

## END-OF-USE PRODUCTS IN REVERSE LOGISTICS

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**Abstract:** Reverse logistics is a very useful tool for enterprises which have to deal with end-of-use products. Forward logistics is not able to manage them, because they show up on the beginning of reverse supply chain. That is the reason for growing importance of reverse flows. Reverse logistics is quite new logistics system. This paper presents the idea of reverse logistics and end-of-use products problems.

**Keywords:** logistics, reverse logistics, end-of-use products

Logistics should be treating not only as a theoretical discipline, but also as a practical one. The reason for that are a strong connections between logistics and many others areas of knowledge and economy activities. Logistics might be consider as a discipline and also as an activity which is supporting management of materials, transport, production, distribution or all infrastructure. Also, it can be an important factor for effectiveness assessment or determinant of competitive position.

The most common logistics definition says that it is the part of the supply chain which is connected with planning, implementing, and controlling flows and storage of products, services and related information from the point of origin to the point of consumption in order to meet requirements of customers[3].

The forward logistics processes are characterized by activities concerning flows of goods, their physical movements, materials and products storage and flows of information needed in each economical process and its successful realization[16]. So in very short way traditional logistics consist in delivery the final product to the end consumer.

For past decades enterprises have been using forward logistics processes in their economic performance and their management was fully successful. But since few years forward logistics become insufficient for some parts of management. A lot of companies faced of problems concerning high costs of materials to production, high costs of waste final disposal or problems with return products. Additionally many countries made their law stricter, what became a reason for firms to find some alternative ways to manage their problems.

Such alternative is reverse logistics. In Poland reverse logistics is really new system and not many companies are using its support, but in many other countries reverse logistics is very popular and useful, especially in developed countries. This subsystem of forward logistics is the answer for growing technical and technological innovations, which cause environmental pollution and conflict between growing economy and ecology. Here was necessary to create environmental management where the most important tool is reverse logistics. Their role is to recreate and restore the economical and ecological balance.

Because reverse logistics is quite new system, there are also many different terms in literature, which sound different but mean the same. “Green logistics”, “ecologistics”, “return logistics”, “waste logistics” or “reverse distribution” – all the terms have the same meaning as reverse logistics[12].

The most common definition of reverse logistics is the one made by Council of Logistics Management – this organization also standardize the name. By definition reverse logistics is the term used in connection with the role of logistics in recycling, waste disposal and managing hazardous materials. In wider perspective reverse logistics include all activities connected with logistics and used for reduce, recycling, substitution or reuse materials and final disposition[19].

Farther definition says that reverse logistics is the movement of products or materials in the opposite direction for the purpose of creating or recapturing value, or for proper disposal, so the reverse flows may consist products or packing[15].

Reverse flows are very different from forward flows, the same as different is reverse logistics from forward logistics (see Table 1). The greatest difference between them is, that all processes of reverse logistics are leading inversely.

Planning strongly connected with forecasting in reverse logistics is hardly more difficult than in traditional logistics. Its because usually the demand for new products and materials in forward flows is known and in reverse flows unknown is the returns rates and waste volumes. Also the distribution is harder in reverse logistics. In forward one all products are taken from one distribution place and transporting to sales points. In reverse logistics products and materials are taken from different points and are collected in one distribution place. Than, usually the quality of materials and products in reverse flows is lower than in forward. They might be damaged or just used, what makes necessary to add some more value for them before will be use again [14].

Table 1. Main differences between forward and reverse logistics [7].

<b>FORWARD LOGISTICS</b>	<b>REVERSE LOGISTICS</b>
Quite easy forecasting	Not predictable forecasting
Distribution from one point to many	Distribution from many points to one
Uniform product quality	Different product quality
Uniform product packaging	Damaged product packing
Specified destinations and routes	Not specified destinations and routes
Specified decision options	Not specified decision options
Uniform pricing	Pricing depends on many factors
Speed importance	Speed is not necessary
Clear costs of distribution	Costs of distribution less visible
Consistent inventory management	Not consistent inventory management
Controllability product life cycle	Complexity of product life cycle
Easy negotiations in supply chain	Complicated negotiations in supply chain
Well-known marketing methods	Complicated marketing by many factors
Large transparency of processes	Small transparency of processes

Reverse logistics characterization is quite hard because of the differentiation reverse processes in comparison with forward logistics. Reverse logistics system has its beginning when the used products are coming back to the supply chain or when some kinds of wastes show up in the production processes. So reverse logistics processes are strongly connected with production wastes or returned products. To make sure that after creation of reverse logistics system in the company there will be the stable flow of used products or wastes, there are forming special organizations, like collection centers, which collect and manage objects for reverse logistics and reverse flows. Than the objects are selected, what means the control and tests of quality, which products or materials can be remanufacture and reuse. These with very small value are disposing on the landfill. And these, which are still valuable for the enterprise are farther reprocessing and remanufacturing and after depending on this value are using in processes like reusing, repairing, refreshing or recycling. When products are on the end of reverse supply chain, than they can join the beginning of the forward supply chain[6].

Reverse logistics systems take two forms: closed and open loop systems. In a closed loop system companies pull back their products and refurbish and resell or reuse them or recycle them into new products. In an open loop system manufacturers assume responsibility for collecting and finding markets for their products, but do not use the materials themselves[10]. Further it is possible to divide closed loop systems into physical and functional closed loops. In physical closed loops the recovered materials are used by the same user and in functional closed loops they are used for the same functionality. Closed loop supply chains has also been used as a term to denote the holistic view on supply chains combining both forward and reverse logistics[7].

Managing end-of-use products effectively can result in many benefits: improved customer image, input data for development initiatives, material savings and spare parts[18].

Companies can also seek to prevent future legislation by taking a more active stance towards end-of-use products. Leasing products increases flows of used products as companies have to take the leased products back after use. Leasing is becoming more commonplace in industries where products represent an investment for the customer. More and more products are being designed modularly so that they can be upgraded by replacing just a few parts and taking the replaced parts back. In many cases this is also more profitable, as profits are made more and more in supplies and service rather than direct sales[11]. Growing environmental awareness amongst consumers also contributes to the increase in interest as there is increasing demand for products that are made out of used parts[17]. Furthermore consumers may insist that companies take care of end-of-use products.

End-of-use products are basically products that have been used and their original use has been completed. When something is done with the end-of-use products they can be characterized as end-of-use returns, which can be defined as products that are returned after their use is completed[5]. Returning does not imply that products are sent to the original supply chain members, but can also include other specialized players[2].

Reverse logistics in brief refers to managing products that flow backwards in the supply chain. End-of-use products are one type of reverse flow[15].

There are three product characteristics that have a large impact on the organization and profitability of reverse logistics systems: composition, deterioration and use pattern. Related to the composition of products a company needs to determine the different materials in a product, their values and potential hazardous nature. They also need to establish how components are fastened and whether reprocessing is technically feasible. Furthermore the company should find out what the legislative requirements are for each of the materials, components. Related to the composition the number of materials (homogeneity) and how the products are put together (disassemblibility) are keys to determining the costs of disassembly

and reprocessing. Testability is another major factor related to the composition of products. These factors can basically be described as the complexity of the product[1].

It may be worthwhile to take recovery into account when designing a product. Depending on the level of desired recovery attention should be paid to[4]:

- a) Redesign for collection (like pallets that can easily be broken down)
- b) Redesign for disassembly (like pallets that can easily be cleaned)
- c) Redesign for maintenance and repair
- d) Redesign for reassembly.

It is possible to divide design issues related to closed loop supply chains to four main areas: avoiding/reducing toxic materials, making disassembly easier, using more homogenous and recycled materials and including information aiding return and reuse[8]. Toxic materials should be avoided because of possible release into the environment. The ease of disassembly is key to making reuse, remanufacturing and recycling profitable e.g. permanent joints inhibit disassembly. Each component designer tends to use the optimal material for their own part, making products complex and recycling more expensive. To aid reuse of components or material recycling, information on product content and components should be added to the products. ISO has even created standards for this kind of labeling. Companies should however keep in mind that making disassembly, repair and reassembly of their products easier for themselves often also makes it the same for others: which may be undesirable[9].

End-of-use products denote flows of goods that are disposed after their use has been completed. It is mainly this group of returns flows that has triggered the interest in reverse logistics in the last ten years. Some authors use the term end-of-life in this case. However end-of-use offers a broader perspective, because products that have come to the end of their original use are not necessarily at the end of their economic or functional life. An example of end-of-use products is for example products that have come to the end of their lease period. End-of-use returns are typically driven by economics, environmental regulation or asset protection. While direct reuse may be impossible in most cases remanufacturing and recycling are typical recovery alternatives[5].

Managing end-of-use products has been studied in the field of reverse logistics, which belongs to supply chain management. Most of the previous work on reverse logistics has focused on environmental issues such as sustainable development or operational issues such as inventory control or network design. In previous literature there is basically one type of returns processes for end-of-use returns: products are collected and recovered and excess products are disposed of or sold as scrap. The drivers for being involved in product recovery are economics, marketing, legislation, and asset recovery. Previous literature discusses three criteria to consider when determining the economic viability of being involved in recovery: product characteristics, infrastructure and reverse flows, markets for reprocessed products, components and materials.

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