Challenges of Implementing Reverse Logistics in Ensuring Circular Economy Goals

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Abstract. Our planet is struggling to provide the necessary natural resources for about 8 billion people, and our Earth's important ecosystems are on the verge of collapse. In 2015, the Department of Economic and Social Affairs of the United Nations presented in its annual report that worldwide, as population increases, the need for land, food, and important natural resources in 2030 will be twice as high as the same needs in 2010. The developing world economy contributes to a large extent to the destruction of the Earth's resources. Most companies still tend to operate on the basis of a linear take-make-dispose economic model. Meanwhile, the principles of circular economy not only encourage the reduction or elimination of waste and pollution, maximizing the efficiency of the use of products and materials, but also promote the natural regeneration of systems [4]. Researchers believe that one of the most difficult parts of the circular economy is reverse logistics, where the hardest part is managing the collection of waste from consumers to capture value and convert materials back into resources. The focus of this article is on the role of reverse logistics in the circular economy and closed-loop supply chains. The purpose of this article is to reveal the importance of reverse logistics and the most important challenges in ensuring the implementation of the principles of circular economy.

Keywords: Circular economy · Closed cycle supply chain · Reverse logistics · Reverse logistics activities

1 Introduction

The developing global economy contributes to a large extent to the destruction of the earth's resources. Most companies still tend to operate based on a linear take-make-dispose economic model, where they turn the raw material, receive it into a finished product, and sell it on the market to the end user. In turn, the consumer discards the product (completely or partially consumed), so the manufactured product reaches the end of its life cycle [5]. With this linear approach, companies not only don't worry about what happens to the product when it is discarded after its final use, but they also don't worry about the resources used to produce the product. Therefore, it is not surprising that more and more attention is paid to those who are looking for more efficient use of

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resources and more efficient processes in different areas of production and at different stages of consumption and who use the principles of circular economy. The circular economy is well known for boosting economic growth, generating new companies and employment opportunities, lowering prices, enhancing supply security, and minimizing environmental impact while saving on material costs. Esposito et al. believe that one of the most difficult parts of the circular economy is reverse logistics, where the most difficult part is managing the collection of waste from consumers to capture value and turn materials back into resources [3]. Such a circular model of reverse logistics allows us not only to protect the environment, save raw materials, but also to achieve maximum financial results.

The Circular Economy Action Plan of the European Union is not integrated in Lithuania's strategic documents or transposed into legislation. There is also no institution responsible for the implementation of circular economy principles. This, along with limited financial instruments, forms a barrier for Lithuania to move toward a circular economy and implement the goals of the European Green Course. Furthermore, it has been observed that the literature on reverse logistics enablers for firm-wide competitiveness is still developing [14]. To eliminate this gap, the article aims to reveal the importance of reverse logistics and the most important challenges in ensuring the implementation of the principles of circular economy. To this end, the first chapter of the article introduces the concept of circular economy. In the second, the features of closed-loop supply chains are revealed, and in the third, the essence of reverse logistics and the main activities that ensure the functioning of the closed-loop supply chain are revealed. In the fourth chapter, the problem of implementing reverse logistics activities is presented. The article ends with conclusions on the contribution of reverse logistics to ensuring the implementation of circular economy goals. The article is based on the analysis, systematization, and summarization of scientific literature examining the concept of the circular economy, the principles of closed-loop supply chain operation, and the challenges of implementing reverse logistics.

2 Concept of Circular Economy

A new European growth plan built on the European Green Deal and the idea of competitive sustainability was unveiled by the European Commission in 2020 in the Annual Plan. The European Union sets an ambitious goal for itself and for all of us, to transition to a fully circular economy by 2050.

The circular economy offers ways and solutions to achieve a sustainable lifestyle and an environment-friendly economy. The European Commission has been working on an action plan since 2015 to implement the circular economy, which consists of both industrial policy and regulatory measures. All levels of government, industry, inventors, investors, and consumers have a crucial role to play in advancing the circular economy's objectives.

The European Commission released a new circular economy action plan in March 2020 with the goal of making Europe greener and more competitive. To ensure that resources are used as long as possible in the EU economy, it encompasses activities that cover the entire life cycle of products, such as product design, promotion of circular economy processes, and the promotion of sustainable consumption. To ensure the

sustainability of the European Union economy and to turn climate and environmental problems into economic opportunities, companies are encouraged to switch to a clean circular economy, whose cycle aims to preserve the value of raw materials, materials, and products as long as possible, and to reduce the amount of waste generated as much as possible. Companies are encouraged to pursue sustainable development through efforts to expand value through improved or new business models and services.

Using creative products and solutions that can be reintroduced into biological and technological cycles and processes, the circular economy seeks to avoid the depletion of resources and discover ways to protect and repair the environment [17].

To define the concept of circular economy, different authors present different definitions of the concept of circular economy. Korhonen et al. present the circular economy as a closed-loop economic system, where raw materials, products and their components lose their value the least, when renewable resources are continuously used, and systemic thinking forms the basis of the system [13]. Hofmann states that it is an economic model that effectively uses various resources to reduce waste, maintain the value of materials, assets, and reduce the use of primary resources and products [9]. Kirchherr et al. argue that it is an economic system in which manufactured products with an end-of-life cycle must be replaced by products that can be used in production more than once by recycling them [12].

In line with the idea of sustainable development, the circular economy converts the conventional one-way linear economic model of "take-produce-throw" into a feedback circular economy mode of "raw material - product - waste - renewable raw material," which uses resources and protects the environment more effectively to achieve the greatest economic and social benefits with the fewest resource and environmental costs. The circular economy includes five main areas: 1) make (product design and production processes); 2) use; 3) reuse; 4) remake using secondary raw materials; 5) recycle.

According to Ying and Zhou, the circular economy is basically an ecological economy that requires human economic activity according to the 3R principle (reduce, reuse, and recycle [10].

The circular economy pursues multifaceted goals - it encourages protecting the environment, saving materials, creating additional jobs, and saving money for producers and consumers. The circular economy not only reduces companies' dependence on limited natural resources, but at the same time helps companies create greater value. Regarding the benefits for companies following the principles of the circular economy, Jabbour states that "the most important benefits for companies are: 1) reduction of raw material waste by reducing the use of energy and materials in production, which helps companies reduce waste and carbon emissions, reduce energy-related costs, waste management and emissions control; and 2) increasing competitive advantage through process innovation [11].

The advantages provided by the circular economy are analysed by various scientists, but in practice, various challenges of the development and implementation of the circular economy are encountered. The main challenges faced by companies in implementing circular economy goals are the lack of knowledge and competence and resources, confusing and unstable market demand, and complicated cooperation between different participants.

2.1 Closed-Loop Supply Chain

Because it integrates sustainability with corporate growth, the circular economy is particularly appealing to businesses. Ritzen and Sandstrom claim that, due to the continued overconsumption of resources on a worldwide scale and the subsequent harm to the environment, such integration is essential for many businesses. However, the circular economy is seldom, and often only partially, implemented in practice [16]. This is presumably due to the significant changes, time and work needed to go from a conventional linear model to a circular economic one. From a logistic point of view, the circular economy can be seen as the integrated direct and reverse management of the movement of products or materials in the supply chain. Therefore, companies that have decided to apply/or are applying the principles of circular economy in their operating models must also apply these principles when adapting their supply chains [15].

Given the closed loop of the circular economy model, the same principle must apply to supply chains: supply chains must also become closed. The presented supply chain model (see Fig. 1) shows that in a circular economy, products and materials used in the supply chain that would already be considered waste in the direct chain are taken back into the chain for new processes and are reused.

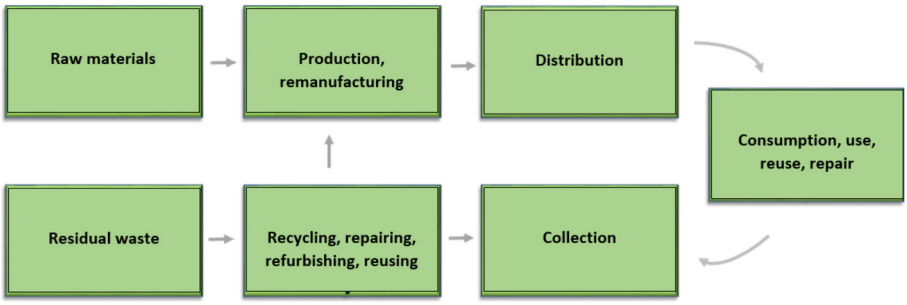

Fig. 1. Circular economy supply chain [8].

In this way, closed-loop supply chains can be considered economically and ecologically sustainable. The purpose of such chains is to close the resources in the supply chain ring to achieve the highest level of material efficiency, creating added value in the supply chain [7].

According to Defee et al., the closed-loop supply chain consists of five main processes: product acquisition, reverse logistics, inspection, disposition, and reordering. Reconditioning), distribution, and sales [2].

3 Concept and Activities of Reverse Logistics

When the shortage of raw materials began to appear in the global economy and environmental requirements appeared in legislation, companies were forced to respond to this by adapting their supply chain systems and processes. The circular economy emphasized

the maximum circulation of end-of-life products and encouraged the reuse or recycling of products. As part of this aspiration, reverse logistics has become a key component of the circular economy [1].

Esposito et al. believe that one of the most difficult parts of the circular economy is reverse logistics [3]. Therefore, to understand how important reverse logistics is for the circular economy (and at the same time for the reverse supply chain), it is necessary to clearly understand how reverse logistics is defined, what activities are assigned to it, and what reverse logistics goals and processes are related to the circular economy.

The scope of the original definitions of reverse logistics is limited to the movement of materials and products in the opposite direction of the direct flow, such as from a customer to a retailer or from a supplier to a factory. Bernon et al., note that the new definitions of reverse logistics that emerged in the 1990s not only described reverse flow, but also emphasized the activities of this flow, such as disposal, remanufacturing, and remanufacturing, reuse [1].

Rogers and Tibben-Lembke stated that reverse logistics refers to the movement of materials and products from their normal destination to capture or gain value from the materials and products or dispose of them properly [18]. This means that end-use materials are treated as valuable industrial nutrients and not as waste.

Analyzing the activities carried out in the context of reverse logistics and closed-loop supply chain, activities mentioned by various authors can be observed, which are also attributed to closed-loop supply chain and separate reverse logistics. Bernon et al. distinguishes the following activities when defining reverse logistics: the management action of logistics functions, reuse and recovery actions, distribution, value recovery (recapturing values), reverse flow or return, where the return can be when products are cancelled, returned due to repair or renewal, and due to excess products [1]. In turn, Govindan and Bouzono distinguished reverse logistics activities aimed at extracting value from returned products - these are: collection, inspection and separation, reprocessing, disposal, and redistribution [6].

There is no unified agreed list of reverse logistics activities; activities can be broken down and supplemented by other processes that contribute to the goals of reverse logistics. The reverse supply chain and reverse logistics activities collected in Table 1 show the complexity and interdependence of these processes.

After evaluating the closed-loop supply chain and reverse logistics activities discussed in the scientific literature, we see that the activities are intertwined and there is no clear separation, which activities should be treated only as closed-loop supply chain activities and which are classified only as reverse logistics activities. It is therefore not surprising that some authors use the concepts of closed-loop supply chain and reverse logistics interchangeably. This is also because some activities may be performed at different points/stages of the closed-loop supply chain, and some activities may be performed multiple times, at different points in the closed-loop supply chain, and at different times, with different purposes (e.g., transportation/checking/sorting).

To ensure the implementation of circular economy principles in a closed-loop supply chain, a theoretical model of reverse logistics activity in a closed-loop supply chain can be created by performing selected basic functions of reverse logistics (see Fig. 2).

Table 1. Activities classified as reverse logistics and closed-loop supply chain.

Activity	Closed loop SC	Reverse logistics
Collection/acquisition	Defee et al., (2009)	Fleischmann et al., (2000)
Presorting/disposition	Defee et al., (2009)	Goltsos et al., (2019)
Inspection	Defee et al., (2009);	Fleischmann et al., (2000)
Sorting out	Guide Jr., Van Wassenhove, (2002)	Fleischmann et al., (2000)
Separation/extraction	Guide Jr., Van Wassenhove, (2002)	Fleischmann et al., (2000)
Transportation	Guide Jr., Van Wassenhove, (2002)	Fleischmann et al., (2000)
Storing/storaging	Guide Jr., Van Wassenhove, (2002)	Fleischmann et al., (2000)
Reprocessing	Guide Jr., Van Wassenhove, (2002)	Fleischmann et al., (2000)
Distribution	Guide Jr., Van Wassenhove, (2002)	Bernonas et al., (2018);
Return		Bernonas et al., (2018)
Returns management		Bernonas et al., (2018)
Recovery	Defee et al., (2009);	Bernonas et al., (2018)
Repairing/maintenance	Defee et al., (2009);	Fleischmann et al., (2000) Bernonas et al., (2018)
Refurbishing/reconditioning	Guide Jr., Van Wassenhove, (2002)	Fleischmann et al., (2000) Bernonas et al., (2018)
Recycling		Fleischmann et al., (2000) Bernonas et al., (2018)
Disassembly		Fleischmann et al., (2000)
Shredding		Fleischmann et al., (2000)
Remanufacturing	Guide Jr., Van Wassenhove, (2002) Defee et al., (2009)	
Reassembly		Fleischmann et al., (2000)
Product testing		Fleischmann et al., (2000)
Repacking/repackaging		Fleischmann et al., (2000)
Reuse	Guide Jr., Van Wassenhove, (2002)	Bernonas et al., (2018)
Cleaning		Fleischmann et al., (2000)
Waste management		Fleischmann et al., (2000)
Remarketing	Defee et al., (2009)	Remarketing
Resale	Defee et al., (2009)	
Disposal	Guide Jr., Van Wassenhove, (2002)	Bernonas et al., (2018)

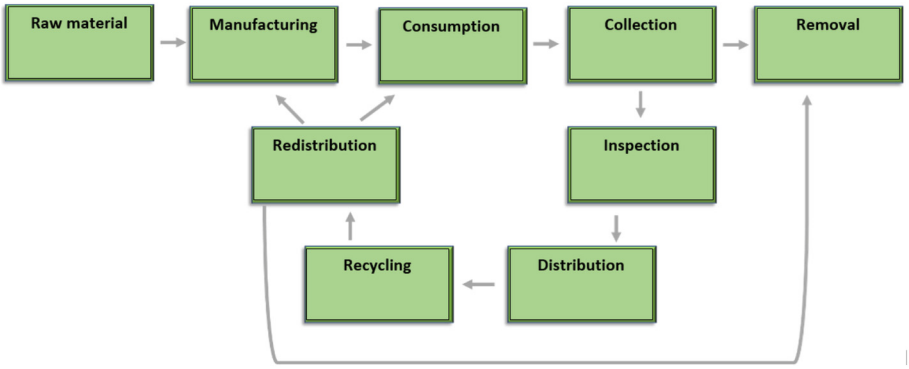

Fig. 2. Reverse logistics activity model in a closed-loop supply chain [2].

4 Challenges of Implementation of Reverse Logistics Activities

Reverse logistics is becoming an increasingly used practice to close the loop and become part of a closed-loop (annular) supply chain. According to Govindan and Bouzon, as in many fields, in reverse logistics, there are many factors that influence the successful implementation of reverse logistics. Some factors can determine/accelerate the implementation of reverse logistics, while others, on the contrary, can slow it down. The factors identified by them form a circle of success for the successful implementation of reverse logistics, where each factor has influence on the other factor.

Economic benefit and financial situation. Benefits can be direct or indirect. Direct benefits are achieved when materials are returned to the process, reducing the need for raw materials and returning value to the product. The indirect benefit of improving a company's social image is by attracting attention and attracting consumers. However, the company's limited financial resources can limit the implementation of reverse logistics, and too little understanding of the benefits of reverse processes (direct and indirect) can stop companies from obtaining economic benefits.

Legal framework or legislation. These factors are considered mandatory for companies, as they regulate and establish environmental requirements and other restrictions or instructions of activity. The absence of a legal base or unclear regulation are considered obstacles to achieving the goals of reverse logistics. Also, the introduction of the legal framework can result in an increased financial burden on the company to meet the requirements.

Corporate social responsibility. Improving social life and fostering environmental protection is one of the success factors of the company's activities, often in the long term. In this way, companies not only contribute to the development of sustainability, improve their image, but also attract users/customers who support it. Customer expectations for the company (to be socially responsible) are also one of the factors that force the company to choose the path of reverse logistics implementation, which in turn can cause the company's financial burden.

Leadership and management. The participation of the company's top management in the processes of implementation of the reverse logistics system can be a stimulating factor, and the absence of this leadership, in contrast, can stop these processes.

In turn, the authors mentioned in their article single out three areas in which logistics specialists are faced with the challenges of implementing reverse logistics:

Communication or communication challenges. For a company that implements the principles of a circular economy through the processes of a reverse logistics system, it is very important to properly communicate both with customers and with suppliers who provide the company with various raw materials and products. Even poor communication within the company can have a negative impact on processes.

Information challenges. Information is of great importance in the reverse logistics system. To prepare the process of reverse logistics, to manage it properly, it is necessary to have the right information, which allows you to see and evaluate demand and consumption needs, information on used and returned products, material and product movement times, their movement costs, restoration, and write-off costs. Information collection and processing becomes an essential factor in a successful reverse logistics system.

Process-driven challenges. In short, it is the absence of a standard process/system for reverse logistics. Since reverse logistics is a relatively new field, companies often tend to treat reverse logistics as direct logistics - only the other way around. This is a fundamental mistake. Reverse logistics must be built and designed from the very beginning of the operational process, considering all the contributions of the participants of the reverse logistics system. Undoubtedly, to evaluate the activity of such a created chain, criteria must also be created for evaluating the processes of the reverse logistics system for this. Therefore, from the beginning of the process, the company's employees, customers, and partners must have a clear picture of how the reverse logistics system works and how its processes are evaluated. Such a reverse logistics system must be standardized and approved within the company.

5 Conclusions

The circular economy is a social, environmental, and economic paradigm that pursues multifaceted goals - it encourages protecting the environment, saving materials, and creating additional jobs. To ensure the sustainability of the European Union economy, to turn climate and environmental problems into economic opportunities, companies are encouraged to switch to a clean circular economy.

The circular economy strongly depends on closed-loop supply chains that have the purpose of closing resources in the supply chain ring to achieve the highest level of material efficiency. To do so, the closed-loop supply chain must consist of several processes: product acquisition, reverse logistics, inspection and disposition, reordering, reconditioning, distribution and sales.

In order to maintain the value of assets in the supply chain as long as possible, it is necessary to ensure the operation of a closed-loop supply chain, where reverse logistics activities have a great influence. The success of these reverse activities is nothing more than a properly arranged model of the reverse logistics system, clear responsibilities, and resources of the participants of this model.

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