# THE ROLE OF REVERSE LOGISTICS IN CREATING ADDED VALUE IN METALLURGY

Paweł KUŻDOWICZ[a], Marcin RELICH[a], Anna SANIUK[b], Helena VIDOVA[c], Krzysztof WITKOWSKI[a]

[a] *University of Zielona Gora, Faculty of Economics and Management, Zielona Gora, Poland, EU,* *p.kuzdowicz@wez.uz.zgora.pl*, *m.relich@wez.uz.zgora.pl*, *k.witkowski@wez.uz.zgora.pl*

[b] *University of Zielona Gora, Faculty of Mechanical Engineering, Zielona Gora, Poland, EU,* *a.saniuk@iizp.uz.zgora.pl*

[c] *Slovak University of Technology in Bratislava, Faculty of Materials Science and Technology in Trnava, Trnava, Slovakia, EU,* *helena.vidova@stuba.sk*

**Abstract**

The processes of reverse logistics in creating added value for producers in metallurgy are presented here. Steel Industry is the primary industry which plays important role on the national development and economy sustainability. This industry's supply chain and logistics system is considered complex and appears to be part of other industries' supply chain and logistics systems, such as infrastructure or automotive industries. The premise is the choice of reverse logistics for steel supply chain on the one hand, considering their versatile applications. On the other hand, an extremely important issue is that their production is characterized by high dynamics, has a significant impact on the environment, contributing significantly to the use of the valuable resource. This paper will focus on the economic and environmental optimization of reverse logistics processes in steel supply chain. The presented article is part of a research on developing application methods for the settlement of environmental-economic support for reverse logistics processes aimed at reducing consumption of energy and raw materials by metal manufacturers, which ultimately translates into added value in terms of so-called environmental benefits.

**Keywords:** logistics, reverse logistics, recovery, steel supply chain

## 1. INTRODUCTION

In waste management, it must be recognized that the "substance", which for one holder is waste, for another, or even the same operator, at another place and another time can be a useful raw material or intermediate, and this means that waste should be recovered and used effectively, in accordance with the philosophy contained in both Polish legislation and in the new framework of the European Council Directive on waste 2008/98/WE of 19 November 2008.

It should be noted that in the new Framework Directive, solutions to existing problems of waste management were sought, by the formulation of clear and understandable regulations, even for small and medium enterprises. Important objectives were: the reduction of bureaucracy, avoidance of duplication of regulations, the full implementation of the basic principles of environmental waste management, such as the precautionary principle, the principle of sustainable development and the fundamental principle of "polluter pays". At the same time, the new directive still allows for the application of all instruments from the repealed directive which were considered to be effective. In light of the requirements which the new framework directive on waste has introduced is a particular challenge to introduce effective and efficient recovery logistics systems, at the spatial, organizational, and information level. The task of these systems is to direct all waste to designated storage locations, while maintaining the hierarchy of recovery values, as directed by the legislation, based on the principle of sustainable development [1].

Logistics systems activities require the assurance of adequate economic and environmental efficiency levels on the demands of sustainable development [2]. Reverse logistics - because of the complexity and increasing importance in logistics processes - has become one of the most important areas of the eco-efficiency rise. New system solutions are observed as essential to increasing the eco-efficiency level of reverse management.

At the beginning of the twenty-first century, we are fully aware that environmental, social and economic challenges facing the global community are still serious. Sustainability, and its interdependent solutions, as put forward, must become an integral part of the development processes of the modern world. According to systems theory, one can say that the balance must apply to all relationships in the development macrosystem of environment - economy - society, as well as to internal relations, specific to each of the subsystems constituting the macrosystem [3].

The overriding goal of sustainable development is the high quality of life of societies, determined not only by the level of consumption of goods and services produced by man, but also the scope and efficiency of environmental services. The determinant of quality of life is understood as the level of development and efficiency of the functioning of the economy, the state of awareness and social knowledge, and the determined quality of the natural systems of biodiversity and their productivity [4]. The implementation of the concept of sustainable development into business practice and the need to meet the challenges of the twenty-first century, at the root of which lies the widespread awareness of the profound global ecological crisis, are now causing particular attention to be given to issues related to environmental quality and cost-effective exploitation of resources [5]. The assumptions of sustainable development clearly indicate that the search for new solutions to technical, technological and logistical resources, and rationalization of the economy, energy and waste should be a priority for all business sectors and services [6, 7].

## 2. CHARACTERISTICS OF STEEL INDUSTRY IN POLAND

Apparent steel use (ASU) in Poland was 12M tons in 2007. In 2009 steel marked turned to worse - adverse global crisis spillover hit Poland badly. Steel consuming sectors' downturn made its painful mark on steel output and steel revenues. Poland's ASU was merely 8.19M tons in 2009, down 32% as compared to 2007. 2010 saw Poland's economy picking up again. GDP growing at 3.8% was to a high degree built by increasingly high internal demand and investments coming back. Positive impact was brought about by projects co-financed from Cohesion Found. 2010 saw all steel-consuming sectors growing production, and in effect Poland's spiked 20% vis-a-vis 2009 [8].

2011 saw the metal industry in Poland growing very rapidly. Manufacture of metal products in 2011 was higher by 18.5% than in 2010 (structural metal products as high as 24.8%) while metal shipments increased by 12.0%. The manufacture of machinery and equipment in Poland reported a decline for the third consecutive year. In 2011 it was lower by 3.6% as compared to the previous year. The sector's negative bottom-line was impacted by lower sales of general-purpose machines. Other subsectors recorded an increase in revenue compared to last year's [8].

The year of 2013 was another year of market downtown, which was also experienced by Polish steelworks. Low performance was a result of irregularities yhat occurred in the sale of reinforcing steel, however, introduction of the reverse charge on October 1, 2013 made it possible to considerably mitigate these problems. In foreign trade (ca. 80% represents the trade within the EU countries), a small decrease in import (-3% y/y) was recorded and somewhat larger drop occurred in export (by -12% y/y). Export to third counties experienced the highest decline (-37%). In 2013 Polish crude steel production was at the level of 8 MT, that being 4.9% less than in 2012. Apparent consumption of finished steel products in Poland in 2013 was 10.3 MT and was lower by 1% against the level of 2012 [9].

## 3. THE STEEL SUPPLY CHAIN

Over the past decade, many of the steel industry studies have been carried out. Most of them aimed to improve the performance of the industry [10, 11]. However, the results provided by those papers laid us to an understanding of the supply chain in steel industry. The steel industry has distinct characteristics that separate it from other industries [12] as follows:

- High capital needed to be invested
- Long life of products
- Lots of players in the global market

Therefore, this industry needs a well-designed of methodologies or techniques to manage and integrate the supply chain leading to control cost while still having a competitive advantage. A schematic of the steel supply chain and current technologies used in national steel industry is shown in **Fig. 1**.

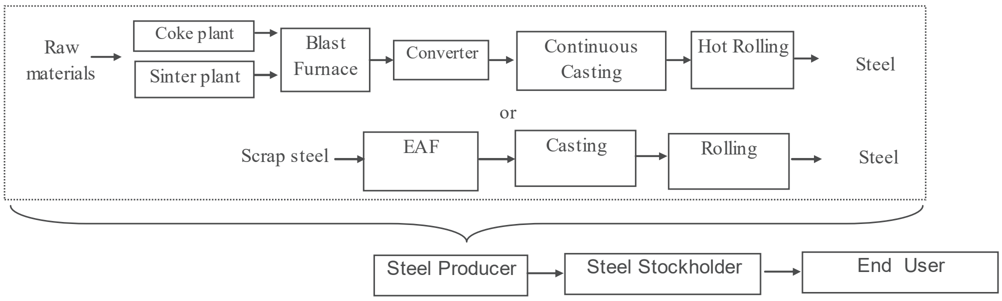


**Fig. 1** A schematic of the steel supply chain

The steel supplier can be classified as a general steel producer who converts steel scrap into billets, which are then rolled into a variety of steel products. The end user sources their material from a steel stockholder who performs a break bulk role within the supply chain. They order in large quantities from the main producers on long lead times and then sell the material in small quantities on short lead times, according to the customer's requirements [13, 14].

For steel supply chain it is typical that many European metallurgical companies are forced to import iron ore from remote destinations. For these companies it is necessary to determine the amount of iron ore that will have to be ordered and to create such a delivery schedule so that the continuous operation of blast-furnace plant is not disrupted and there is no exceedingly large stock of this raw material [15].

## 4. REVERSE LOGISTICS, RECYCLING AND RECOVERY

The world steel industry applies the principles of reduction, reuse and recycling in many ways, in order to improve the sustainability of the industry.

Logistics covers the planning, coordination and control both in the aspect of time and space, the course of actual processes in the realization of which organization is a participant, for the purpose of efficient and effective goal achievement by an organization [16, 17]. It particularly concerns spatial and timely arrangement (where?), state (how much and in what configuration?) and flow (where from, where to and by what means of transmission?) of goods constituting the components of these processes, i.e. people, material goods, information and funds [18].

Reverse logistics is the process of moving goods from their typical final destination for the purpose of capturing value, or proper disposal. The objectives of reverse logistics are comprehensive (integrated) in their nature. Reverse/returned logistics system model for steel enterprises within the social scope is presented in **Fig. 2**.

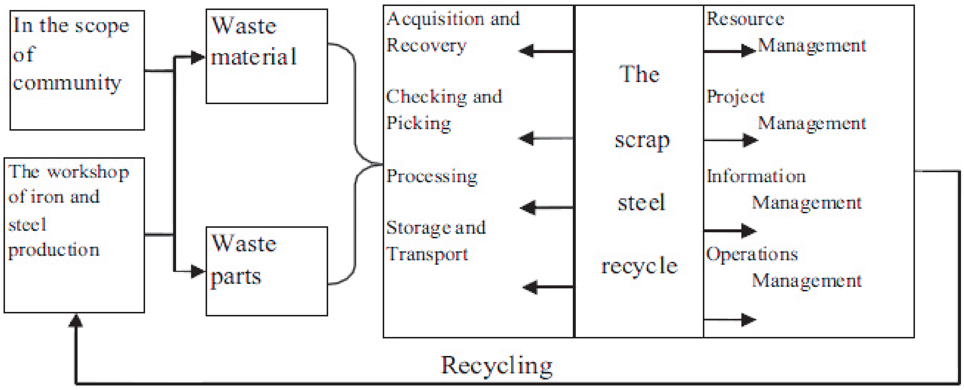


**Fig. 2** The model of reverse logistics system for steel industry within the social scope [19]

Reverse logistics also includes processing returned merchandise due to damage, seasonal inventory, restock, salvage, recalls, and excess inventory. It also includes recycling programs, hazardous material programs, obsolete equipment disposition, and asset recovery [20].

Defining these new areas requires a reference to the classification of the types of recovery process assigned to the various stages of integrated supply chain, which is presented by Thierry et al. (see **Fig. 3**). There are 8 types of recovery/disposal options: direct reuse/resale, repair, refurbishing, remanufacturing, cannibalization, recycling, incineration, and landfilling. Each of the product recovery options involves the collection of used products and components, reprocessing and redistribution. The main difference between the options is in reprocessing: repair, refurbishing, and remanufacturing upgrade the product. What they differ in is the degree of upgrading [21].

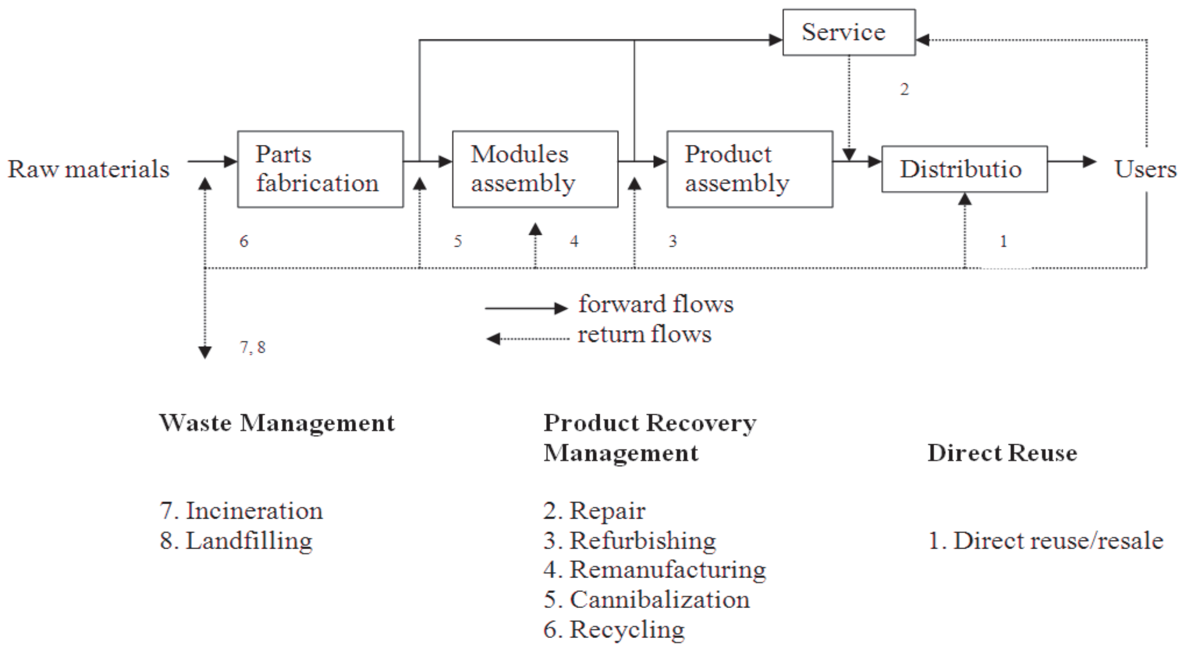


**Fig. 3** Different kinds of recovery in integrated supply-chain [21]

Steelmaking and BF slag had the largest share in the structure of waste in 2013 and accounted for approx. 59.5 % of total waste. The volume of scrap was approx. 5%, mill scale approx. 4%, sludge approx. 3%, refractories approx. 1 % and the other waste 27%. In 2013, the volume of waste in steel and iron industry dropped by 14.5%. Over 93% of waste products were recycled and the remaining part (4%) was disposed and temporarily stored (approx. 2%). The waste management in industrial plants is shown in **Table 1**.

**Table 1** Waste management in 2009 - 2013 (k mt) [9]

| Specification/Year | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|
| Total waste, of which: | 3 729 | 4 078 | 4 458 | 4 794 | 4 097 |
| recycled | 3 474 | 3 842 | 4 269 | 4 351 | 3 811 |
| disposed | 209 | 117 | 128 | 245 | 165 |
| temporarily stored | 43 | 119 | 61 | 198 | 92 |

The world steel industry applies the principles of reduction, reuse and recycling in many ways, in order to improve the sustainability of the industry. This fact sheet outlines the achievements that the industry has made in each of the three Rs: reduce, reuse and recycle. One of the main purposes of reverse logistics is the rational management of natural resources and their sustainable use supported by the development of return chains enabling waste management. It should be emphasized that for many participants, the traditionally understood logistics chain of waste remains outside their area of interest, and yet the return of waste flow chain has important consequences for the entire supply chain, verified it in terms of value creation through the use of reverse logistics processes in accordance with the principle of the three Rs.

The World Steel Association has estimated the recycling rates for products that contain a significant portion of steel, and identified target rates for 2050 (see **Table 2**).

**Table 2** Steel industry recycling rates [22]

| **Market** | **2007** | **2050 Target** |
|---|---|---|
| Construction | 85% | 90% |
| Automotive | 85% | 95% |
| Machinery | 90% | 95% |
| Appliances | 50% | 75% |
| Containers | 69% | 75% |
| **Total** | **83%** | **90%** |

These goals, when accomplished, will result in an additional 38 million tons of steel being recycled worldwide by 2050. This equates to 54 million tons less $CO_2$. Steel recycling accounts for significant raw material and energy savings. Over 1 400 kg of iron ore, 400 kg of coal, and 55 kg of limestone are saved for a ton of steel scrap used. From an environmental point of view, steel recycling has an enormous impact on the reduction of $CO_2$ emissions. If 450 million tons of hot rolled steel were produced from 100% scrap rather than new materials, the total $CO_2$ savings would be approximately 634 million tons in one year [22].

## CONCLUSION

The strategic objective of waste management planning is the handling of waste in accordance with the principles of the waste management hierarchy, i.e. firstly the prevention and minimization of waste generation and to reduce their hazardous properties and, secondly, maximum utilization of material and energy components of the waste, and where waste cannot be subjected to recovery processes, to be neutralised.

Recovery logistics in waste management systems meets the demands of the new Framework Directive of the European Parliament and Council 2008/98/EC of 19 November 2008 on waste (OJ. EU of 22 November 2008 No. L 312 / 3) whose primary task is to develop instruments to promote the idea of a "recycling society", seeking to avoid waste and to use waste as a resource.

In light of the requirements, which introduced a new framework directive on waste is a particular challenge to introduce efficient and effective recovery logistics systems, in spatial, organizational, and information fields.

The task of these systems is to direct all waste to designated storage locations, while maintaining the hierarchy of recovery values, which the legislature based on the principle of sustainable development pointed to.

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