

## AN ECONOMIC ANALYSIS OF THE REVERSE LOGISTICS OF ELECTRONIC EQUIPMENT

BUMBOVÁ Monika, VOZŇÁKOVÁ Iveta, NIKOLSKAJA Martina

*VSB - Technical University of Ostrava, Ostrava, Czech Republic, EU*

### Abstract

This article is a synthesis of knowledge about reverse logistics, which has become, with the growing trend of our consumerist society, an important source of raw materials and has led to an urgent need to protect the environment. The content is focused on reverse logistics, its issues, options, and other aspects regarding the utilization of management processes. This is a summary of the theoretical knowledge in the field of product returns and how these products can be further used, both directly and indirectly in production, such as for research and development and marketing utilization, for instance, in communication with a customer. The article applies benchmarking, analyses existing research and uses deduction to find general options to improve reverse logistics and its non-legislative support in order to continue the increase in the number of companies that support reverse logistics. Using practical research focused on electronic and electrical waste, the article compares the economic evaluation of various methods and technologies of waste disposal in response to valid Czech and EU legislation. It describes the economic aspect of reverse logistics in areas such as: dismantling, mechanical, pyrometallurgy, hydrometallurgy and electrochemical for mobile phones and computers in restricted primary sources.

**Keywords:** Reverse logistics, recycling, waste, waste management legislation

### 1. INTRODUCTION

The benefits of reverse logistics are increasing becoming a key aspect of businesses. There is a large number of companies that use mineral resources in their business activities. These businesses must address how to not increase their input costs and how to manage the resources as effectively as possible. The number of minerals that are available in limited quantities is beginning to increase. The demand for these minerals is starting to exceed the supply and the price of these resources is slowly rising. Another parameter that must be taken into consideration is the storage of disused electronic equipment, which not only costs money, but also with the rules mandated by the European Union, these businesses must consider their social responsibility towards the environment. The aim of this article is to evaluate the effectiveness of the process of recycling electronic waste in terms of the economic-technical-ecologic point of view and to show how to use and reintegrate certain raw materials into production and thus reduce the need for the storage and liquidation of disused appliances.

Reverse logistics - Returns management - is a part of an integrated logistic chain - Supply Chain Management (SCM). One of the several existing definitions of SCM is an activity that integrates key processes from the end user to the initial supplier that provide products, services and information that mean an added value for customers and other interested parties (Lambert M. Douglas).

Reverse logistics is also defined in several ways, for example by "The Council of Logistics Management". Reverse logistics is the process of planning, implementing and monitoring the effectiveness of a cost-effective flow of materials, supplies, finished products and related information from the point of consumption to the point of their origin with the purpose of recovering the value or for other uses.

The same authority also allows the definition that reverse logistics is the process of moving goods from a typical destination to another place with the purpose of obtaining a value otherwise unavailable or for other uses.

The costs of reverse logistics have long been considered as necessary costs of trade and often they reach up to nine times of the value compared to the costs of the process from the manufacturer to the customer (Pernica).

Process management in the integrated logistics chain is often complemented by reverse logistics - returns management, which is not typically given the necessary importance. Multinational companies have begun to be interested based on the Environmental Policy of the EU and parts of the US, which have been increasing costs for waste disposal in landfills and also because of the ever-increasing direct sales via the internet and e-shops. The growing public awareness about the impacts of landfills on the environment can also not be neglected.

Initially, reverse logistics focused on activities related to product returns because of complaints or the return of unsold goods. The second process of reverse logistics appeared a bit later when legislation on the manufacturers' responsibilities for a product throughout its whole lifetime was applied. Effective management of this reverse flow has become an integral part of the supply chain and can help to maintain a long-term competitive advantage on the market.

Opportunities to succeed with reverse logistics on the market need to be planned during strategic processes where marketing management, logistics, production, finance, sales and research and development are discussed.

The operational aspect usually involves daily activities in reverse logistics to avoid misunderstandings that might directly affect the relationships between the buyers and suppliers and the end user - the customer.

Timely defined and implemented procedures of reverse logistics may provide opportunities for companies to effectively manage the reverse flow within the supply chain and reduce its costs and the waste of resources.

With the help of marketing support, the costs for reverse logistics can be streamlined by minimising the purchase risk, by deepening customer trust and by promoting the company with its ecologic activities. These contributions are hard to quantify and therefore are considered to be indirect contributions.

Among direct contributions are those that can create added value by, for example, making it possible for the reclaimed products to be returned into circulation with a fast and professional procedure or they can be reused in a revised form or as spare parts. This process can occur as maintaining sales, minimising operating costs and costs for substandard, outdated or faulty products or their parts. The effort to increase a company's sales can be complemented by secondary sales, rising prices for newer products and selling older stock at a discount or withdrawing older stock completely in order to avoid lowering prices. With complaints, which are also addressed by reverse logistics, positive phenomena can occur thanks to good communication with the customer, which is a source of information for developing or improving a product and maintaining its position on the market. Therefore, products that are in demand can be produced in the future and the amount of returned products will decrease. Preventing high costs for reverse logistics can also be done by using suitable designs and materials that satisfy the increasing demands of buyers. Properly identifying individual parts of products is an appropriate way to reduce the financial demands of landfilling.

The legally-enforced ecological behaviour of companies pursuant to "green laws" intends to reduce or eliminate impacts on the environment of both returned products and products after their useful life or obsolesce. In this case, emphasis is put on recycling materials and the possibility to reprocess them. Therefore, companies are forced to follow ecological behaviour or to leave the market of the European Union. Based on the environmental policies of the EU, companies cannot survive without sophisticated reverse logistics that would allow them to meet their legal commitments. Companies must develop such systems that are not only functional, but also are the least economically demanding and that reduce the overall costs for reverse logistics and might become a secondary source of raw materials ([www.cie-plzen.cz/lexikon](http://www.cie-plzen.cz/lexikon)).

Based on these findings, it is possible to state that reverse logistics has become a fairly problematic but very complex issue. Over time, the collection, sorting, dismantling and subsequent processing of products or their parts, by-products (e.g. packaging material) has become its task. The aim is to enable the evaluation of raw materials obtained this way in accordance with environmentally-friendly practices with regards to limited resources. Every production company has only a limited number possibilities to process materials in terms of bringing the highest possible value back with regards to the environment and economic aspects.

## 2. REVERSE LOGISTICS AND ITS IMPACTS

When disposing of waste from electrical and electronic equipment, companies must observe Waste Act 185/2001 Coll. and Decree no. 352/2005 Coll. applicable in the Czech Republic. These laws are based on EU regulations.

Waste is every chattel that no longer serves its purpose and that the owner wants to get rid of it or is legally obliged to get rid of it in a certain way.

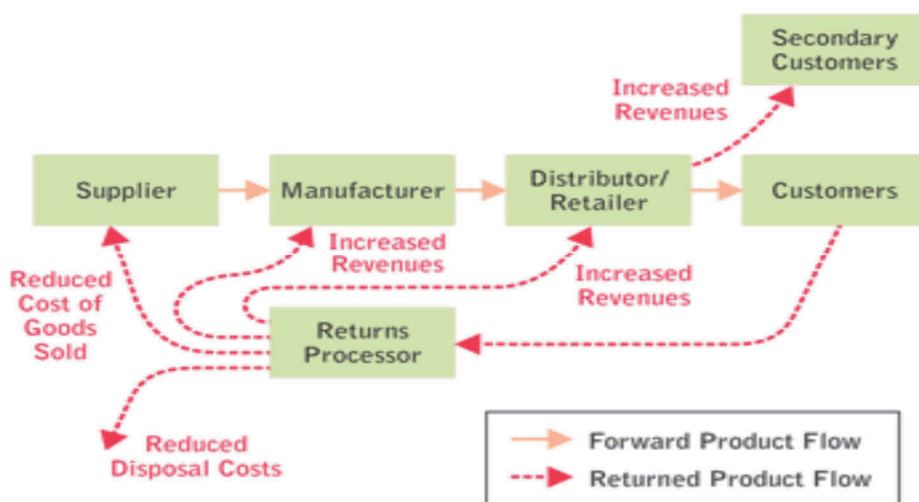
Waste can be described as hazardous if we can point to one or more hazardous properties.

Waste can be collected at predetermined locations where it can be stored, processed, used, transported or disposed of. In terms of the economy and the environment, it is more preferable to use secondary raw materials from waste than processing primary resources.

**Table 1** The financial impacts of reverse logistics

	Reverse flow	Reprocessing	Remarketing	Recycling	Storage
Revenues	Environmentally responsible behaviour contributing to uplift of the brand.	Increased sales from reprocessed products as they are produced at lower costs	1) Sales of modified and reprocessed products, parts 2) Environmentally responsible behaviour contributing to uplift of the brand.	1) Recycling of parts and materials that can no longer be used in the product 2) Environmentally responsible behaviour contributing to uplift of the brand	Environmentally responsible behaviour contributing to uplift of the brand.
Costs	1) Cost reduction by returning some parts 2) Reduction of costs linked to storing, increasing speed of activities of the reverse flow	Reducing production costs by reprocessing and remanufacturing products and sold parts		Reduction of operational costs thanks to proper liquidation	Reduction of costs for fees associated with landfilling.
Assets	Reduction of obsolete inventory by increasing the speed of activities of reverse flow		To prevent the accumulation of old, unsalable inventory in stock. Selling such stock on second-hand markets		

Source: Mollenkopf, Diane A., Closs David J.: The Hidden Value in Reverse Logistics, Supply Chain Management Review, 7.1.2005, [www.scmr.com/article/CA6249660.html](http://www.scmr.com/article/CA6249660.html)



**Fig. 1** The impacts of an effective reverse chain in parts of the logistics chain

Source: The Hidden Value in Reverse Logistics, Diane A. Mollenkopf and David J. Closs, Supply Chain Management Review, July 1, 2005

Due to the constantly-accelerating innovations and the rising number of devices with a shorter service life, there is a build-up of electrical waste and thus there is a possibility of further use of such previously-used resources. Based on the research by students at VŠB - TUO, the possibilities of processing electrical waste were tested on the products listed below.

Recycling is done through mechanical processing, disassembly into individual components, crushing, grinding and pyrometallurgical, hydrometallurgical and electrochemical methods.

Based on the laboratory analyses, the following ratios in the individual devices were found:

**Table 2** Composition of original products

	total weight	plastics	metals	other parts	printed circuit board / plastics / metal	other
computer hard drive - 80 Gb	355.9 kg	4.6g	333.9kg	4.6g	10.2g	1.8g
Samsung GT mobile phone without battery	66.2g	28.5g	22.9g	8.0g	6.8g	
Samsung SGH mobile phone without battery	46.5g	26.9g	1.5g	8.4g	9.7g	
floppy drive	349.5g	11g	267g		68.5g	
LG Super Multi DVD drive	872g	172.5g	515.5g		179g	
LG Rom DVD drive	754g	193g	397.5g		159.5g	

Source: Panoš, M. Ekonomické zhodnocení recyklace vybraných druhů elektromateriálu, VŠB-TUO, 2015

By evaluating the experiment and analysing the economically used material, it was discovered that waste processing provides a definite benefit in larger volumes. Printed circuit boards were the most useful part for recycling.

**Table 3** The purchase of individual electronic parts on average

Electro material	CZK/Kg
processors	3500
connectors	3700
mobile phone boards and phones with no battery	620
mobile phones with a battery	230
complete PC cabinet	10

Companies such as OZO Ostrava, Asekol, Elektorwin, Ecobat and Ekolamp deal with the purchase and processing of electrical waste in the Czech Republic. Purchase prices vary according to region and more strict legislation has made the purchase more difficult. Stricter legislation should reduce thefts of nonferrous metals in general.

**Table 1** Economic yield

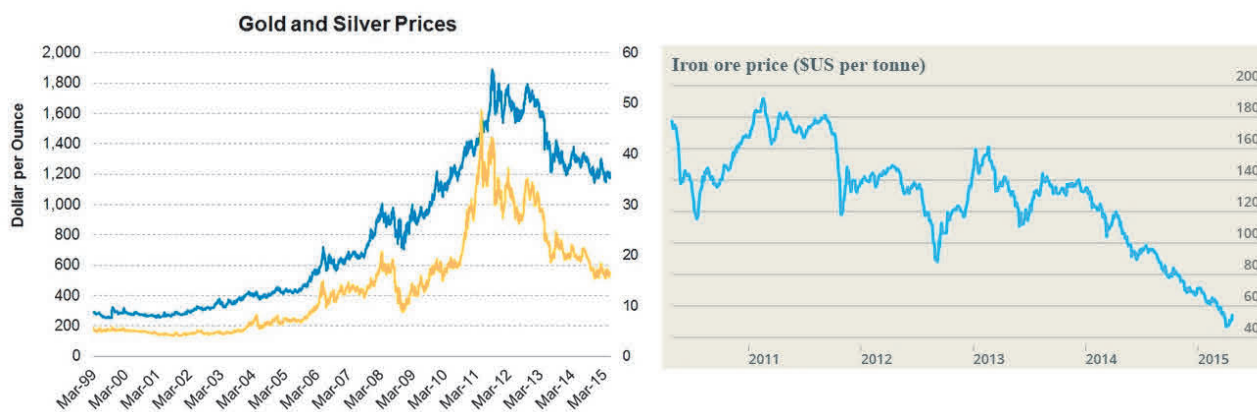
original product	total repurchase price in CZK	price for depositing in a landfill kg / CZK
disassembled computer	454.25	-11.29
whole computer	89.7	-3.77
mobile phone motherboard without a display	2.59	-3.48
whole mobile phone with no battery	7.77	-3.48
whole mobile phone with a battery	6.48	-11.16
total revenue	560.79	-33.18

Source: Panoš, M. Ekonomické zhodnocení recyklace vybraných druhů elektromateriálu, VŠB-TUO, 2015

Based on the comparison of a repurchase of substandard products with depositing in a landfill, it is clear that it is more preferable and profitable to return the unwanted or outdated products and to recycle them and return the obtained materials back into production.

#### Price trends of selected commodities

The price trends of iron ore, gold and silver has declined since 2011, which according to analysts, has been caused by shortfalls of market demand within the deepening recession, oversupply and production stagnation.


**Fig. 2** Price trends in gold, silver and iron ore for given periods

Despite the decreasing price trend of its basic raw materials, the price of iron itself is increasing. The price of iron waste in the western countries has risen by approximately 20% since the beginning of 2014 compared to the previous year. Depending on the increase in prices for energies, the price of transport in China is also growing. China is one of the four largest suppliers on the iron market and a further legislative increase in wages by approximately 10% is expected.

The price of iron and other expensive metals will continue to be affected by the increasing input prices, changes in exchange rates, change in export policies in China and problems in Australia, which covers 70% of the global market. During the period 8-year from 2006 to 2014, the price per ton of iron rose by more than six-fold.

The biggest positive effect of reverse logistics appears to be the benefit for the environment. We can observe these positives on:

- the reduced energy demand in the processing of recycled raw materials.
- the restriction in mining of non-renewable raw materials and through recycling, the demand for these raw materials is satisfied through recycled materials.
- reducing landfill waste because the capacity for waste deposits is limited.

### 3. CONCLUSION

During today's turbulent times, reverse logistics is experiencing a large boom. Companies that use recycled materials in their economic activities reduce their costs since the purchase and processing of these materials is much cheaper than purchasing primary materials. Approximately 5.9 millions of tons of e-waste are produced each year in Europe. Statistics show that this production of e-waste is increasing 3 to 5% every year. By processing e-waste from which nonferrous and ferrous metals, precious metals, plastics and other materials are obtained, it is possible to achieve significant savings of natural non-renewable resources. The more electrical equipment that enters the recycling process, the smaller the amount of natural resources that are needed for the production of new commodities. Harmful materials contained in many appliances can be captured during the recycling process and be ecologically disposed of.

Companies that buy recycled e-waste materials thus carry out the ideas of sustainable development not only in terms of the environment, but also in terms of economy. Today, companies are being pushed to put emphasis on reducing production costs, which can be achieved by the repeated use of recyclable resources. Another reason for the boom in reverse logistics is the introduction of regulations that push companies to focus on environmental protection. Companies that utilise reverse logistics in their business are supported by the European Union through financial grants.

### REFERENCES

- [1] LAMBERT M. DOUGLAS: The Eight Essential Supply Chain Management Processes, Supply Chain Management Review, September 1, 2004, <http://www.scmr.com/article/CA630007.html>, přístup 25. 3. 2007
- [2] MOLLENKOPF , DIANE A., CLOSS D., J.:The Hidden Value in Reverse Logistics, Supply Chain Management Review, 7.1.2005, [www.scmr.com/article/CA6249660.html](http://www.scmr.com/article/CA6249660.html)
- [3] PANOŠ, M. Ekonomické zhodnocení recyklace vybraných druhů elektromateriálu. In Diplomová práce. VŠB-TUO, 2015
- [4] PERNICA, P.: Logistika (Supply Chain management) pro 21. století, strana 554, <http://www.cie-plzen.cz/index.php/cz/lexikon-metod/reverzni-logistika> 2.9.2015