process, namely filling the beverage liquid into the package. Machines used in aseptic

packaging ensures aseptic conditions in an economical manner, safer sterilization of packaging materials, and increase flexibility and reduce waste.

The company uses an aseptic packaging process to retain the drink's color, texture, natural taste and nutrition for up to twelve months without preservatives or refrigerants. According to Nura (2018), antimicrobial packaging has received considerable attention from companies because it can help regulate the growth of pathogenic and rotting microorganisms on food surfaces. According to Sarkar (2020), there are three types of packaging, namely primary packaging, secondary packaging, and tertiary packaging. Packaging on filling process categorized as primary packaging because the packaging material is in direct contact with the contents of the package. This section also serves to cover the product and hold it in place.

After the packaging goes through the filling process, a straw added to the package. This process is called straw applicator or the process of adding a straw to beverage packaging. Straw applicator machine can apply the straw to the package with minimum use of glue. With the addition of a straw, consumers can easily enjoy a drink. The company also provides various kinds of straws for packaging, according to consumer demand.

The next process is cardboard packer where the beverage product packaging is put into a cardboard box. Cardboard packer machine can switch between production of carton boxes, trays, and wrapping units in different packaging patterns. At this stage, carton box packaging can be categorized as secondary packaging because it is outside the primary packaging. This section is used to group the main packages together. After the packaging process is complete, beverage products from company can be distributed to consumers.

According to Sarkar (2020), the main function of packaging is to provide protection, preservation, and promotion. Efficient food packaging must protect food from microbial contamination and protect food from physical damage such as leakage. Based on the stages of the beverage packaging process that has been analyzed, it can be said that company has produced efficient food packaging.

The recycling process is carried out to reduce production waste. This is because distributing products to consumers involves packaging, most of which is discarded after its useful life (Niero & Hauschild, 2017). Therefore, packaging waste needs to be handled to prevent adverse environmental impacts (Geueke, Groh, & Muncke, 2018). Recycling is also done to support sustainable circular supply chain. The value of a product is maintained in various ways when it reaches the end of its useful life, for example by reusing the product or by recycling the product (Brunoe, Andersen, & Nielsen, 2019).

Post-consumption beverage carton packaging or UBC (Used Beverage Cartons) collected and then recycled. company is working with two recyclers in Tangerang and East Java. Beverage carton packaging of company has several layers, all of which can be recycled. The recycling process begins with the melting process, which is the separation of the paper layer from the polymer and aluminum layers. The smelting process uses a hydropulper machine, by means of the UBC layer, dissolved only by adding water and yielded pulp as well PolyAl (polymer and aluminum coating). After that, pulp and PolyAl will be separated for further processing into products that have high economic value and are well accepted in the market.

Recycled paper from UBC can then be turned into newsprint, paper bag, and notebooks. As for the PolyAl material in UBC can be recycled into corrugated roofs, building materials, and *shelter*. The building materials were used to build a reading library at the schools in Jakarta and Depok. Shelter from recycled products PolyAl placed in the Kawasan Banjir Kanal Timur, DKI Jakarta.

Based on the recycling process that has been analyzed, it can be said that company participates in efforts to reduce beverage packaging waste and is supporting circular supply chain. This is done with UBC's recycling method to achieve a sustainable supply chain.

Circular supply chain is a process that systematically updates technical materials and regenerates biological materials towards the vision "zero-waste". Ideally, implementing a circular supply chain will not produce waste because it is designed to systematically restore and regenerate resources in industrial and natural ecosystems. One of the goals of implementation circular supply chain that is, to recover value from waste by collaborating with other organizations in

the same or different industrial sectors (Farooque, Zhang, Thürer, Qu, & Huisingh, 2019). Workable solutions to achieve circular supply chain namely by application of recycling.

In aseptic packaging, there is a layer of aluminum in the beverage packaging. Aluminum lining is used in aseptic cardboard because it can prevent oxidation and minor damage, keeping perishable food and drinks safe without refrigeration and preservatives for months. Aluminum Stewardship Initiative (ASI) has announced the company as the sixth company, and the third end user of ASI certified aluminum, less than a year after the certification program was launched.

In addition to responsibly managed sources, company also uses renewable materials, which consist of biomass and can be supplied continuously, such as wood. The use of renewable materials will play a role in achieving a circular supply chain. In reuse, reuse and source of recycling, renewable materials have an important role. The company aims to use 100% recycled materials to produce all packaging.

Furthermore, in the circular supply chain process at company, namely beverage packaging. This process begins with the filling process, which is filling the beverage packaging. Then, followed by the straw applicator process, namely adding a straw to the beverage packaging. Then, the cardboard packer process, which is the packaging of beverage products in cardboard boxes. After the beverage packaging process is complete, cardboard boxes containing the beverage products can be distributed to consumers. Drinking products will be consumed by consumers and discarded afterwards.

Post-consumption beverage packaging or Used Beverage Cartons (UBC) is sorted, collected, and recycled. Since 2005, company together with the Pulp and Paper Center (BPPK) to ensure the processing of UBC. Until 2020, there are six collecting partners who will supply used packaging and actively collect UBC. The company also supports sorting facilities. This is realized by providing several supporting facilities such as scales to support the centralized weighing of packaging in collectors' warehouses, press machines which is used to improve the quality of the packaging bales to be sent to the recycling plant, and manuals forklift to facilitate the moving and transport of packing bales.

With the supporting facilities, it will increase operational efficiency and the quality of UBC collection. In addition, company also supports the improvement of collector partner warehouse infrastructure by expanding the sorting and storage area, as well as the mode of transportation for separate collection of packages. After the UBC packaging is collected, the packaging will go through a recycling process.

The company works together to provide technical development to entrepreneurs in the paper recycling industry to increase the effectiveness and efficiency of production capacity performance, as well as improve the quality of recycled end products. The UBC recycling process begins with a melting process using a hydropulper machine, namely the separation of the paper layer from the polymer and aluminum layers by simply adding water. Consolidation results are in the form of pulp and PolyAl (polymer and aluminum coating). Pulp and PolyAl will be separated and processed further. Recycled paper from UBC can be turned into newsprint, paper bag, notebooks and more. Meanwhile, PolyAl material can be used as a wave roof, building materials, shelter, and others. So, this is wherethe recycled products end.

Based on the analysis that has been described, it can be said that company has implemented circular supply chain in the production of its beverage packaging. This is shown in the efforts of company to reduce beverage packaging waste by using the UBC recycling method. So, this effort is in line with the goal of circular supply chain that is, to restore value from waste products and regenerate resources systematically in industrial and natural ecosystems.

“Plan” process on beverage packaging production at company includes planning in the recycling process to achieve circular supply chain. This begins with the use of responsible sources and renewable materials, the beverage packaging process, the collection process of Used Beverage Cartons (UBC), UBC recycling process, as well as UBC recycled products that can then be used by the public. Next, “Source” process includes the procurement of raw materials for making beverage cardboard packaging. The material used is taken from responsible sources, such as paperboard that has passed standard certification Forest Stewardship Council®(FSC®), polymer coating with Bonscuro Chain of Custody certification, and Aluminum Stewardship Initiative (ASI) certified aluminum coating. The company also uses renewable materials which play an important role in recycling sources to achieve a circular supply chain.

"Make" process in the production of beverage packaging includes the beverage packaging process. This process begins with a filling process namely filling the beverage packaging, then the straw applicator process namely adding a straw to the beverage packaging, then cardboard packer process is when beverage products was packaged into cardboard boxes. "Deliver" process includes the process of distributing beverage products to consumers. Then, the process "Return" includes the collection process for post-consumption beverage packaging or Used Beverage Cartons (UBC) which will then be sorted and recycled. Recycled products such as notebooks, roof sheet, and building materials can be used for community needs. The process "Enable" includes all activities related to management of circular supply chain implementation in the production of beverage packaging at company.

The recycling process of UBC (Used Beverage Cartons) starts with collection process of the used beverage packaging. Then, UBC was carried along the entrance way of the factory, all the way to the collection room. After that, UBC went through the smelting process, which requires hydropulper machine. Water was added to the UBC and hydropulper machine will do the smelting process. Results of the smelting process includes pulp and PolyAl (polymer and aluminum coating).

Later, pulp and PolyAl will be processed further. The recycling process of pulp and PolyAl was done in the recycling room for each smelting results. Products of the recycling process of pulp includes newspaper, paper bag, and many more. Meanwhile, products of the recycling process of PolyAl includes roof, building material, and others. Those recycled products then were stored in the warehouse or storage for pulp and PolyAl, which later will be distributed.

6. Conclusion

Application of circular supply chain at company begins with the use of responsibly managed sources and renewable materials in the manufacture of packaging. The beverage products from company are packaged and distributed to consumers. Post-consumption beverage packaging or Used Beverage Cartons (UBC) is sorted, collected, and recycled. UBC recycled products are used to become various kinds of products that have high economic value and are well accepted in the market. It is found that concept of UBS shows the implementation of circular supply chain was significantly increase of market potential.

Performance of circular supply chain in the production of beverage packaging at company based on SCOR (Supply Chain Operation Reference) includes the process "Plan" which includes all planning in the recycling process, "Source" process which includes the procurement of raw materials as materials for making beverage cardboard packaging and the use of renewable materials, "Make" process which includes the process of packaging drinks, the process "Deliver" which includes the process of distributing beverage products to consumers, the process "Return" which includes the collection process of Used Beverage Cartons (UBC) which will then be sorted and recycled, and the process "Enable" which includes all activities related to the management of circular supply chain implementation in the production of beverage packaging at company.

References

Brunoe, T. D., Andersen, A.-L., & Nielsen, K. (2019). Changeable Manufacturing Systems Supporting Circular Supply Chains. *Procedia CIRP Vol. 81*, 1423-1428.

Cabot, M. I., Luque, A., Heras, A. d., & Aguayo, F. (2019). Aspects of sustainability and design engineering for the production of interconnected smart food packaging. *Plos One*.

Coelho, P. M., Corona, B., Klooster, R. t., & Worrell, E. (2020). Sustainability of reusable packaging–Current situation and trends. *Resources, Conservation & Recycling: X Vol. 6*.

Colorado, H. A., Gutierrez Velasquez, E. I., & Monteiro, S. N. (2020). Sustainability of additive manufacturing: the circular economy of materials and environmental perspectives. *Journal of Materials Research and Technology Vol. 9*, 8221-8234.

Farooque, M., Zhang, A., Thürer, M., Qu, T., & Huisingh, D. (2019). Circular Supply Chain Management: A Definition and Structured Literature Review. *Journal of Cleaner Production Vol. 228*, 882-900.

Geueke, B., Groh, K., & Muncke, J. (2018). Food packaging in the circular economy: Overview of chemical safety aspects for commonly used materials. *Journal of Cleaner Production Vol. 193*, 491-505.

Gurlich, U., Hummelberger, D., Kladnik, V., & Tacker, M. (2020). Circular Packaging Design Guideline: Design Recommendations for Recyclable Packaging. *FH Circular Packaging Design Guideline Ver. 3*, 19-21.

Hahladakis, J. N., & Iacovidou, E. (2018). Closing the loop on plastic packaging materials: What is quality and how does it affect their circularity? *Science of The Total Environment Vol. 630*, 1394-1400.

Haupt, M., & Hellweg, S. (2019). Measuring the environmental sustainability of a circular economy. *Environmental and Sustainability Indicators Vol. 1-2*.

Kravchenko, M., McAlone, T. C., & Pigosso, D. C. (2019). Implications of developing a tool for sustainability screening of circular economy initiatives. *Procedia CIRP Vol. 80*, 625-630.

Kristoffersen, E., Blomsma, F., Mikalef, P., & Li, J. (2020). The smart circular economy: A digital-enabled circular strategies framework for manufacturing companies. *Journal of Business Research Vol. 120*, 241-261.

Manavalan, E., & Jayakrishna, K. (2019). An Analysis on Sustainable Supply Chain for Circular Economy. *Procedia Manufacturing Vol. 33*, 477-484.

Meys, R., Frick, F., Westhues, S., Sternberg, A., Klankermayer, J., & Bardow, A. (2020). Towards a circular economy for plastic packaging wastes – the environmental potential of chemical recycling. *Resources, Conversation and Recycling Vol. 162*.

Niero, M., & Hauschild, M. Z. (2017). Closing the loop for packaging: finding a framework to operationalize Circular Economy strategies. *Procedia CIRP Vol. 61*, 685-690.

Nura, A. (2018). Advances in food packaging technology-A review. *Journal of Postharvest Technology 06(4)*, 55- 64.

Rivera, X. C., Leadley, C., Potter, L., & Azapagic, A. (2019). Aiding the Design of Innovative and Sustainable Food Packaging: Integrating Techno-Environmental and Circular Economy Criteria. *Energy Procedia Vol. 161*, 190-197.

Sarkar, S. (2020). Food Packaging and Storage. In *Research Trends in Home Science and Extension Vol. 3* (pp. 27-51). AkiNik Publications.

Schöggl, J.-P., Stumpf, L., & Baumgartner, R. J. (2020). The narrative of sustainability and circular economy - A longitudinal review of two decades of research. *Resources, Conservation & Recycling Vol. 163*.

Setiadi, V. (2018). The empowerment of sustainable design in food packaging as designer responsibilities. *IOP Conference Series: Earth and Environmental Science 106*.

Stewart, R., Niero, M., Murdock, K., & Olsena, S. I. (2018). Exploring the implementation of a circular economy strategy: the case of a closed-loop supply of aluminum beverage cans. *Procedia CIRP Vol. 69*, 810-815.

Tetra Pak. (2020). *About Tetra Pak: Tetra Pak Indonesia*. Retrieved from Tetra Pak: https://www.tetrapak.com/en-id/about-tetra-pak/the-company/tetra-pak-indonesia

Vegter, D., Hillegersberg, J. v., & Olthaar, M. (2020). Supply Chains in Circular Business Models: Processes and Performance Objectives. *Resources, Conservation & Recycling 162*.

Biographies

Zahrah Aulianti is a student of Industrial Engineering (streaming in supply chain engineering), Faculty of Engineering, in Bina Nusantara University, Jakarta Indonesia.

Taufik Roni Sahroni is a Lecturer and Head of Industrial Engineering Study Program, Faculty of Engineering, Bina Nusantara University Jakarta. He received a Doctor of Philosophy in Manufacturing System Engineering in 2012. He has been involved in teaching and research for national and international universities for more than 20 years, inclusive 7 years industrial experiences. His interest research field includes Industrial & Manufacturing Engineering, Supply Chain, Casting Technology, Operation Research, Human System Integration and Concurrent Engineering.