

## **CHALLENGES OF WEEE ON REVERSE LOGISTICS: A CASE STUDY ON A COLLECTION NETWORK IN FINLAND**

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### **Abstract**

The adoption of European Union's directive on Waste Electrical and Electronic Equipment (WEEE) causes essential changes in the field of electronic scrap recycling. In Finland the new legislation was put in force in August 2005. The aim of the study is to discuss the problems of WEEE logistics considering the requirements of WEEE directive. This paper first describes the requirements of the legislation and the current situation of recycling management in Finland. The case study presents how collection of WEEE has been organised in Northern Finland. The problems and challenges of collection phases are discussed and an optimal model for the future is presented. The results prove that logistical costs are high and there are unnecessary handling and transportation stages in the current reverse supply chain of WEEE. The study also shows that legislation constraints, diverse characteristics and reuse value of EEE have an important impact on the strategic priorities of the future reverse logistics system of WEEE. The real challenge of collection lies in ensuring that WEEE is collected separately so that reusable equipment are separated from non-reusable ones.

**Keyword:** Waste Electrical and Electronic Equipment, reverse logistics, collection process, recycling

### **Introduction**

The production of electric and electronic equipment (EEE) is one of fastest growing businesses in the world. Technical innovation and market expansion of EEE are accelerating the replacement of outdated EEE, leading to a significant increase in waste EEE (WEEE) that creates a new environmental challenge. WEEE is a non-homogeneous and complex in terms of materials and components. Many of the materials are highly toxic, although WEEE has high residual value (He et.al, 2006). In Western Europe 6 million tons of WEEE were generated in 1998, and the amount of WEEE was projected to increase at least 3-5 % per year (European Commission, 2000). It is expected that in 12 years the amount of WEEE will be doubled. The European Union (EU) has established a comprehensive body of environmental legislation. The European Union's directive on Waste Electrical and Electronic Equipment (European Parliament and Council, 2003) causes essential changes in the field of electronic scrap recycling. The EU Directive on WEEE is based on the Extender Producer Responsibility. Producers are requested to finance the collection, treatment, recovery, and environmentally sound disposal of WEEE. The directive imposes a high recycling rate for all targeted products. Reuse, recycling and recovery rates ranging from 50% to 80% according to the category of equipment considered, must be achieved by producers of EEE by end of year 2006. The target of collection rate to be achieved by Member States is 4kg WEEE/inhabitant/year (ACRR, 2003). For the national implementation of the WEEE directive, several degrees of freedom exist. As a consequence, different structural alternatives for the reorganisation of the treatment system are possible (Walther & Spengler, 2005) In Finland the new legislation was put in force in August 2005.

This paper first describes the requirements of the WEEE legislation and current situation of recycling system in Finland. A case study presents how the collection of WEEE has been organised in sparsely populated Northern Finland. The problems and challenges of collection process are discussed and an optimal model for the future is presented.

## **Reverse logistics**

The management of reverse flows is an extension of traditional supply chains with used product or material either returning to reprocessing organisations or being discarded. Reverse supply chain management (RSCM) is defined by Prahinski and Kocabasoglu (2006) as the effective and efficient management of the series of activities required for retrieving a product from a customer and either dispose of it or recover value. The definition of reverse logistics by other authors (Rogers & Tibben-Lembke, 1999; Dekker et. al 2003) is quite similar. Activities highlighted in reverse logistics include transportation, warehousing, distribution and inventory management. Transportation is usually the largest component of reverse logistics costs (Stock, 1996 p.76). In general, the effective management of reverse logistics activities is essential, because if the total costs associated with the reclamation efforts exceeded the total cost of new materials or products, firms would have no financial incentive for implementing a reverse logistics system. Regulatory constraints, products characteristics, return volumes, transportation costs, disposal costs and viable disposition alternatives all have an direct impact on the strategic priorities of the reverse logistics systems. There are four disposition alternatives on the reverse supply chain (Phahinski & Kocabasoglu, 2006):

- Reuse, that is, to immediately reuse or resell the product;
- Product upgrade, which is to repackage, repair, refurbish or remanufacture the product
- Materials recovery, which includes cannibalisation<sup>1</sup> and recycling'
- Waste disposal, which includes incineration and landfilling the product.

## **The implementation of WEEE Directive in Finland**

Finland's legislation on waste provides that producers of electrical and electronic equipment shall organise the recycling and waste disposal of waste ensuing from products that they have brought to the markets and shall be responsible for the costs incurred. The producer shall (Elker Oy, 2005):

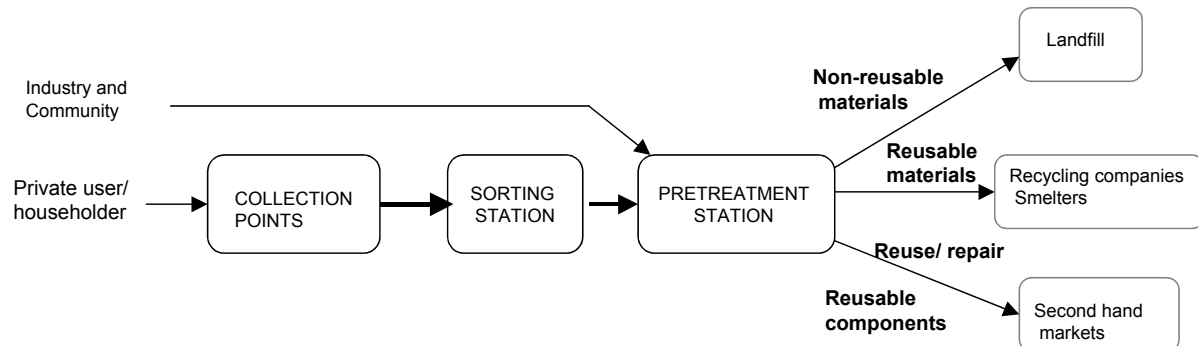
- Organise a separate collection of collectable electrical and electronic waste and the necessary storage and delivery to a preliminary treatment plant. Furthermore, a sufficiently extensive network of collection stations must be arranged so that the end user of the product shall have reasonable opportunity throughout country to submit the "non-wanted" product for recycling, exploitation or other waste disposal.
- Mark all products brought to the markets after 13 August 2005 with label indicating the producer of product and enclosed separate collection label.
- Give information to the preliminary treatment plant and households concerning the collection systems and places.
- Inform the Pirkanmaa Environment Centre annually of products introduced to the markets and the accumulation of the disposed products.
- Submit an application to the Pirkanmaa Environment Centre for registration in the producer data file and enclose information on the collection station network and agreements related to arrangements for waste disposal.
- Give sufficient security for equipment used in households to the Pirkanmaa Environmental Centre, for example, recycling insurance or blocked blank account to ensure the fulfilment of waste disposal obligations.

In Finland electrical and electronic equipment producers and import business have formed so far five producer co-operatives (Serty, Flip, Selt, ICT and Nera) for purpose of organizing the collection and recycling of WEEE. Within the supply chain of WEEE, various tasks like collection, transportation, sorting and disassembly of products and storage and selling of material fractions as well as reusable products and parts are conducted. The producer co-operatives are sourcing the reverse logistics from regional operators; usually from a social economy enterprises or public institutions. A private user or household can bring product to a collection point free of charge. So far there are about 180 collection points that are in most cases provided by the municipal and in some cases private companies or social economy enterprises. On the other hand, non-private users, such as industry and offices, are not allowed to return WEEE to collection points and they are also charged. They should agree with regional operator about the collection or return the WEEE to sorting stations. The regional handling of

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<sup>1</sup>Market cannibalisation is defined as the decline of product or service sales due to the introduction of another product or service, which is a substitute.

WEEE includes the sorting the EEE to re-usable and non-reusable ones. Also WEEE is divided to different product categories. At the pre-treatment stage the reusable appliances, spare parts and those materials that have reuse value are disassembled, stocked and delivered onwards. In figure 1, the main steps of reverse supply chain of WEEE in Finland are presented.



**Figure 1: The reverse supply chain of WEEE in Finland**

### **The case study**

The case study (Poikela & Lehtinen, 2006) was carried out during December 2005 – February 2006 in the region of Oulu in Northern Finland where c.a. 200 000 people are living. The aim of the case study was, firstly, to describe the present WEEE collection concept in the Oulu region. By mapping the collection network we were able to find out the problems and overlaps. Secondly, a new, more optimal model is introduced, and proposals for future acts are suggested. The present stage of WEEE collection was studied by finding out the bottlenecks, volume and “waste” as defined in lean concept. The material and information flows between the actors were mapped and workers in different stages were interviewed. The collection network studied is operating for Elker Ltd, which is a company established by three producer co-operatives for manage the collection. Elker Ltd. pays transportation costs of collection on the ground of the number of containers and for handling costs on the ground of weight.

### **The present collection model.**

The present stage of the collection network studied is presented in the figure 2.

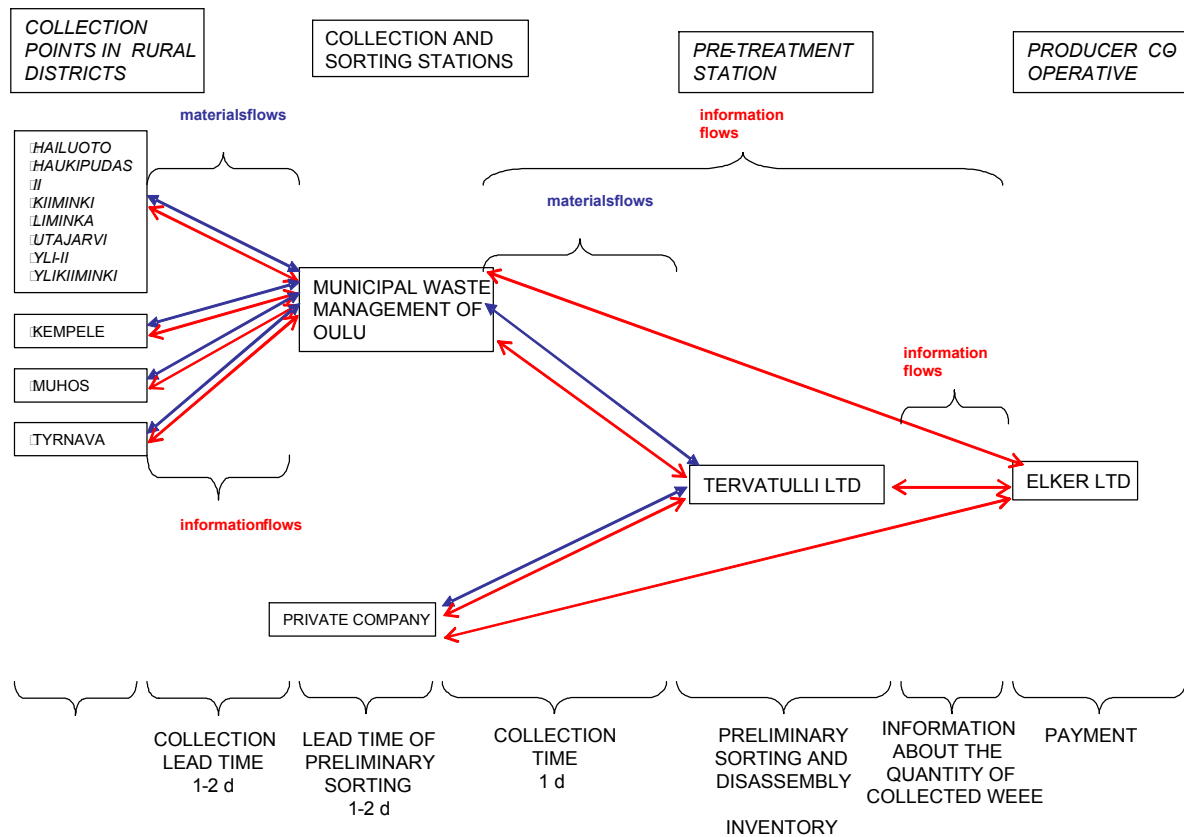
### **Collection points in rural districts**

There are totally 13 collection points in the area situated within 100 kilometres from Oulu. Local municipalities maintained these points and each municipality has its own collection point. The whole system is managed by Oulu Municipal Waste Management Company providing containers to the collection points and taking care of transportation. At collection points the returned equipments are just put into containers or cages without any sorting. Only lamps were stocked separately. The amount of WEEE brought to these collection points varies greatly; the containers are filled up from one week to four weeks. When a container is full the personnel from the collection point orders the transportation. The legislation of WEEE demands that the return of WEEE is documented and signed by the user. In practice, the documentation is often forgotten and users are returning their equipment without guidance. The wrong handling and improper storage facilities, especially in wintertime, damage easily returned reusable units and also allows an opportunity for stealing. On occasion, the workers have even given away working equipment that legally belong to the producer co-operative.

The transportation from collection points to sorting station situated in Oulu was done once a month or when ordered. The main problem observed was that the cages were heavy and there was a lack of proper equipment (forklifts etc) to handle the containers. Therefore, loading and unloading took a long time.

## Sorting points

From the collection points the WEEE is transported to the premises of Municipal Waste Management Company, which also operates as a local collection point. In the premises of the Waste Management Company WEEE is separated into cages for different product co-operatives. A private company maintains the other sorting point, presented in the figure 2.



**Figure 2. The present model of WEEE collection network in Oulu region**

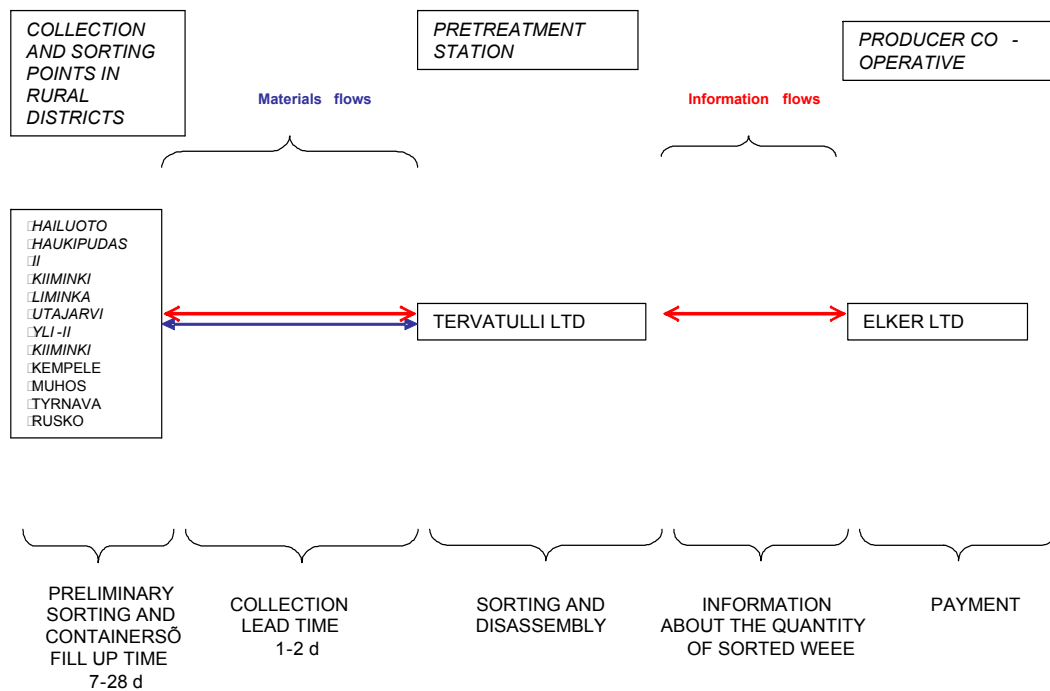
### Pre-treatment station

Tervatulli Ltd is a social enterprise that reprocesses electrical and electronic equipments and the materials that are generated by disassembling and sorting. Tervatulli Ltd picks up Elker's WEEE from sorting points by own trucks. In the pre-treatment station the WEEE is sorted to 17 different product categories and weighted. The reusable equipments and components are separated. The WEEE is stocked in a pre-treatment station until it is delivered to treatments plants or dispose. The information about the collected WEEE is sent to Elker Ltd.

### The new model for collection network

A proposal for new model for collection network is presented in figure 3. In this model the non-value added stages are removed. The main difference in the material flow is that the first sorting is done already in collection point from where the material is going directly to the pre-treatment station. Also reusable or repairable equipment should be marked and handled differently in sorting stations. It was evident that packages and handling systems should be design to fit better to different categories of WEEE. For example, sorted WEEE should be kept in roller cages instead of containers. In addition, general guidelines for collection process are needed. Workers of sorting stations have in general low education and they need advice and education concerning the legislation and documentation. The documentation of returned WEEE is so far made by hand. In future, a common electronic system

should be introduced to all stages of collection chain. The transportation costs could be reduced by outsourcing transportation to local carriers who are able to combine WEEE with other freight.



**Figure 3: The new model for WEEE collection network in Oulu region.**

### **Main challenges and problems of WEEE collection in future**

The legislation of WEEE was put into practice in August 2005 in Finland. The producer co-operatives and local operators are looking for the most economical practices to organise the collection. Main challenges of WEEE collection rise from the contradiction between the legislation and benefits of the producers. First, the legislation emphasis the reuse of WEEE. For clear reasons of efficiency, the examination of reuse potential should take place as much upstream as possible, in order to send reusable appliances to adequate reuse channels without damages (ACRR 2003 p.18). The case study shows that in the present system, wrong handling and storage damage easily returned equipment and also allows an opportunity for stealing. On the other hand, the producers do not favour reuse flow. They are afraid of cannibalisation e.g. that reuse appliances change the market but, also because the sorting and handling of reusable WEEE increase collection costs.

Second, the legislation demands that all the end users shall an opportunity in the whole country to return the disposed product reasonably. So far no decisions have been made concerning the collection policy in Northern Finland; for example the distance from collection point situated in Lappish village to a pre-treatment station could be hundreds of kilometres.

Quite often the users have left their equipment at the retail store when a new appliance has been bought which caused a lot of problems for retailers. One proposed solution is a mobile collection point of WEEE. In this system collection trucks remain at scheduled times, in identified areas of the municipality, so that citizens can bring their discarded electrical and electronic appliances.

A third contradiction that effected on collection is the reuse value of EEE. For example, refrigerators have negative value because they have few valuable components, but high transportation costs. On the other hand, circuit boards have positive value because they contain many valuable materials. Thus, the transportation and handling stages of low reuse value categories of WEEE should be minimised.

## **Conclusions**

From the results of the case study presented here it can be concluded that the collection and recycling of WEEE as established in Finland has evidently environmental advantages, but the logistical costs are high and there are unnecessary handling and transportation stages. The results highlight the importance of cooperation and good communication between the actors of the network and between different producer co-operatives in order to optimise collection process. The responsibilities and roles of different parties have been unclear which have increased the handling stages and logistics costs. The study also shows that legislation constraints, diverse characteristics and reuse value of EEE have an important impact on the strategic priorities of the future of reverse logistic system of WEEE. The real challenge of collection lies in ensuring that WEEE is collected separately that reusable equipment are separated from non-reusable ones, and both are sent to the adequate treatment facilities. Thus, an efficient collection system will depend on accessible and efficient collection facilities and adequate and consistent guidance to the personnel in collection points. Finally, it needs to be pointed out that long distances in sparsely populated areas of Finland and the diversity of the WEEE brings special challenge to manage efficiency the reverse logistics.

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