

RESEARCH ARTICLE

Reverse Logistics Channels: An Exploratory Study for Household Waste Collection

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Abstract

Collection and recycling of post-consumer waste in a cost-efficient manner with an acceptable service level are of increasing interest in business practices as well as in research. Because it is a new topic in Turkey, yet there is not enough concern and study about waste collection within the framework of channel structure and logistics management. This study attempts to explore the current situation of household waste collection channel structures in the metropolitan area of the city of Izmir, Turkey. An exploratory study was implemented in order to identify the recycling activities, collection activities and logistics functions of household waste collection. A sample of related participants was interviewed in the metropolitan area of the city of Izmir in order to define the functions and structures. As a result of this study, reverse logistics channel structures were determined. In addition to that, suggestions for the improvement of these channels were discussed with regard to the service level and total cost.

Keywords: Household waste, Logistics, Reverse logistics, Turkey.

Introduction

Reuse of products and materials in any case is not a new concern. Issues on collecting and reusing materials in Europe is regulatory driven and in North America profit driven. It is seen that effective and efficient management of product returns is an intriguing practical and research question. Growing green concerns and advancement of reverse logistic concepts and practices make it all the more relevant [1]. Collecting and distributing used packages and materials needs a well-established logistics channel, which is named reverse logistics. Accordingly, reverse logistics topics have increased in relevance both in practice and the academia. As it is addressed by the practitioners and academicians reverse logistics is very expensive and also complicated. In addition to that, reverse logistics has some mutual issues with "Green Logistics" [2]. The new European Union (EU) "Thematic Strategy on the prevention and recycling of waste" sets out the objectives and means by which the EU can further improve the management of waste and make better use of its material and energy resources. In addition to that, the The Organization for Economic Co-operation and Development (OECD) is developing policies and tools in order to encourage waste prevention and minimisation and to manage materials in a sustainable manner. Needless to say, those measures triggered the "Municipality of Izmir - Turkey" in order to increase recycle waste. Municipality of Izmir set targets in terms of waste

recycling. Table 1: Illustrates past records and targets with regard to the waste types. This paper attempts to analyse current situation of reverse logistics channels for household waste collection. First of all, reverse logistics channel will be discussed and then a case study based on observation and interviews with the related participants will be presented in order to propose an efficient model for Izmir.

Literature Review

Reverse Logistics Concept

Concerns about the environment, sustainable development, regulations and profit issues made the companies responsive about reverse activities. Reverse movement can start [3]; (a) either when products or services have reached the end of their useful life, or (b) due to quality problems that occurs (returned products). Product in the reverse flow it will have been returned either by consumers or by other companies in the distribution chain [4]. Reverse logistics deals activities associated with the handling and management of equipment, products, components, materials or even entire technical systems to be recovered. If the value of the product and/or the return rate is high, reverse logistics activities can

Table 1: Recycle rate past records and targets for municipality of Izmir

Waste Type	Recycle Rate (%)									
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Glass	32	35	37	40	43	45	48	52	56	60
Plastic	32	35	37	40	43	45	48	52	56	60
Metal Cans	30	33	35	38	42	45	48	52	56	60
Paper	20	30	35	38	42	45	48	52	56	60

be very critical for the firm. Reverse logistics is one of the toughest supply chain challenges [5] and related with cost saving [6]. Reverse logistics is critical to overall corporate success [7-9]. The competitive advantage can be both tangible and intangible [10]. Traditionally it has been a function within the firm but now it has become an area of organizational competitive advantage [11, 12]. The significance of reverse logistics is seen in case of bottom line performance and environmental impact [13].

The scope of reverse logistics throughout the 1980's was limited to the movement of material against the primary flow [13] and one of the earliest descriptions for reverse logistics was given by Lambert and Stock in 1981. The Council of Logistics Management (CLM) published the first known definition of reverse logistics in the early nineties (Stock, 1992); "...the term often used to refer to the role of logistics in recycling, waste disposal, and management of hazardous materials; a broader perspective includes all relating to logistics activities carried out in source reduction, recycling, substitution, reuse of materials and disposal."

European Working Group on Reverse Logistics – REVLOG defines reverse logistics as "the process of planning, implementing and controlling backward flows of raw materials, in process inventory, packaging and finished goods, from a manufacturing, distribution or use point, to a point of recovery or point of proper disposal" [14,15].

From then to today some broader definitions were introduced however it is accepted in general that reverse logistics encompasses the logistics activities all the way from used products no longer required by the user to products again usable in a market. In these logistics activities the main operations are collecting and transportation of used products and materials [16]. As Reverse Logistics Association mentions it, reverse logistics is helping companies in every industry to achieve greater financial performance than ever before. In fact, reverse logistics is become increasingly recognized as an essential part of business success, and so the need for qualified reverse logistics professionals is exploding [17].

Supply chain networks are developed to speed outbound flow however they often are ill equipped

to handle reverse flow. New trend in supply chain management is the development of reverse logistics functions to manage the flow of products and services moving back through the supply chain [18] and needs different models for different product/package type for different industries. The reverse flow may involve an entirely different channel [19-21]. Such differences mean that new approaches are needed [22].

Reverse logistics management addresses a number of processes that have a direct or indirect impact to cost of quality. It applies to a network of activities that do take place in organizations but are either hidden or unrecognized and uncontrolled. The impact of reverse logistics management on environmental management, quality management and cost parameters has been addressed in the literature to some extent.

Reverse Logistics Channels and Household Reverse Channels

Reverse logistics activities are classified mainly as products (return to supplier, resell, recycle etc.) and packaging (reuse, recycle etc.) in practice [23]. Recycling introduces new flows in logistics channels. Some flows can directly adapted on the current structure but mostly new structure is needed. Also actors and their roles in the channels are changing. As Jahre [24] mentioned successful recycling requires that recyclables can compete with primary materials in price as well as in quality. In this point end-users level of consciousness, type of attitude and willingness comes very important. As Anderson and Brodin [25] mentioned, end-users who are consumer and produces household waste in this channel has a major role in recycling. End-user's role covers many topics, but most important is the active role in physical distribution.

The main criterion that is normally used to classify recycling schemes is whether the initial transport (delivery) is performed by the consumer (household) – i.e. bring schemes – or by a waste manager –i.e. kerbside collection [24]. An overall goal of such systems is to obtain high recovery rates for the lowest possible cost. A challenge in this respect is the inherent characteristic of uncertainty in supply [26]. Supply refers here to

'consumed items' that are being returned, i.e. products at end-of-life [27].

Methodology of the Study

This study attempts to explore the current situation of household waste collection channel structures in the metropolitan area of the city of Izmir, Turkey. An exploratory study was implemented in order to identify the recycling activities, collection activities and logistics functions of household waste collection. This part of the study attempts to define the "objectives of the study" and, "research approach and methodology".

Objectives

In this study we have three main objectives, which are shown below;

- To explore the different household reverse channels in Izmir,
- To define the participants of those channels and their logistics activities in the system,
- To bring preliminary solutions for the improvement of these reverse channels.

Research Approach and Methodology

A case study was implemented in order to cover the above-mentioned objectives. The case study was carried out with the participation of the different parties involved in the household waste reverse channel in Izmir. The sources of information were the interviews with;

- Director of "Department of Environment Protection & Development", Municipality of Izmir.
- Director of "Directorate of Waste Management", Municipality of Izmir.
- Manager of a recycling company operating in Izmir.
- Department Director of a recycling company in Izmir.
- Two managers of IZGEP (Recycling Company having multiple partners in Izmir)

The type of interview used was in-depth interview consisting of open-ended questions with regard to the above-mentioned objectives of the study. The interviews were conducted in August 2008.

Findings

Household Wastes in Izmir

Fractions in household waste are; paper, glass, metal Cans (Fe & Al) and plastic. Attributes of those materials are given as below;

•

- **Paper:** Almost any household waste paper can be recycled. Recycling paper requires 28-70% less energy, produces 95% fewer emissions, requires less water, and far fewer raw materials. However, paper cannot be recycled indefinitely.
 - **Glass:** Glass is infinitely recyclable with no loss in quality when reprocessed⁹. Recycling involves collecting bottles and jars, crushing and melting them in a furnace. Using recycled glass reduces the amount of energy required and the amount of new raw materials needed. Recycling also reduces CO₂ emissions.
 - **Metal Cans:** The two most common metal items found in household waste are aluminium and steel cans, which together comprise 3% of household waste. Aluminium and steel can both be recycled indefinitely as the metal can be re-melted without any loss of quality. Recycling aluminium is very energy efficient; producing aluminium from recycled materials uses only 5% of the energy used in primary production and generates only 5% of the greenhouse gas emissions associated with manufacture from raw materials
 - **Plastic:** Recycling plastic is complicated by the fact that there are about 50 different types of plastic. Currently, plastics must be sorted manually into the different types prior to recycling although technology is being introduced for automatic sorting.
- Our case study is based on non-hazardous materials and packages. Hazardous materials were excluded from the scope of this case study.

Household Reverse Channels in Izmir

There are two types of household behaviour in Izmir. First type of households are not involved any sorting activity. Waste materials are delivered to the trash containers by using various types of plastic bags. Some apartment buildings have dedicated employees for this delivery. It can be said that the only value addition activity of the households as the first stage of the channel is to collect, store and bring the waste materials to the collection level. The official waste collectors operated by the municipalities collect waste materials. Collected waste materials are delivered to the transfer levels located in *various locations in Izmir* by using the waste trucks. These transfer levels are not involved in any sorting activity. In other words, these transfer stations only give the consolidation service for the waste materials. The next level for the consolidated waste materials is to go either landfill field where only long term storage is achieved or to go compost field where value

addition activity is done on the waste material (See **Fig. 1-Channel Type I**). Considering the fact of valuable materials in waste materials, above stated channel has an alternative flow in many parts of Izmir (See **Fig. 1-Channel Type II**). Unofficial waste collectors coming before the official waste collectors dig, sort and collect the valuable materials (paper, glass, plastic and cans) from the waste containers. In terms of logistics point of view, intensive value addition is achieved in the collection level of the channel. Estimated number of these unofficial collectors is 10,000 within the municipality of Izmir. Although, they are not involved in any official organization, they have a very strong coverage and sorting competency. They work only in their locations using at least two shifts. These waste collectors are from the poor and underdeveloped areas of the city. Working conditions are very poor for these waste collectors and they are exposed to infectious diseases due to the substandard health conditions. Waste collectors mainly use very primitive handcarts. Valuable materials are delivered to the small transfer levels by the waste collectors. Although waste collectors sort the paper, glass, plastic and cans in the drop-off centres (waste containers), they do not sort these valuable items within their handcarts. Registered and unregistered small transfer stations operate in Izmir. Sorting function is not taken place in every transfer station. The transfer stations transfer materials to the big scale operators. Sorting function is achieved for the materials in this level. They serve to the domestic and international end markets.

On the other hand, second type of households is involved in the sorting activity (See **Figure 1-Channel Type III**). Private companies are

involved in this process as the main organizer of this process. In this channel type (**Fig. 1-Channel Type III**), households are encouraged to separate recyclable materials from the rest of their waste and either put them into a kerbside box or take them to a collection point. Although, the legislation includes measures to force the households to this process, at present, there are no actions to compel them to do so. In order to increase the response rate from the households, training activities have been achieving especially among the young Primary and High School students.

Jahre [24] suggested the *collection complexity* and *sorting complexity* in household waste channels. If recyclables are separated at source, *sorting complexity* is low; however, due to the sorted materials *collection complexity* is high. In other words, the larger the number of fractions in relation to the number of materials, the higher the collection complexity.

As far as the case of Izmir is concerned, household behaviour tends not to participate in sorting activity. Needless to say, unofficial waste collectors play an important role in terms of eliminating the sorting and collection complexities at the same time. Although we do not have an official figure, their contribution to the recycling process is very high. Some estimates that that they collect 100 kg waste in a day.

We believe in the importance of individual (unofficial) waste collectors in order to increase the recycling rate in Izmir. However, they need to be managed by an authority in order to increase the service level. We propose a system in order to make the system more efficient.

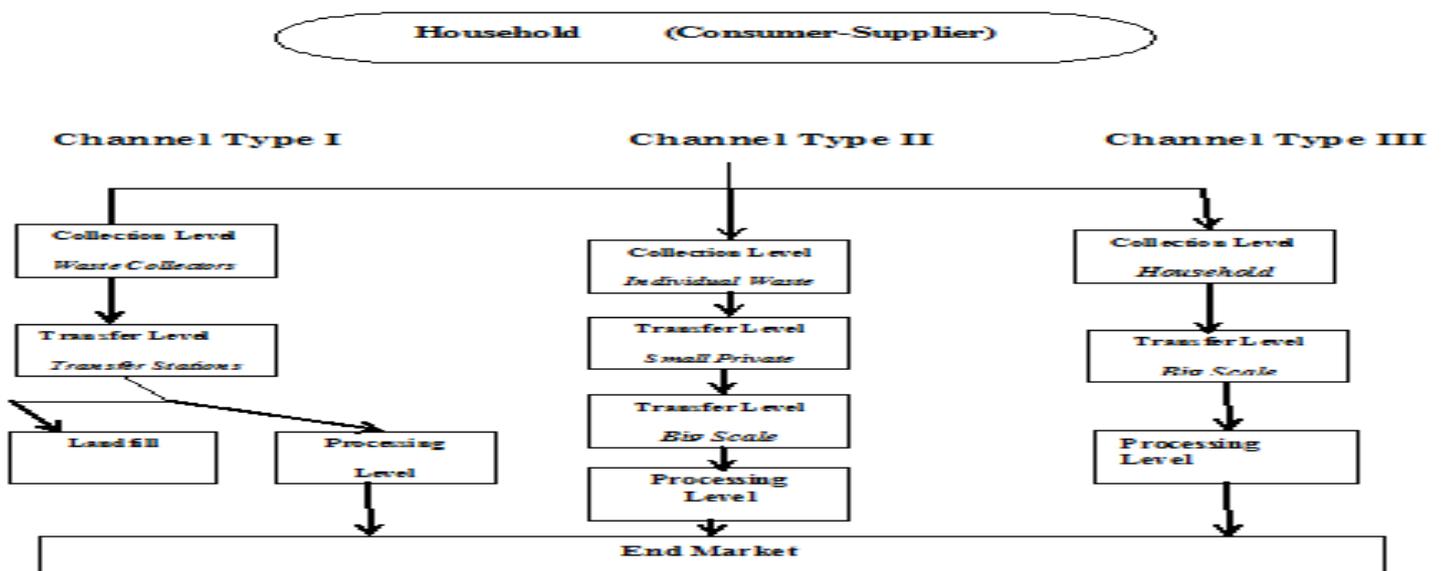


Fig. 1: Household waste collection channels in izmir

Coordinated Activity: These waste collectors do their activities individually and in a very fragmented way. They determine their locations and working times. Needless to say, they may cause some problems especially in terms of traffic jam in some part of the city. In order to achieve the coordinated activity among those collectors, a central body is needed. Municipality of Izmir can take an active role to educate, organize and direct those waste collectors in a much more efficient way. We propose the “*individual waste collector certification*” for those collectors.

- **Improvement in Health Conditions:** Working conditions are very poor for these waste collectors and they are exposed to infectious diseases due to the substandard health conditions. Health conditions can be improved by using special garments and mandatory health check-ups. Some municipalities in Turkey started to check health conditions of those collectors in their cities.
- **Improvement in Tools:** Waste collectors mainly use very primitive and sub-standard handcarts. A dedicated and standard handcart can be designed in order to enhance the collection and sorting activity of those collectors. Individual collectors operate their handcarts by their power. These handcarts can also be powered by alternative energy sources (battery etc.).

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- **Micro Finance:** We approach those collectors as the entrepreneurs. As already mentioned, 10,000 waste collectors are involved in

recycling activity in Izmir. They can be financed in that manner in order to improve their activities.

Conclusion

Recycling of household waste is very strategic because of reducing environmental risks and also giving to end-user money saving guarantee in some cases. Models developed for to increase the recycling rate are mainly based on households. They are encouraged to separate recyclable materials from the rest of their waste and either put them into a kerbside box or take them to a collection point. These models also suggest big-sized recycling firms in order to collect the waste from collection points. Without any economic interest, the consumer is likely to take a passive role as supplier in the system (Flygansvær, 2003). However, we showed another channel type where individual waste collectors play an important role. We also observed that those collectors make an important contribution to the recycling process. Those waste collectors must be approached as the small entrepreneurs in recycling business and encouraged to do their activities in a much more efficient way. Those waste collectors are very important intermediaries in developing countries. Eliminating their jobs can cause big social problems.

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