Sustainability of reverse logistics

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1 Introduction to the Reverse logistics

The economic goals but an accumulation of waste, growing of waste dumps and related legislation on waste collection and elimination have motivated the development of reverse logistics. The producers also started to perceive the benefits of reusing or recycling their products. Management of these processes can be supported by different quantitative approaches, from which very effective seem to be mathematical models. In this article we mention the possibilities of balance model of reverse logistics.

Why is reverse logistics the most important for today in many companies in the world? The main task of reverse logistics "collection, sorting, dismantling and processing of the products, components, by-products, surplus stocks and circulating material where the main aim is to ensure the new use or material recovery in a manner that is environmentally friendly and economically interesting."

The results of Reverse logistics and its priorities in company are, on the one hand, for example minimization of return flows associated with the claimed goods, the other is a wise use of returnable packaging "upgrade" products, the processing or resale.

For optimum solution must be taken into account and the whole emphasis on optimizing the whole instead of partial optimization of logistics subsystems. The importance of reverse logistics, therefore, cannot be underestimated and, together with the analysis leading logistics can help to optimize logistics as a whole.

2 Theoretical part

Analysis: Sustainability of Reverse logistics

Sustainability of reverse logistics is associated with an effort to use the value of things maximally. It is based on economic and ecological thinking of people. In recent year, new modern processes and technologies have been developed, which contributed to development of reverse logistics. The first written works connected with reverse logistics are dated to 1990s. However, these works did not deal with ecological impact. They mostly solved only problem of claims of the goods and their impact on total costs of the company. The result of this thinking was that hazardous substances were often put to the waste dumps.

Two streams prevailed in the literature, which put emphasis on a different side of reverse flow management and on different subject matter. Currently, reverse logistics tries to combine economic and ecologic targets. Its main effort is to reduce wastage of sources by extending of product lifetime. Sustainability development of reverse logistics was to a great extent influenced by the development of internet sales, which deals with much greater share of returned products as in traditional sales in the stores. It is possible to presuppose that together with development of internet technologies and growing confidence of potential customers in internet sales, material flows connected with reverse logistics will grow.

Nowadays, sustainability of reverse logistics tries to combine economic and ecological targets and its main aim is to reduce wastage of sources by extending of lifetime of products or their parts. An indicator of rate of growth of profit and decrease of storage and combustion of waste is used to measure the success of reverse logistics in the plant, however, from the perspective of state it is considered as indirect indicator. Reverse logistics is relatively new field, only 10-15 years old of research based mainly on experiences, where a specification of precise processes depends on many factors. In contrast to the traditional logistics, the reverse logistics deals with a process of reverse obtaining of goods, that are subject of claims, consumed products and used packing, or the handling units back from the customer to the dealer or companies charged with their treatment. So it is an opposite process than process in the classic supply chain. The main aim of sustainability is to provide new utilization or material assessment of products that are objectives of the reverse logistics regarding the environments and economic profitability.

An important role is played by the sustainability of reverse logistics mainly in branches with high value of goods, or with great share of returned products. E.g. the focus of the company dealing with iron is oriented mainly on the way how to use by-products arising during the production of iron and steel so they can be further used and processed. Production of electronics focuses on creating of products that are easily removable and recyclable, which is connected with their efficient reverse take-back.

Figure 13: Figure1 Reverse logistics in the company

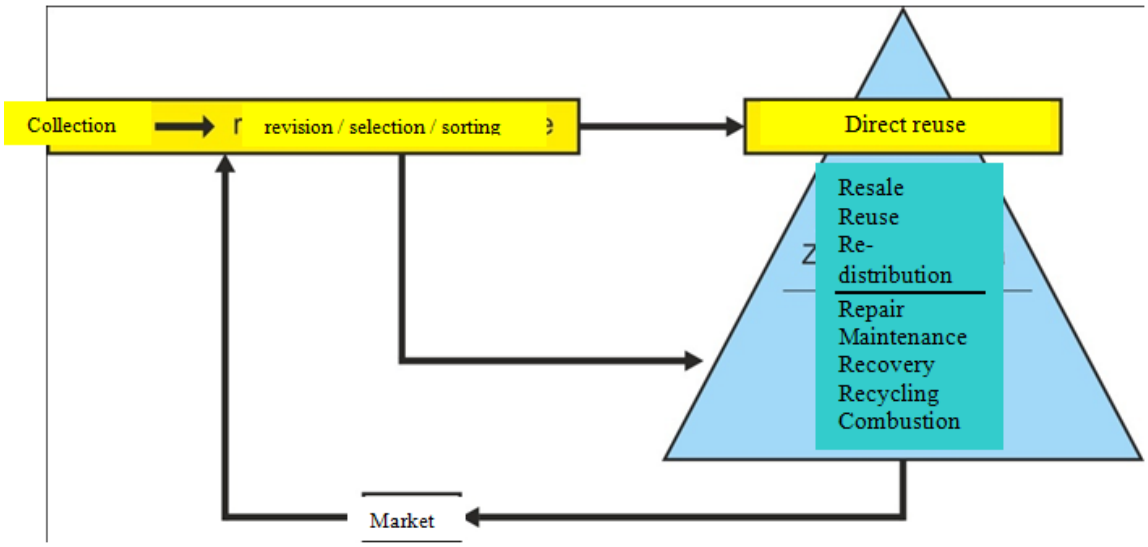
Source: (http://www.blumberg-advisor.com, 2012)

The reverse logistics and its sustainability in the company are influenced by three basic factors:

- **Economy** – For the company it can mean direct profits (reduction of costs, added value form recovery, etc.), indirect profit (ecological trade mark, improvement of relations with the customers, etc.).
- **Legislative** – Legislative related to the environment of the respective country, recycling quotas, etc.

- **Civil associations and foundations** – They can also be driving forces for the companies to participate on recycling of materials and re-utilization of the products.
- **Implementation of Reverse logistics –** Reverse logistics processes also depend on concerned products, therefore it is necessary to take into account the type and characteristic of products that are returned back for their recovery or re-utilization. Characteristics that have to be monitored are the following: composition of the product, level of its deterioration and possibility of use of patterns during processing.

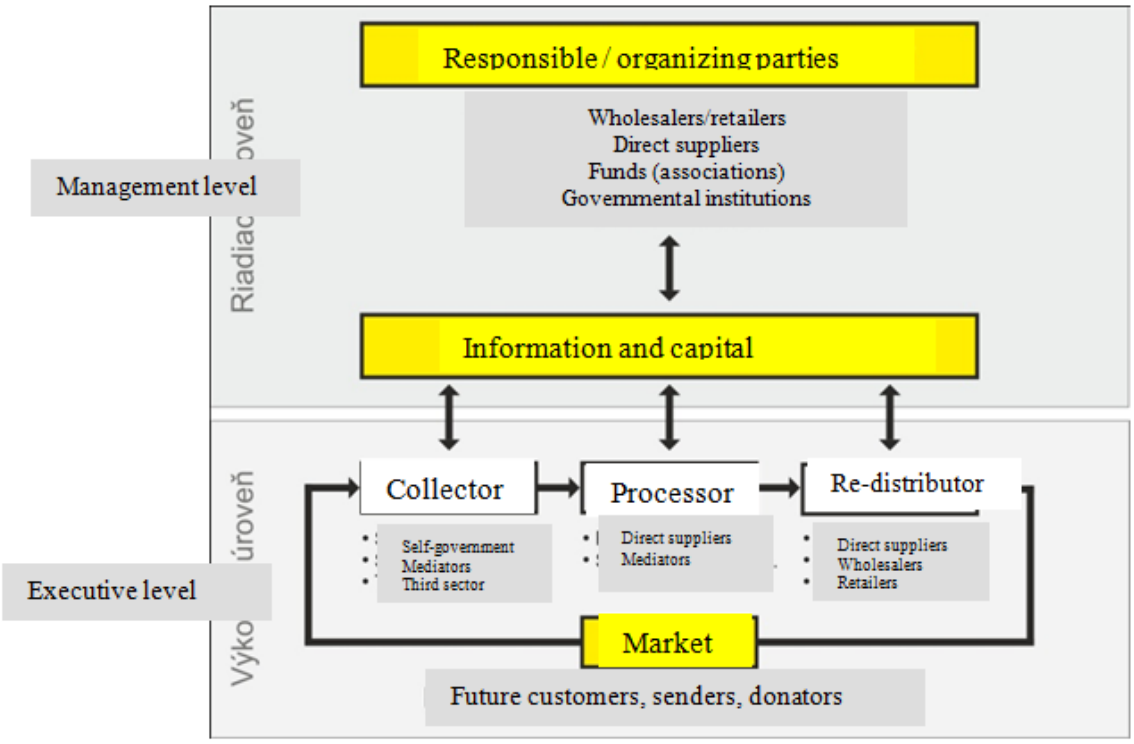
Figure 14: Process of reverse logistics



Sustainability process of products recovery includes phases such as collection of products, when it is necessary to perform inspection of state and classification of products. The results of classification may be groups of products that can be directly put into the use (e.g. excess inventory) or those, which are suitable for reprocessing (total repairs at the level of models, recycling, and combustion process) according to type of the product.

Several subjects participate in processes of the reverse logistics. Producers, wholesalers and retailers belong to the group of subjects that support necessary supply chain for sustainability of environment. For example, mediators and recycling specialized companies belong to the group of subjects that directly specialize in reverse logistics. Opportunistic subjects are e.g. charitable organizations. Also governmental institutions influence these processes in terms of legislative that may be influenced by different foundations and civil associations for sustainability of environment.

Figure 15: Division of management levels in the plant



Source: (Škapa, 2005)

The reverse logistics is closely connected with recycling and waste management of the plant. The aim of environment sustainability is to minimize of waste from production and packaging, which has significant influence on the environment. For this reason, some countries have implemented legislation measures according to which the company has to provide at least partial recycling of its products and packaging. The European Working Group on Reverse Logistics – REVLOG was established in 1998 within the European Union. It deals with projects and qualitative methods for supporting of decision-making in the reverse logistics. This group understands the reverse logistics as an inspection of backward flows of basic materials in such a way they could be repeatedly used and separates the term of reverse logistics from the waste management, which deals with materials that cannot be further used. (http://www.fbk.eur.nl/OZ/REVLOG/, 2012)

Although the reverse logistics has its part on costs, it may be difficult to imagine its impact on profit. It is true that the company more often concentrates on their costs aspect of claims management than on profit one. To achieve success of the company, it is necessary to aggressively manage also this profit aspect. In order to understand the way how the sustainability of reverse logistics can create a value, it is necessary to understand both components of this process - marketing and logistics. Effective processing of claims can improve perception of the product quality by the customer, to minimize purchase risks and reputation of the whole company. Such processing can be achieved by reliable information system.

Advantages for the company arising from sustainability of the reverse logistics can be divided in terms of return (economic benefit). It is mainly production return, where the companies may again use, repair or recover defective or redundant products, redundant material, etc. Then it is distribution return, if it is e.g. withdrawal of a product from the market, unsold or products

damaged during the transport, in redistribution of warehouses, the products which can be renovated and in case of packaging and transport techniques, such as pallets and packaging. Finally, the return is also important for the customer, as far as it consists in warranties, services connected with the product and with use of the product until the end of its lifecycle.

Division of the Reverse Logistics

If we base on institutional point of view, it means on point of view according to institutions that perform individual steps, the logistics is divided to three levels. They are macro level, meta level and micro level.

Macro-logistics represents a view from national economic aspect. This system may be e.g. system of flow of the products or people in the entire economy and its sustainability. The role falling to this level is e.g. sustainability of optimal infrastructure for movement of people and goods. Meta-logistics deals with logistics of the companies cooperating within the chains that form a value. Micro-logistics refers to logistics activities ongoing in the one plant.

The main activities of the reverse logistics may be divided into three main groups according to character of goods:

collecting of goods, which are subjects of claims from the consumer back to the supplier,
waste and material losses connected with production,
collecting of goods from the store back to the supplier.

These are categories of goods, which warranty period expired, which were damaged during the transport, or were not sold and the supplier is obliged to take such goods back.

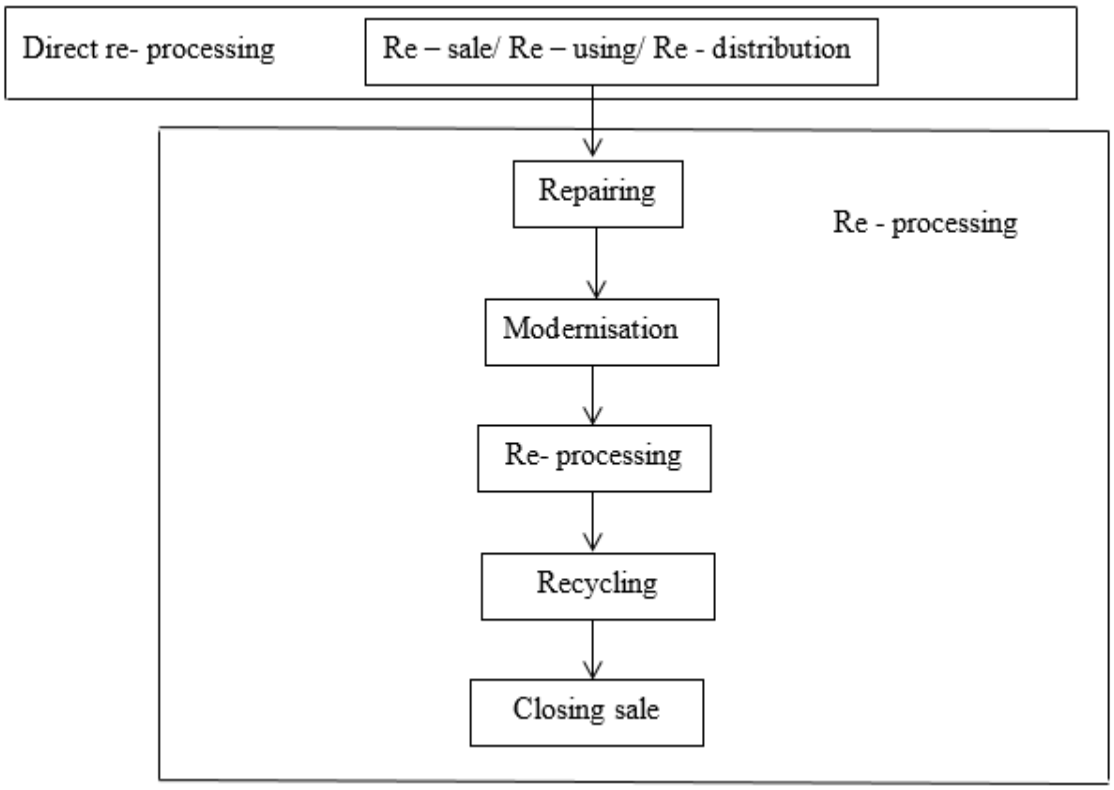
The reverse logistics system is based on four main processes:

- **Gatekeeping** – it means input logistics, which decides on admittance of the passive logistics element (product, material) into the system of reverse logistics.
- **Collection** – collecting of products and materials for their further processing.
- **Sorting and Separation** – materials are divided according to the way of their further processing.
- **Disposition/Re-processing** – products are processed according to character and reason of their admittance into the back flow; it includes repair, dismantling of further used components, recycling and deposition in the dumping site or combustion.

Modelling of reverse logistics in choose company in Slovakia

The Reverse logistics has object with its basic elements, cooperation with it and then we could tell about inverted pyramid. (Dekker, 2004)

Figure 16: The process of reverse logistics



The objective model of reverse logistics is primarily balancing and optimization material flows only from producer to final consumer, as well as the reverse material flows in the opposite direction from the consumer back to the manufacturer. These models are usually designed to return the product within its reuse (distribution to other consumers Resale - Networks for Re-Use / Re-Distribution / Re-Sale) or the product is returned to the manufacturer because of its remaking, innovation or change package (Networks for Remanufacturing / Re-Design). The content is also recycling, but not with regard to the environment, but in order to use raw materials for re-production (Networks for Recycling). (Dekker, 2004)
Further processing and manipulation with the product is determined mainly by its properties, such as: construction features – simplicity of disassembly, homogeneity of separate parts of the products, presence of dangerous substances, simplicity of transport, way of use - intensity and length of use, lifetime of the product – rate of moral obsolescence and depreciation of the product and its individual parts, repair ability.

Ways of further processing of returned goods:
Recycling – disassembling of the product and reuse of treatable parts.
Repair – removal of defects of the product and its putting into working condition.
Re-processing – inspection of separate parts of the product and replacing of damaged parts by the new ones.
Upgrade – more complicated than repair, but the product gains better quality and value.
Direct rescue – direct use without any repairs.
Cannibalization – dismantling of the product, functional parts are used for replacing of the same broken parts of other product.

3 Case study in choose companies in Slovakia
HOPI s.r.o. has implemented and certified environmental management system pursuant to ČSN EN ISO 14001:2005. This certification covers the following activities: warehousing, assembly,

cross-docking operations, purchase and sale, transportation of dry, chilled and frozen goods throughout the entire HOPI in the Czech Republic and Slovakia. (http://www.hopi.cz/en/o-nas/environmentalni-strategie, 2014)

Waste heat utilisation:

- The side effect of the compressors of the cooling systems is heat
- We are capable to utilise this heat to keep our administrative buildings warm
- We use the waste heat to pre-heat service water
- Lighting
- We are gradually replacing old lights with new, more efficient models
- We are using new reflective surface technology
- We are installing movement sensors in order to increase lighting efficiency

Solar energy:

- Our solar power plant allows us to utilise solar energy
- The solar power plant is installed on the roofs of our company´s warehouses
- As such, we do not occupy any arable land to operate our solar power plant
- We generate electricity for our own consumption
- We reduce the burden on the distribution network
- Support of the forest planting
- We purchase paper from a supplier who supports the "TREES FOR LIFE" programme
- This supplier plants 1 tree for every 10 cartons of paper sold
- In this way, we are able to support the planting of approximately 700 trees every year

Transportation:

- We update our fleet with vehicles meeting EURO 5 and 6 standards
- We have a wide-ranging fleet of assorted tonnage
- We lower the number of vehicles by optimising the transportation process
- We save fuel by optimising transportation
- We train our drivers to drive economically

Waste:

- We actively reduce the generation of waste and packaging
- We sort our waste
- We offer our waste for further processing
- We use packaging machines – thus saving foil
- We are a part of the REMA system – "Green Company" (collection and subsequent recycling of old electrical appliances)

4 Case study for these ways of returned goods by Operator "Green dot"

This system enables us to use the GREEN DOT registered trademark on the packages of all IKEA products. Thanks to the GREEN DOT system our Company has a guarantee of separate packaging waste collection, recovery and recycling, and last but not least, of environmental education of the Slovak population and promotion of separate waste collection in municipalities.

At **Nestlé** we do all we can to be friendly to the environment. This includes our responsibility for the packages of our products after their life cycle. In Slovakia, the authorized organization ENVI-PAK takes care of our packaging waste collection, recovery and recycling. ENVI-PAK has developed a modern European packaging waste management scheme that is based on a shared responsibility of subjects involved in the waste management chain: from packaging producers, retailers, customers, collection companies to recycling companies.

We realize that the association of obliged persons in an authorized organization is a guarantee of their compliance with their regulatory duties in relation to packaging, thus preventing the introduction of environmental taxes and/or fees. Authorized organizations at the same time conduct awareness campaigns and play a preventative role by motivating obliged persons to be socially responsible in doing their business.

From the beginning of its operation **Xella Slovensko** has declared that its products are not only state of the art in terms of technology, but at the same time friendly to the environment. Since June 2007 this effort has been reflected in our participation in the GREEN DOT system. Xella Slovensko through the authorized organization ENVI-PAK takes part in a system with precisely defined rules of take-back, recovery and recycling of packaging waste that is fully in line with the European Directive 94/62/EC concerning packages and packaging waste.

Coca-Cola bottle products in various packages based on our customers' preferences including glass bottles, aluminum cans, combined and plastic packages. An important element of environmental protection is the sorting and recycling of these packages, and therefore packages of all our beverages are recyclable. Packaging waste makes up approximately 30% of all municipal waste. ENVI-PAK meets and even far exceeds the packaging waste recycling and recovery limits on our behalf. It would be virtually impossible to meet the packaging waste recycling and recovery limits without a thorough waste separation in the municipalities.

Kofola is responsible in relation to its products in all stages of their life cycle, including disposal of packaging waste from our beverages. That is why we have been for many years a Client of the authorized organization ENVI-PAK that not only takes care of our statutory duties under the packaging legislation in a comprehensive manner, but has effectively developed a separate packaging waste collection system in Slovakia.

Pepsi fills its beverages in different packages designed to protect the tasty content and at the same time to be as environmentally friendly as possible. We combine the reduction and recycling principles to minimize our negative environmental impacts. We use less material to manufacture the packages, and we take care that all our packages are fully recyclable. The authorized organization ENVI-PAK is in charge of the take-back and recycling of our product packages in Slovakia. Thanks to its international background, stability and professionalism we have a guarantee to meet our duties in line with the applicable Slovak legislation. Most of our products end up in the hands of end consumers and packages end up in the waste that is the responsibility of the municipalities. Since in 2009 municipalities faced problems in maintaining their separate waste collection schemes, we appreciate that it was ENVI-PAK who gave them a helping hand by giving municipalities direct payments for all separately collected packages. Our recognition goes to ENVI-PAK also for conducting awareness-raising and education campaigns and for promoting separate waste collection among the general public.

This is true in relation to the meeting of our statutory recycling and recovery limits duties that we have always exceeded, which reassures us that METRO has been meeting its environmental obligations, as well as in relation to the great cooperation in the field of legislation, legislative amendments, consulting, seminars, etc. Moreover, ENVI-PAK has been cooperating with municipalities, conducting environmental protection awareness campaigns, and promotes separate waste collection. We are happy to take part in these projects through ENVI-PAK. (https://www.envipak.sk/en/About-Envipak/Packaging-Waste-References.alej, 2014)

With regard to the environment, the plant with ecological strategy should cope with two basic directions:

Production of ecological products – to develop designs (eco-design) and produce products that will not increase pollution of the environment not only during their use, but also after it. Use of ecological production processes – to design and operate such production, transport, packaging and waste technologies that will not increase pollution of the environment (cleaner technologies).

During implementation of these requirements, the plants cope with traditional problems, which have to be solved during development of these products and designing of production, transport, storage and packaging systems (such as functionality, low costs, quality, manufacturability, protective properties during storage and transport, etc.), and the others, such as:

How to design the product for its sustainability, so the waste will be minimized, how to optimally use a recycled source when it enters technical preparation of production, as well as during production itself, transport, during its use and at the end of use. How to design the product for its sustainability, so the subsequent recycling will be simplified under application of the above mentioned approach.

Main principles for sustainability of reverse logistics that have to be used are the following:

- minimizing of consumption of materials (de-materialization of production), material unification, demountable connections of the components in order to minimize consumption of dangerous materials, easy separation of dangerous parts of the products in order to optimize use of materials from renewable sources, optimization of use of recycled material elements, maximizing of components lifetime (key components of the product), reduction of energy severity of production in order to minimize emissions,
- minimizing of danger of waste creation, to gain, evaluate and provide objective indicators about recycled materials in the form of national database/stock-exchange of recycled materials with a focus on functional (composition, properties, alternative application areas), environmental (impacts on environment during their acquiring) and economic indicators (prices, marketing of recycled materials).

Above mentioned principles need to be solved by a logistics concept as a part of supply, production and distribution logistics, particularly its specific part – reverse logistics (pre-recycling and recycling). This has to be solved throughout the entire logistics chain simultaneously at all supply levels, in all strategies of the plants in order to achieve new forms of performing of business and to obtain competitive advantage of the entire chain organization, and so of each plant.

There are last few questions that need to be discussed:

- most of the working processes, organization structures and implemented plant practices come from the past, from the time before starting of use of information technologies,
- managers like to get rid of the responsibility for these areas and they consign their problems concerning the environment, IS/IT, and thus also implementation of electronic form of carrying on business, to their creative employees in design stages and to informatics,
- designers and informatics do not know processes in the areas of management and carrying on business, or they do not understand them, their knowledge is limited to description of existing state in the way how it is provided by the managers. However, in order to achieve success of designed processes, all these issues have to be resolved for sustainability of environment.

5 Reverse logistics and its impact on the environment

Directive of the European Commission from 24th March, 2009 define the conditions of recycling of plastic packaging and contents of heavy metal concentrations as follows:

- plastic crates and plastic pallets, containing excessive amount of heavy metals are produced or repaired in controlled process of recycling,
- the sum of concentrations of heavy metals in plastic crates and plastic pallets,
- may exceed valid marginal value defined in the Article 11, clause 1 of the directive no. 94/62/EC provided that these crates and pallets are kept in closed and controlled cycle,
- the material used for recycling comes only from other plastic crates or plastic pallets,
- use of another material is technically limited to the minimum necessary amount and in no case it can exceed 20% of the weight,
- plastic crates and plastic pallets, containing excessive amounts of heavy metals are marked in permanent and clearly visible way,
- member states shall ensure that during the lifecycle of respective plastic crates and plastic pallets, at least 90% of dispatched plastic crates and pallets containing excessive amount of heavy metals (as specified in the Article 2) shall be returned back to the producer, packaging company or authorized representative.

Besides this Directive of EC, there are also many other legislative restrictions and modifications related to waste and packaging, published by European Union, as well as by individual member states. It is the most priority for finding results from research oriented on environment and its sustainability in EU.

Recycling of Shipping Containers

Properties of Returned Products

Possibilities of manipulation with returned products are mostly given by their character. According to the authors Brito and Dekker, we recognize three main criteria that are specified below. (Brito Pereira Maduro, 2003)

These criteria are construction characteristics of the product, way of its use and lifetime.

a) Constructional characteristics – for the reverse logistics, mainly the following are determining:
    - simplicity of disassembly,
    - homogeneity of separate parts of the products,
    - presence of dangerous substances,
    - simplicity of transport.
    - All these characteristics influence economic aspect of the reverse logistics.
    - It is essential that these characteristics are determined during preparation of production of respective product.

b) Way of use – it is arrangement of sources of used goods, intensity and length of product use.

c) Lifetime – it deals with the following questions:
    - rate of depreciation of product,
    - ability to repair the product,
    - rate of depreciation of individual parts,

- rate of moral obsolescence.

Example for company produces goods from each kind of material

Waste paper, which is thrown into the blue container, is made of many different kinds of paper. Newspapers are another of the paper as a container for the flour, and these are of course different from the construction paper, which is made from the TV box. Any kind of paper is also processed differently. It is therefore necessary paper collected more separate the individual species. On the sorting line the strip, after which the mixture of paper and moving staff around your waist it collected various kinds of paper. Sometimes it must be selected as the garbage that there wrongly threw irresponsible citizens. Separate paper is compressed into bales and transported to processors in paper mills. There is used for the manufacture of new paper, as well as when the paper is produced from wood. Paper can be recycled five to seven times.
Recycled paper is produced as newspapers, books, cardboard boxes, packaging for eggs, kitchen towels, and toilet paper. (http://www.envipak.sk/sk/ZELENY-BOD/Co-sa-stane-s-odpadom-po-vytriedeni/Papier.alej, 2014)

Glass-recycling
In the production of clear glass must never get into the furnace coloured glass. In addition, there must not get any other dirt, metal, ceramic, porcelain, etc. Glass of green waste containers are first sorted and removed the greatest pieces of dirt. Then wander splinters special automatic line, which ensures the purity of separated glass. Coloured or clear glass venturing into processing glassworks. There are shards of treated produce new glass containers, which have the same physical, chemical and hygienic properties as if they were made from natural materials. Thanks recycling save a lot of energy and raw materials (eg. Earthy, glass sands) and especially glass can be recycled and used indefinitely. Made of recycled glass is made new mineral and beer bottles, jars and other glass products. (http://www.envipak.sk/sk/ZELENY-BOD/Co-sa-stane-s-odpadom-po-vytriedeni/Sklo.alej, 2014)

From yellow plastic containers are equally graded the sorting line. From a mixture of plastic pilgrim on the belt manually collected PET bottles, plastic film and polystyrene, which have special separate processing. Workers from the belt and throw dirt that plastics do not belong. Categorized types of plastics, including plastic waste mixture remaining after initial sorting, are pressed into bales and taken to the processing of the recycler. The result of recycling plastics lives in most cases so. granulate, which is the starting material for the production of new plastics. Plastics are in fact usually made of small balls of material (grade), which was heated and then pressed into the mould. Raw is actually the same starting material, but that was not created from oil, but from the sorted waste. Retranslates of plastic waste can be found in most new plastic products.

Plastic Raw-plats recycled plastics can produce a number of things:

- From granulate originating from old PET bottles are made new PET bottles.
- Expanded polystyrene insulation is processed into blocks or lightweight concrete and other heat insulation.
- Some mixtures of plastics are processed into new products, such as. building and garden elements such as fences, grass paving or garden composter, noise walls for highways, waste bins and garden furniture.
- From recycled plastic fibres are also produced from them then load rugs or clothing, padding jackets and sleeping bags.

- From plastic bags, sheets or bags are produced films again, waste bags, or become part of an alternative fuel for cement plants and other operations. steel-recycling

Metals in Slovakia graded either separate collection of towns and villages, or collection sites, where citizens can cast metal waste. Technology sorting, cutting, breaking, pressing, briquetting, crushing and similar technologies lead to treatment of scrap metal. Scrap metal is a traditional source of secondary raw materials in ferrous metallurgy, wide application has graded alloy steel. Graded metal wastes migrate into the hut, where they translate. What remained in the waste (such as food scraps or colour canned), burned at 1700 ° C by compression-aluminium. When recycling formed of metal again hardware cans, cans, castings, bars, plates, keys, bicycle frames and other metal products. (http://www.envipak.sk/sk/ZELENY-BOD/Co-sa-stane-s-odpadom-po-vytriedeni/Sklo.alej, 2014)

Among the common wood waste include old pallets, wood processing residues (cuttings, shavings, chips, sawdust), worn wood (posts, sills, packaging, old furniture) and the remains of wooden material (board, plywood, lumber used). First, the wood waste sorts to processors cuttings. After sorting is used to production of paper, board, wood flour, charcoal, wood products in arts and toy industry, production of concrete, lighter fluids, fertilizers and soil improvement, energy production, such as litter for cattle. (http://www.envipak.sk/sk/ZELENY-BOD/Co-sa-stane-s-odpadom-po-vytriedeni/Sklo.alej, 2014)

A container that is used for packaging, protection, handling, supply and presentation of goods from the producer to the user or consumer. Containers are also non-returnable parts of packaging used for the same purposes.

Division of Containers

Consumer Pack
Consumer pack is the immediate protection of the product or a group of products, and in the point of sales it is a commodity unit for the final user or the consumer.

Group Packs
They are intended to form a group of certain number of commodity units at the point of sales regardless of whether they are sold to the final user or consumer. They can also serve as a mean for replenishment of products during the sale. They may be removed from the product without influencing its properties.

Transport (Tercial) Packs
They are intended to simplify handling and transport of certain amount of commodity units or group packs in order to avoid physical damage during manipulation and transport.

Reusable packs
These packs are originally designated to perform minimum number of roads or rotations during their life cycle; they are refilled or used for the same purpose for which they were intended, with or without use of additional products present on the market that enable refilling of the pack. This reusable pack becomes a waste only if it will be not used anymore. Both reusable and not reusable packs have to be unbroken, in original shape and without mechanic impurities when they are returned back.

6 Implementation of Sustainability of Reverse Logistics into the Plant

The reverse logistics is new, continuously developing area and there is only limited amount of information about it. The Council of Logistics Management in USA defines this logistics as following: “It is a process of planning, implementation and control of efficient, costs effective flow of raw materials, intermediate products, finished products and related information from the point of production to the point of consumption in compliance with the requirements of the customer. Difference is in the fact that reverse logistics includes these activities in backward order: “It is a process of planning, implementation and control of efficient, costs effective flow of raw materials, intermediate products, finished products and related information from the point of consumption to the point of production for the purpose of their recovery or disposal.” To be more specific, the reverse logistics is a process of transfer of goods from specific final destination for the purpose of recovery or removal.

Reconstruction or recovery can be also included in definition of the reverse logistics. Redesigning of packaging materials or reducing of air pollution and energy consumption in transport are very important activities, but they should be valued more in the world of "green" logistics. We do not speak about the reverse logistics if any goods or material is not sent “back”. The reverse logistics also includes processing of goods returned due to its damage, seasonal goods, waste, withdrawal of goods and in case of excessive stock. It also includes recycling and activities with dangerous material.

However, awareness of science and art of logistics has been continuously increasing. Great interest in the reverse logistics was provoked additionally. Many companies that did not pay much time and energy to management and understanding of the reverse logistics in the past, started to pay more attention to this subject. These companies have also tested backward operations with the best specialists in the field. Some companies even become ISO certified in backward processes. The third parties specializing on backward processes register great boom of demand for their services.

A conservative estimate is that the reverse logistics has a significant share on logistics costs in the USA. Logistics costs are estimated approximately on the level of 10.7 % of American economy. However, it is not possible to determine accurate number, as far as most companies do not know their extent. According to one research, logistics costs are calculated on the level of 4 % of total logistics costs of the companies. Calculated on % GDP, costs of the reverse logistics form about 0.5 % of total GDP of the USA. Mr. Delaney estimates that logistics costs were $ 862 billion in 1997. (DELANEY, 1998) According to the research of Mr. Rogers and Tibben-Lembke, they were $ 35 billion. (Rogers Dale S., 1998) Sustainability of the reverse logistics is different for each type of industry. It also depends on channels the company uses. However, it is clear that total amount of activities of the reverse logistics is high and it is still increasing. In certain fields of business, the reverse logistics can be critical for the company. Usually companies, where the value of a product is high, or where the ratio of returned products is high, have to do their best to improve backwards processes. The best example is automobile industry. The market of recovered spare parts of the vehicles is estimated on $ 36 billion. For example, 90 – 95 % of total amount of sold starters and alternators for replacement were recovered. (http://en.wi ki pedi a.org/ wi ki / Tyl enol, 2011)

7 Case study

Green Solutions in DHL

The Go green solutions we help our customers to reduce their environmental footprint. This is not only good for the environment; it is also a recognized competitive factor: In the face of climate change and the harmful effects of global warming, consumers increasingly consider environmental issues in their purchasing decisions. This is why many of our business customers

have introduced climate protection goals. The same applies to investors who consult sustainability rankings when looking for viable investment options.

With our global presence and our expertise, our business sectors can support customers in achieving their environmental goals. Our portfolio ranges from individual climate neutral shipments for private customers to the optimization of multinational corporations' entire supply chains. Environmental protection is an integral part of our Group strategy: Back in 2008, we introduced a measurable climate protection target – and were the first logistics provider to do so. By 2020 we want to improve the carbon efficiency of our own transport services and those of our subcontractors by 30 percent compared with the base year 2007. We have taken this approach because we view environmentally friendly and efficient logistics as an opportunity to create value – for our environment, for us as a company and for our customers.
GO GREEN Products and Services

Optimized transport routes, vehicles with alternative drive systems and energy-efficient warehouses: There are many ways to reduce climate-damaging CO2 emissions and other environmental impacts in the transportation and storage of goods.

Working with our customers, we want to leverage this potential. At DHL, we call this GOGREEN. We believe that environmental protection and business success are not just compatible, they are closely interlinked. With our expertise and global presence, we can offer our business customers a broad portfolio of green products and services. By providing detailed Carbon Reports, we show them where they stand in terms of greenhouse gas emissions. Though CO2 emissions have the biggest impact on climate change within logistics we also report other greenhouse gases (GHG) like methane or nitrous oxide. And in accordance to the internationally recognized, cross-sector standard 'Greenhouse Gas Product Lifecycle Accounting and Reporting' we also take upstream emissions into account that originate in the production and transport of fuel and energy.

In our Green Optimization service, we work with customers to identify areas for improvement, and ways to achieve a reduction of greenhouse gas emissions. We analyse our customers' entire logistics chain, and work with them to optimize trade routes and transportation modes. Additionally, we suggest ways to improve their overall environmental performance.

And to compensate for unavoidable emissions, we offer Climate Neutral services. Participating in the voluntary emissions trading scheme, we purchase carbon credits from selected projects, reducing emissions and benefitting local communities. Since January 2014 we do not only offset CO2 but other greenhouse gases like methane or nitrous oxide as well, taking GOGREEN from carbon neutral to climate neutral. Based on the new GHG Protocol for Products we also include upstream emissions from the production and transport of fuels and energy.
(http://www.dhl.sk/en/about_us/green_solutions.html, 2011)

The process of reverse logistics may be divided into 2 basic parts. It depends on the fact, whether the main part of the backward flow consists of products or containers. If it consists of products, high percentage comes from the customers. Total returned products are estimated at about 6 % from all traders. The following table presents values according to separate branches:

Table 4: Percentage of return

Branch	Percentage
Publishing of newspapers	50 %
Publishing of books	20 - 30 %

Distribution of books	10 - 20 %
Postcards	20 - 30 %
Distribution of electronics	10 - 12 %
PC producers	10 - 12 %
Producers of CD-ROM	18 - 25 %
Printers	04 - 08 %
Mass-producers	04 - 15 %
Automobile industry (spare parts)	04 - 06 %
Consumer electronics	04 - 05 %

It is possible to see that numbers are different in different branches. Understanding of management of the reverse flows for more branches is one of the most important tasks. Typical activities of the reverse logistics are processes that the company uses for collection of used, unnecessary or damaged products, as well as packaging and transport materials from the final users or from the seller. When the product returns back to the plant, the plant has several possibilities, from which it can choose - returning back to the supplier, sale through retailers, recycling, regeneration, reuse or recovery. After realization of these activities, the product may be sold as recovered, but not as a new one. When it is not possible to renew the product for different reasons - bad condition, legal consequences, environmental restrictions, etc., the company tries to dispose it at the lowest costs. Packaging materials, which are returned back to the company, are usually used again. Univocal reusable pallets may be used more times before their final disposal. In case that they are damaged only slightly, they are repaired. This may be done directly in the plant or in cooperation with other companies, which main activity if repairing of pallets. In case that the repair is not possible, reusable transport materials have to be disposed. European companies are forced to take back the transport materials of their products by legal regulations. In order to decrease costs, the companies try to use these materials in the largest amount.

In one known case that happened several year ago, McNeil Laboratories – a laboratory division of the company Johnson & Johnson reported very serious threat, when someone had poisoned several people by inserting of cyanide into closed (unopened) bottle of Tylenol (similar to Paralen) – known product of the company Johnson & Johnson. (htt p://en.wi ki pedi a.org/ wi ki /1982_C hi cago_Tyl enol _m urders, 2011) Towards a theory of decoupling: degrees of decoupling in the EU and the case of road traffic in Finland between 1970 and 2001, Transport Policy, 12, pp 137-51)

This shocking and terrible act happened twice within several years. However, when it happened for the second time, the company Johnson & Johnson was prepared. Its system of reverse logistics was perfectly set and the company immediately cleaned all channel with all products that could be poisoned. As far as the company Johnson & Johnson reacted so quickly and with high competence, only three days after the crisis, McNeil Laboratories experienced record sales of all time. No doubt that the public would not react so positively, if the company Johnson & Johnson were not able to withdraw the product from the market so effectively by the system of reverse logistics. It is true that this case is a bit extreme, but it helps us to illustrate that abilities of the reverse logistics can be strategic, and how dramatically they can impact the whole company. (Corson, 1990)

Indications of a problem with returning of a product

Dr. Richard Dawe from Fritz Institute identified six indications of a problem with returning of a product. These indications are:

- returns coming faster than their processing
- large amount of returned products in the warehouse
- unidentified or unauthorized return slips
- unknown total costs of the reverse process
- long-time of cycles
- customers lost trust in repair

When there is large amount of returned goods in the warehouse, it is evident that the problem is in manipulation of the company with return slips. When there are many unauthorized and unidentified products in the company the problem is with management of processes. Amount of unprocessed returns can be easily traced. Unfortunately, according to Dr. Dale some of the above mentioned indications cannot be traced so easily. (Rogers Dale S., 1998)

It is necessary to ensure special handling with return slips. When the company does not monitor individual lengths of processes, there is not any method for determination whether the company is successful in this area or not. One of the greatest challenges of the companies when processing the reverse logistics is insufficient amount of information about the process. Many companies have difficulties with successful realization of the reverse logistics because of real internal and external barriers. In one research 300 responders presented which problems cause difficulties when meeting the tasks of the reverse logistics.

The answers of companies can be divided into the following groups:

- importance of reverse logistics in relation to other issues,
- company policy,
- negatives of the system,
- questions of competition,
- carelessness of management,
- financial resources,
- human resources,
- legal questions.

Only a few of asked companies mentioned in the research that they process their costs spent on reverse logistics on operational level. Regarding the fact that successful completion of reverse logistics´ aim is a problem for many companies, it is evident that many obstacles of the reverse logistics really exist. According to respondents of the research, relative irrelevance of the reverse logistics problems (39.2 %) is the greatest obstacle of correctly managed reverse logistics. These companies stated that the reverse logistics was not their priority. Some companies included into the research mentioned that they have problems with rationalization of costs of the reverse logistics system.

Table 5: Reverse logistics barriers

Barriers	Percentage
Importance of the reverse logistics in relation to other issue	39.2 %
Company policy	35.0 %
Negatives of the system	34.3 %
Competition problems	33.7 %
Carelessness of management	26.8 %
Financial resources	19.0 %
Human resources	19.0 %

Legal questions	14.1 %

This approach changes according to type of the company. E.g. in librarianship, the reverse logistics is not considered as important factor. However, in recent time, high rate of returned goods has forced the publishers to operate in red numbers. It is clear that in long-time perspective, these publishers cannot ignore necessity of good reverse logistics and management any more. The second largest group mentioned by the respondents was limited company policy (35 %). This reaction can be related to carelessness of the management and absence of reverse logistics importance, as well as in connection with company strategy for processing of returned items and unmarketable items. Negatives of the systems are another serious problem for 34 % of respondents. During this research project, only few good systems of the reverse logistics were found. Competition problems (33.7 %) and carelessness of management (26.8 %) also hinder the effort of the reverse logistics. Financial and personnel issue were mentioned as barriers in case of 19 % of respondents. This amount is lower than expected, but, of course, it is not negligible percentage. For most of the companies, consistence of managers and regulations are bigger problem than adequate approach to sources.

Problem that is considered to have the lowest impact on management of the reverse logistics is a problem of legal issues. This finding is in contrary to what was expected. General opinion was that during the last few years most of companies realized reverse logistics mainly because of governmental regulations or pressure of the environmental agencies, and not for economic profit. Although it may be true, legal issues do not seem to be a major problem for most of the companies involved in the research.

8 Case study

Rhenus insists on Sustainability

Protecting the environment is not just a Rhenus marketing strategy – rather it is the result of the logistics services provider's enterprising way of doing business. Rhenus insists on using efficient processes, the shortest routes and handling resources carefully in all its business areas. This enables Rhenus to lower costs, satisfy its customers' requirements and play its part in protecting the environment, all at the same time.

Almost every type of transportation or logistics activity without exception requires energy – whether it is a truck route, forklift truck operations or a crane working at a port – and therefore causes emissions. So Rhenus is continually working to find better solutions: avoiding empty runs, fully exploiting existing facilities, linking modes of transportation in an intelligent manner and using environmentally-friendly means of transportation.
You can discover more here about how Rhenus is playing its part in protecting the environment, about the sustainable logistics concepts that we have already introduced and how Rhenus is supporting its customers in keeping their products' carbon footprint as small as possible.

Contract Logistics

Rhenus places great importance on sustainability when building new logistics centres. All the new buildings are certified according to the German Sustainable Building Council's standards. This means that energy efficiency levels are significantly increased even before the start of operating business. Efficient processes, short distances and the latest technology then reduce energy consumption during business operations. Rhenus also uses other energy-efficient equipment – for example, solar panels (for instance, in Basel, Zaragoza and Weil am Rhein), daylight control systems, electric fork-lift trucks and towing tractors or lightweight trucks. Rhenus took delivery of the first hybrid truck in Germany in the Mercedes Benz innovation fleet in 2011. Rhenus Office Systems is using this vehicle.

Port Logistics

Transporting goods by water is the most environmentally-friendly means of shipping items. And this fact can be measured at Rhenus thanks to the pioneer work performed by Contargo with regard to calculating emissions for inland waterway traffic. Rhenus provides comprehensive low-emission transportation services as the leading provider of inland waterway services and with its dense network of ports (maritime and inland waterway) along Europe's waterways. By deliberating shifting traffic to the waterways, e.g. by using the "Greenliner" at the port of Hamburg, Rhenus skilfully reduces journey times, increases the throughput and eases the pressure on the environment at the same time.

Freight Logistics

The Rhenus network is subject to a process involving continual adjustments and optimisation. This enables the company to achieve the maximum load factors, reduce the number of empty trips and prevent truck delivery runs. As a result of its membership within System Alliance Europe, flows of goods are sent to major conurbations in consolidated form, traffic movements are prevented and this protects the environment and the population. At the same time, Rhenus is certifying more and more business centres in line with DIN EN ISO 14001. An internal environmental benchmark enables best practices to be shared among business centres.

Public Transport

Each trip, which is prevented when people switch from private transport to buses and railway services, benefits the environment and people's health. RhenusVeniro represents attractive, comfortable local public passenger services as an eco-friendly alternative to cars. But while economic growth elsewhere often goes hand in hand with increased environmental pollution, expansion at Veniro creates ecological advantages. Every additional passenger, who can be persuaded to change to public transport as a result of attractive local services, benefits the environment and climate. (http://www.rhenus.com/about-us/company/about-ourselves/sustainability.html, 2011)

Green logistics studies and minimizes impacts of logistics on the environment, e.g. measures impact of a specific type of transport on the environment, tries to decrease energetic and material severity of different logistics activities, is related to certification according to ISO 14000 standard. Some activities of the green logistics belong also to the field of reverse logistics. For example, recovery of used product for its new utilization – it is a subject of interest of both reverse and green logistics. But there are many activities of green logistics that are not related to the reverse logistics, such as reduction of energy consumption, designing of one-off packs with decreased consumption of material, etc.

9 Analysis of European Reverse Logistics

Similarly, as in USA, also in Europe management of the reverse logistics is continuously developing. In questions connected with the environment, it has even better position than USA. However, regarding the customer returning of products, European processes of the reverse logistics are behind the American system. I would like to concentrate on European environmental and **green solution** for products and material disposal. Legislation determining conditions what is allowed to do with the product at the end of its lifecycle and what is not allowed, is approved all over the Europe. For example, in many countries legislation states that the producers are obliged to collect their products at the end of their lifetime. Many specialists think that it is only a matter of time, when the similar regulations will be implemented in USA.

German Acts on Packaging

Act on Packaging from 1991

Any other legislation did not invoke such discussion and did not have such enormous impact in Germany than acts on packaging. It is good to examine German system into more details, as far as it has already been discussed in popular business press and basis for systems in other countries has been formulated. It motivates unsolved question of legislation in USA. In 1991 German Bundesrat (German parliament) approved a decree on packaging. This act ordered the producers to organize reprocessing of reusable packaging materials themselves, while local authorities take care about collection and disposal of remaining waste. According to the act, this activity shall be performed by the companies themselves or they shall enter into contract with someone else.

According to Ackerman (Ackerman, 1997), Act on Packaging from 1991 had four main components established to increase responsibility of the producers for waste:
Producers and suppliers shall accept packaging materials, such as pallets, parcels, etc. and to reuse or recycle them. A retailer shall accept secondary materials, such as external packaging, such as a tube from the tooth paste. The suppliers shall these packaging take back and reuse or recycle them.
For primary materials, such as the tube of the tooth paste, the same principles are applied as for the secondary materials, only in case that the branch implements collection and recycling, what corresponds to strict criteria of the government. Deposit/recovery system is necessary for packaging of drinks, colouring and cleaning agents.

Duals System Deutschland (DSD)

In Order to meet the legislation, 400 companies established Duals System Deutschland with the aim to meet quotas for recycling of different types of packaging set by the government. DSD signed three groups. The first group allowed using of a symbol “Der Grune Punkt” for the producers, which put this symbol on their products. The second group entered into contract with private carriers of waste and waste collectors’ in order to ensure collection of packaging with the system “Der Grune Punkt**.** The third group entered into the contract with industrial organizations that guarantee recycling of the waste.

Green Point Program

This program is the most important priority of DSD. Their logo is called “Der Grune Punkt despite the fact that it is printed in black-white on many packaging. To accept a box by involved carrier of the waste, this box has to contain a symbol of the green point. The company, which wants to use this symbol, has to pay license fee to DSD, what depends on several factors. Fees are based on principle of “producer pays” and they shall take into account cost spent on sorting and recycling of different packaging materials. For example, costs spent on plastics are much higher than costs spent on glass, because of increased costs on sorting and recycling of plastic material. Besides this, it is also necessary to take into account volume of the product. This principle “producer pays” requires that the company, which is responsible for condition of the environment, has to pay for costs on disposal. In the case of packaging, the producer of pack is responsible for costs on recycling and disposal of this pack. It is evident that the consumer will indirectly pay for this expense, but finally that producer is the one, who is responsible.

10 Conclusion

There is a strong trend to force the producers to take back their products all over Europe. In some countries, branches operate on the basis of voluntary principle. The government agreed with the branches on certain objectives, which shall be met by the industrial companies. A reverse logistician has to cope with different problems in different countries and branches. In certain branches the government organizes collection, such as in Swedish accumulator industry.

In some cases, a network of these facilities is organized by the industry itself, such as Swedish automobile industry. In other cases, the companies establish their own centres. There are many versions of money, which are used for paying of these systems. In some cases, the branch bears all expenses; in other cases, the customer pays disposal fees, when he/she buys the product.

Future Trends

Distinguishing of Reverse Logistics

It is clear that still more and more companies will pay significant attention on reverse logistics in the future. Many companies have only recently realized importance of the reverse logistics and they still have to realize its strategic importance. In order to reduce costs of the reverse logistics, the companies shall concentrate on improvement of many aspects of their flows of the reverse logistics the future:

- improvement of technologies monitoring inputs
- better communication of data
- faster processing/shorter terms of cycles
- faster decisions

One of the simplest methods how to reduce costs on flows of the reverse logistics is to decrease volume of transported products. There are two ways how to do it. At first products that do not belong to the flow have to be protected against entry. Secondly, immediately when the product is put into circulation, it has to be removed from it as fast as possible.

Reduction of Flow of the Reverse Logistics

There are many hopeful new technologies that can be used in order to ensure that only appropriate products will enter into the flow of reverse logistics, and so they will help to reduce flow of the products into the system of reverse logistics. (Kubasáková, 2013)

You could find some information about Reverse logistics, its needs and advantages and disadvantages in company. In this chapter were used methods as a analysis, comparison, synthesis of information.

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