

## THE IMPORTANCE OF THE CIRCULAR ECONOMY FOR REVERSE LOGISTICS SYSTEMS IMPROVEMENT

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### Abstract

Article presents the relationships between the circular economy and reverse logistic with a particular emphasis on the role of processes in reverse logistics and circular economy principles in the creation of closed loop supply chains. The main links between reverse logistic and circular economy were identified on the basis of a literature review. The main found of the analysis is the conclusion that circular economy concept is broader than reverse logistic, because it is not only covers the reverse flows but also the forward flows in supply chains with several unique characteristics and services.

**Keywords:** Circular economy, reverse logistic, logistic system, closed loop supply chain

### 1. INTRODUCTION

Dynamic social and economic development means that the amount of produced material goods that have to meet different needs is growing. The consequence of that is a huge amount of waste generated both during the production of these goods and after they have been used, as well as the growing demand for raw materials. As the technology develops, the diversity and properties of the increasing amount of waste change. Some of that waste is directed to landfills due to its state and level of wear. The rest, which still has some value, is recovered in order to recycle its components, materials and raw materials or energy. The size and diversity of the material and information streams cause a problem with management of the growing number of returned goods, including those qualified as waste. This ceased to be a matter of a single user and became a global problem a long time ago, therefore it is necessary to introduce systemic solutions. The result is an intense interest in reverse logistics, which has so far focused on the broadly understood entrepreneurial ecology and now has become the source of a concept for a broader approach to the problem of goods returned from the market and a search for management solutions to control their flows. The main goal of reverse logistics is to shape the flows of all kinds of materials and products in the opposite direction to the flows in the classic approach, to reduce the amount of generated waste, minimize the negative impact of waste on the natural environment and to effectively use waste that can be recycled. In connection with the introduction of the circular economy paradigm, reverse logistics becomes one of the key concepts that enable creation of the systems that capture and segment products at the end of their life with the intention of keeping salvageable materials and products in the circular system, allowing a higher level of material recovery and use [1,2]. The aim of the article is to present the relationships between circular economy and reverse logistic with a particular emphasis on the role of processes in reverse logistics and circular economy principles in the creation of closed loop supply chains.

### 2. REVERSE LOGISTIC SYSTEM

The concept of reverse logistics has not been clearly defined in the literature so far, which results in an abundance of terms describing it. The most commonly used ones are: recirculation logistics, recovery logistics, ecological studies, utilization logistics, reverse logistics, and even retro logistics. The development of this concept is attributed primarily to the changing laws, increased consumer awareness and limited access to resources and raw materials, and thus the growing costs of obtaining them [3]. Among the many definitions of reverse logistics (**Table 1**), the emphasis is both on the fact that it concerns the opposite direction of the flow



of goods that still have some value and the fact that it focuses on the management of finished goods [4-6], and information to recapture value or proper disposal. As the main goal of the undertaken activities, Rogers [7] points out material reuse and respect for the environmental [5,8].

**Table 1** Definitions of reverse logistic [own study]

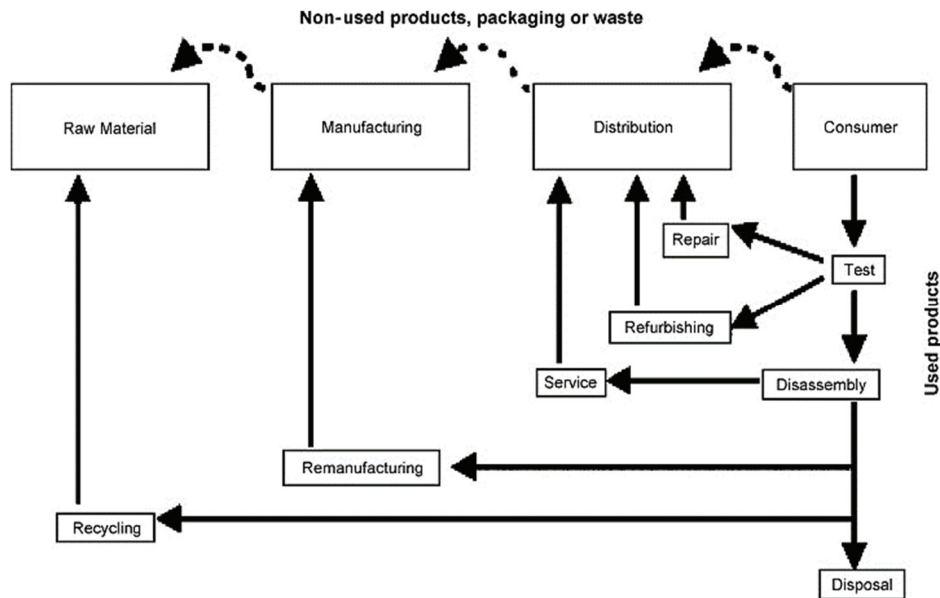
Author/source	Definition	Charakteristic
Fleischman et. al. [9]	A process which encompasses the logistics activities all the way from used products no longer required by the user to products again usable in a market	<ul style="list-style-type: none"> <li>• Focus on the re-capturing of product value,</li> <li>• encompasses all logistic activities from point of consumption,</li> <li>• the objective of reverse logistic is to capture value from returned products.</li> </ul>
Rogers and Tibben-Lembke [7]	The process of planning, implementing and controlling the efficient, cost-effective flow of raw materials, in process inventory, finished goods and related information from the point of consumption to the point of origin for purpose of recapturing value or proper disposal	<ul style="list-style-type: none"> <li>• Focus on efficiency logistics activities,</li> <li>• encompasses all backwards flows of material and information,</li> <li>• the objective of reverse logistic is recapturing value or disposal of gods.</li> </ul>
The Reverse Logistics Association [10]	All activity associated with a product/service after the point of sale, the ultimate goal to optimize or make more efficient aftermarket activity, thus saving money and environmental resources.	<ul style="list-style-type: none"> <li>• Focus on efficiency of aftermarket activities,</li> <li>• encompasses all activities after a product has been sold,</li> <li>• the objective of reverse logistic is reducing costs and negative environmental impacts.</li> </ul>
Council of Supply Chain Management Professionals [11]	A specialized segment of logistics focusing on the movement and management of products and resources after the sale and after delivery to the customer. Includes products returns for repair and/or credit.	<ul style="list-style-type: none"> <li>• Focus in management on the management of aftermarket activities,</li> <li>• encompasses the management and movement of goods and resources,</li> <li>• the objective of reverse logistic is effective management.</li> </ul>

Reverse logistics begins where traditional material flows end; its aim is to create an added value resulting from the management of waste generated at each stage of the value creation chain. The implementation of reverse logistics tasks takes place as part of reverse supply chains, which usually involve other entities than in traditional chains and other activities than usually carried out. In return logistics, used materials constitute the flow and thus it can be perceived as a new form of waste disposal, based on two mutually complementary reasons: ecology and economics [12].

The following process characteristics of reverse logistics are mentioned in the literature [13]:

- repair and re-use - re-inclusion of the unaltered product into the system, its quality may be lower than the new product;
- renovation (renewal) - i.e. restoration of adequate quality of the used products by their disassembly, inspection, and replacement of damaged parts, as well as technological upgrades, which means replacement of obsolete modules and components with technologically better and more modern ones;
- regeneration - restoration of the quality of used products corresponding to the quality required for new products through complete disassembly, detailed repair and replacement of obsolete parts;
- cannibalization - recovery of a relatively small number of parts and modules from the used product and subjecting them to the process of repair, renovation or regeneration;
- recycling - recyclable materials present in the used products are processed to obtain materials for primary or other purposes.

The basic components of the reverse logistics system are: collection, sorting, processing, and design of the distribution and logistics network for returned goods. The reverse logistics systems are a component of existing logistics structures. The conceptual approach to the reverse logistics system, including the implemented processes, is shown in **Figure 1**.



**Figure 1** Processes in reverse logistic system [5,9]

Reverse logistics is significantly different from the traditional approach. It is often accidental in nature, as the amount of returned goods is not fully estimated beforehand. Moreover, it is not certain when they will appear, what will be the degree of their wear, what processes they will be subjected to, and at which stage of the return supply chain they will eventually be used [3,14]. In return logistics, transportation and labour costs are much higher, as the collection takes place from dispersed sources and the products are obtained as a result of manual disassembly. There is also a need to cooperate with the customer who must hand the goods back to the carrier or bring them directly to a collection point. All products flowing in the return logistics chain have a lower value in relation to the initial ones.

### 3. INTEGRATION OF REVERSE LOGISTIC WITH THE CIRCULAR ECONOMY CONCEPT

The traditional linear model of the economy is based on a large amount of easily available resources and energy. The measures currently undertaken to reduce the use of resources and energy (from conventional sources) do not change the nature of the final products. That is why it is so important to undertake further activities that are related to switching the energy sources to renewable ones. They should also contribute to a significant reduction of resource and raw material consumption, but most of all they should implement actions aimed at such design and use of products that will extend their lifetime many times and will enable their reuse after the end of their life, which will reduce the amount of waste. The concept that responds to these demands is a circular economy [1]. It derives from research into nonlinear systems and it captures and manages material flows in a holistic manner. According to the European Commission [15], in the circular economy principle, the value of products, materials, and resources in the economy is maintained for as long as possible and waste production is minimized. The circular economy is also considered a development strategy that enables economic growth while optimizing the use of resources, leading to a deep reconfiguration of supply chains. The circular economy is, therefore, a new concept of creating value built on the rational use of resources [16]. It allows to minimize the negative environmental impact of manufactured products due to such changes at all stages of the life cycle of a product which enable reuse of the implemented materials. This concept is related

to the cradle-to-cradle concept (C2C), which is a way of designing and manufacturing products that is consistent with the concept of sustainable development and allows them to be re-incorporated after completion to the economic cycle [17]. According to the Ellen MacArthur Foundation [1], circular economy means that the product design ensures the possibility of its repair, regeneration and maintains the highest usability and value of products, components, and materials at all times, while distinguishing between technical (regarding non-renewable raw materials) and biological cycles (renewable raw materials). The three fundamental principles of the circular economy are also mentioned: preservation and strengthening of the natural capital, optimization of the use of raw materials, development of the system efficiency.

In logistical terms, reverse logistic derives from some of the activities described in the circular economy. These include repair, refurbishing, disassembly, servicing, remanufacturing, recycling and disposal [1]. The relationships between Circular Economy and Reverse Logistics also includes activities such as collection, maintenance, reuse/redistribution, refurbishing/remanufacturing and recycling. The analyses distinguish between two types of materials: biological and technical types, which shape flows in the economy. The distribution of these materials is conditioned by specific processes leading to their re-use. This chapter also points to the fundamental difference between reverse logistic and circular economy. Reverse logistic focuses on processes related to the flow of technical materials while circular economy covers both types of materials in the forward and back supply chains. Reverse systems are therefore an essential element of the existing and new circular economy systems [18].

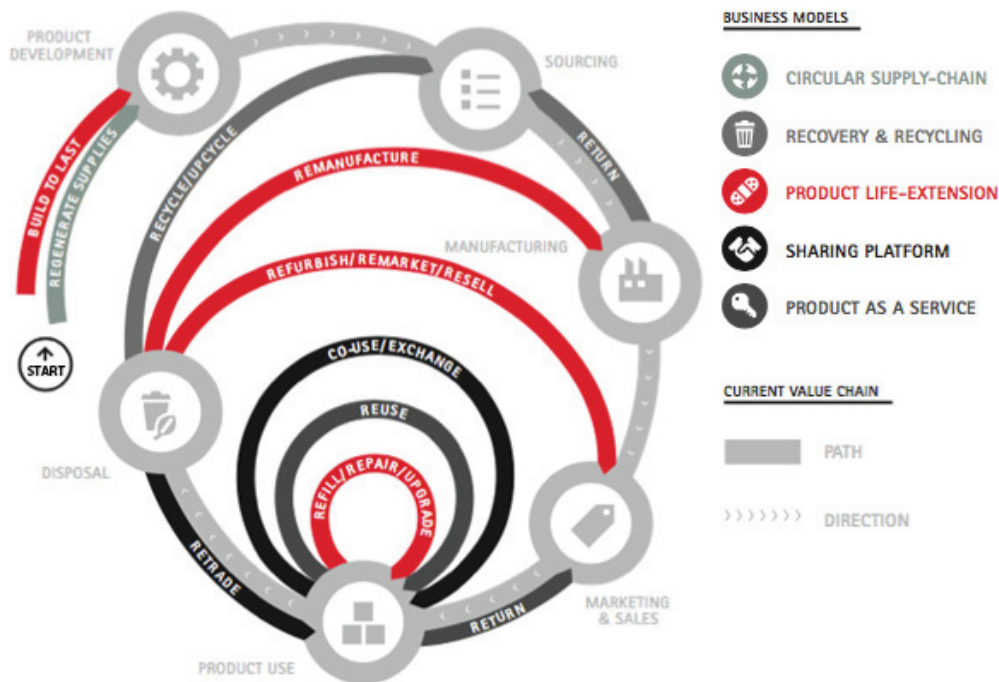
Thus, it can be concluded that reverse cycles are components of logistics are constitute key building blocks of the circular economy [5]. Specifically, they highlight the need for systems that capture and segment products at the end of their life, with the intention of keeping salvageable materials and products in the circular system, which allows for a higher level of material recovery and use [20].

#### 4. CIRCULAR ECONOMY IN CREATION OF A CLOSED LOOP SUPPLY CHAIN

The European Commission [1,15,16] distinguishes the following activities which favor 'loop of the circulation' (the ReSOLVE model):

- regeneration, for example, use of renewable resources, conservation and restoration of ecosystems, return of recovered biological resources to the biosphere,
- exchange, e.g. use of new technologies, new types of transport or substitutes for non-renewable raw materials,
- share, e.g. sharing cars/premises/devices, using second-hand products,
- optimize, e.g. increasing the efficiency of production processes, minimizing the generation of waste, use of large data sets and automation,
- loop, e.g. through recycling,
- virtualize - indirect (e.g. online shopping) and direct virtualization (e.g. books and CDs in a dematerialized version).

A Closed Loop Supply Chain is one of the new business models [21] promoted as part of the circular economy concept (**Figure 2**) [19], which fits in with the activities promoted in the ReSOLVE model and which relies on companies using in their production process the materials that are completely renewable recyclable or biodegradable. It also involves focusing the efforts of companies on management of production residues (by-products and waste) in such a way as to minimize the level of waste transferred to landfills or incinerators. Paying attention to the ecological and economic potential that lies in the waste results from the development of reverse logistic and its integration into the classical supply chain, thanks to which the importance of material flow from the customer to the producer is increased. Establishment of links between traditionally run processes and processes included in reverse logistic constitutes the implementation of the circular economy concept and is an opportunity to respond quickly and efficiently to consumer expectations and needs in the field of recovery.



**Figure 2** Closed loop supply chain among circular logistic business model [22]

A Closed Loop Supply Chain [23] gives companies an opportunity to gain resources that are scarce or have a negative impact on the environment in an alternative way, from already produced but not fully used products. The resources obtained in this way can be used in successive life cycles to reduce costs and increase control over the quality of raw material and the impact of production on the environment. Its effective implementation requires changes in the organizational, material and technical infrastructure of the supply network and also calls for a new approach to the problem of management of supply networks. Until now, those have not been adapted to perform tasks in reverse logistic on such a large scale.

## 5. CONCLUSIONS

The relationship between the circular economy and reverse logistic can be seen in similar activities, general purpose, and some other aspects. Reverse logistics firms have experience in collecting, handling, triaging and bringing products back into the commerce stream. Reverse logistics can help accelerate the adoption and optimization of the circular economy system by sharing the lessons learned by companies handling returns and waste associated with:

- collection and aggregation of products,
- analysis and triage of returned products to determine whether they should be cascaded for another use or broken down into component parts,
- maximizing the recovery and value of component parts,
- seeking and maximizing the value of cascaded products,
- marketing and messaging the value of refurbished and remanufactured products.

However, the circular economy concept is broader than reverse logistic as it is not only covering the reverse sides but also the forward sides with several unique characteristics, for instance, dividing the type of materials with specific treatment, leakage minimization, etc. Reverse logistics is mainly to support maintenance activities related to products and materials in use by working to maximize the number of products recovered, restored and reused. The inclusion of recycled materials into the production supply stream allows to close the material cycle and to obtain a Closed Loop Supply Chain.



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