The necessity of using information technology in Reverse Logistics

Mohammad Rezaee and EsmatzareReisabadi

Department of Industrial Engineering, Persian Gulf University of Technology, bushehr, Iran.

ABSTRACT
Reverse logistics or returns management is one of the subjects that have received increasing attention in logistics and supply chain management in different industries during this period. In recent decades, many companies in developed countries have begun searching in this subject and taking it into account as one of the main processes in their supply chain management. Reverse logistics gain increased attention globally for economic and environmental reasons and it has caused to existence of new global competition between organizations. Reverse logistics include all operations that are related to the product returns such as: collection and inspection, material classification, processes related to returns, reuse and extension of useful lifecycle for used products. Nowadays, making connection and information transaction with suppliers, manufacturers and customers without information technology supporting, is not possible; according this, implementing information technology and e-commerce play an essential role in the chain. E-commerce focused on sharing business information, operating business negotiations, maintaining business relationships, settling and executing agreements by means of telecommunication networks, often the Internet, in order to achieve business transactions. In this paper, at first we consider the reverse logistics and related processes, then we discuss about the differences between forward and reverse logistics, the role of information technology and e-commerce, and new e-business models in reverse logistics. Finally, we talk about the challenges in this topic.

INTRODUCTION

Today, increasing in complexity of production process and number of competitors on the world stage has led traditional methods not to work as before and with the development of global competition, various products have to be made available to the customer at the right time and place. Hence, has been emphasized on customer satisfaction more than before and with increasing diversity in products, customers are demanding higher quality product and service before and after sale from the manufacturer. Thus intensifying global competition and customer demand on high quality and fast service has led to the organizations cannot handle all tasks alone.

In order to avoid incurring high cost of traditional methods to system and moving toward integration and coordination of all activities related to the organization, they need resources and bodies outside the organization.

Supply chain management is a strategy that in addition to reducing costs, leads to greater reliability and faster servicing to customers. One of the significant issues in the field of logistics and supply chain management of different industries is: "reverse logistics and returns management", that it has not been seriously considered so far. In most industries, managers focus on control and management the direct flow and forward of product that moves from the suppliers to manufacturers, distributors, retailers and ultimately the consumer. But in many industries, there is another important process in supply chains, that is formed as reverse flow and the goods will be returned from lower levels to higher levels of chain. Reverse logistic is seeking to evaluation and management of backward flows or in other words the reverse flow in supply chain.

Overall, the value of returns is estimated to be around $43 billion per year, representing an average of 15%-20% of all goods sold [1]. With continuing pressures to reduce operating costs while often incurring additional costs brought about by environmental restrictions, firms must be concerned with the costs of returning materials associated with the products that they deliver [2]. During the last two decades, many companies and industries in developed countries, began investigating in this field and reverse logistics is considered as one of the key processes in their supply chain. Today, in developed countries, the focus of industrial organizations and

Corresponding Author: Mohammad Rezaee and EsmatzareReisabadi, Department of Industrial Engineering, Persian Gulf University of Technology, bushehr, Iran.
services, government and the business firms is on processes of reverse logistics and closed loop supply chain that this is a basis for creating economic real value for goods and services with environmental considerations. Reverse logistics and closed loop supply chain management is one of the important and vital aspects of any business and ensures the manufacturing, distribution, service and support for every type of product. In the current business era that product life cycles are getting shorter every day, Returns policy is defined with a quick response time and greater emphasis is on return management, transformation and restore of finished goods. Also, new government regulations and green regulations that are related to restore and outdated electronic waste and other hazardous materials has forced senior managers in charge of the logistics supply chain processes to a closer look at their reverse logistics processes.

2 The main processes of reverse logistics:

The main reverse logistic processes are 1-collection; 2-inspection, selection and sorting; 3-reprocessing (including repair, refurbishing, remanufacturing, retrieval, recycling and incineration) or direct recovery; and 4-redistribution. Figure 1 presents further definitions about this concept.

In collection, used products are moved to a place for some specific treatment [3].

In inspection and separation, products are inspected and separated by both their reusability and how they can be reused. Inspection and separation include activities such as disassembly, shredding, sorting, testing, and storage.

Reuse determines whether products still have enough quality and are in good enough condition that they can be used again. Examples are reusable bottles, containers, and most rented facilities [4].

In reprocessing, a used product is converted into a usable product. This can happen at different levels: material (recycling), component (remanufacturing), product (repair), selective part (retrieval), module (refurbishing), and energy (incineration).

In recycling, product forms are changed into more basic forms such as scrap metal, glass, plastic, and paper [5].

In remanufacturing, a product in whole or in part is used to create a new and usable product. Some of these activities include cleaning, disassembly, replacement, and reassembly [4].

In repairing, broken products have some aspect of their life cycles restored, possibly with a loss of quality [5].

Refurbishing refers to upgrading a product.

In incineration, products are burned and the released energy is captured.

In disposal, useless products that cannot be reused because of technical or economic reasons are discarded.

In recovery, used material is captured, repaired, and remanufactured, a process that adds value [5].

In redistribution, products are distributed to different markets. This step consists of storage, sales, and transportation [4].

Fig. 1: Product flow in the reverse logistics

3 Differences between Forward and Reverse Logistics:

Reverse Logistics includes all activities in supply chain that are happening in reverse. Table 1 shows comparison between direct logistics (forward) and reverse logistics in different aspect [6],[7].
<table>
<thead>
<tr>
<th>forward logistics</th>
<th>reverse logistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prediction is relatively straightforward.</td>
<td>Prediction is more difficult.</td>
</tr>
<tr>
<td>Transportation is one to many</td>
<td>Transportation is many to one.</td>
</tr>
<tr>
<td>Product quality, packaging, and pricing are relatively uniform.</td>
<td>Product quality and packaging are not uniform.</td>
</tr>
<tr>
<td>Destination, routing, and disposition options are clear.</td>
<td>Disposition and destinations and routing are unclear.</td>
</tr>
<tr>
<td>Accounting systems closely monitor forward distribution expenses.</td>
<td>Measuring reverse expenses usually is impossible.</td>
</tr>
<tr>
<td>Transactions between parties are straightforward.</td>
<td>Extra discussion brings about complexity in transactions.</td>
</tr>
<tr>
<td>There are clear marketing methods.</td>
<td>Complexity in marketing.</td>
</tr>
<tr>
<td>Inventory management is congruous.</td>
<td>Inventory management is not congruous.</td>
</tr>
<tr>
<td>Product life cycle is controlled.</td>
<td>Estimation of product life cycle is more difficult.</td>
</tr>
<tr>
<td>Real-time data is easily available to track product.</td>
<td>Process is invisible.</td>
</tr>
</tbody>
</table>

4 Importance of Information Technology in Reverse Logistics:

Today, due to increased business competitiveness especially in the realm of logistics activities and rising costs achievement to resources, the importance of efficient use of resources is evident. On the other environmental concerns and creating a financial interest in the reuse of parts and products has led to more popularity of reverse Logistics. So organization to remain competitive and increase the speed of response to customers, makes strategic decisions in different time (short term, medium term and long term) but due to the poor quality of information and lack of integrity at different levels, decision-making in order to improve the reverse logistics and direct coordination with the forward logistics is difficult and costly.

Information is considered one of the most important components of each chain and infrastructure of integration in supply chain management, coordination and decision-making in time. Hence, managers need accurate and in time information to make decisions in these fields and take advantage of the achievement of management science and technology including the Internet, World Wide Web of information technologies such as e-commerce.

New information technologies can affect the organizational structure, strategy, exchange correspondence and communications, operational procedures, relations customer - supplier and bargaining power and it leads to increased productivity, flexibility and competitiveness of the organization [8]. Gunasekaran et al., provided a framework for measuring costs and performance measurement in virtual enterprises and supply chains in order to increase competitiveness in the world markets. In this framework, authors emphasized on the role of IT and knowledge and skills related it in the 21st century [9].

IT can influence three parameters: speed, time and cost activities and provides three overall changes in an organization the following:

- Replace (automating existing processes)
- Support (assistance for existing processes such as decision-making and communication)
- Innovation (Ability to create new methods)

4.1 The necessity and applying of ICT systems in reverse logistics:

Recently, concepts related to design and supply chain management has become topics of interest and this has led to the development of information and communication technologies such as EDI, Internet and World Wide Web, because in this way, it can dominate better on the complexity of the relationship between the buyer - customer [10]. In addition to enhanced performance, it increases the level of customer service. Investment in information technology in the supply chain, not only increase profits and improve the company's financial performance, but also has a positive impact on the profitability and performance of all members of the company that are linked in a chain [11].

Sharing of information between members of a supply chain using EDI technology should be increased, thereby reduce uncertainty and increase performance of shipping between suppliers and ultimately increase the overall performance of the chain. To acquire a supply chain with the ability to use information technology, companies need to redesign the organizational and technical processes, changes in the traditional distribution channels, methods of customer service and staff training that requires enormous costs. To develop and implement an integrated supply chain through information technology, there are many problems such as lack of integration between IT and business models, poor infrastructure for IT and the failure to use information technology in virtual enterprises [12]. ICT systems in reverse logistics include three major issues the following:

1. Facilitate the process, particularly support activities related to reverse logistics
2. Product information, including data related to type and how to return
3. Redistribution in market and in particular trying to integrate market

It is obvious; Product information is the essential component in efficient administration of the returning, however, due to uncertainties in some important features such as place of start, time of return and quality, ICT systems are faced with certain complexity. Since the information about returning is rarely available. The ICT systems acquire the information and important data from the previous systems and in some cases, the major information are collected by the monitoring and reverse engineering. The ICT systems that are used to control
and coordinate the reverse logistics processes, is applying for the decision-making to select the appropriate restore method (including: proper using, reproduction and recycling) and also supports the administrative tasks related with returning in order to achievement to better management and more efficient. After resuscitation, parts and products used must be returned to the market, but the markets are demanding these products are scattered and with expanding the use of e-commerce in recent years, many efforts have been made to integrate the electronic specialized markets.

4.2 The Interactivity Issue between Forward and Reverse Logistics IT systems:

The need for co-ordination among processes between forward and reverse logistics system also imposes a requirement for interactivity between the supporting IT systems. Business processes between trading partners in the forward supply chain have been supported by legacy EDI systems and Value-Added Networks (VAN) for electronic transactions and network configuration, respectively. This relationship, often described as business-to-business E-commerce and networking infrastructure is also known as Extranet. Electronic Data Interchange (EDI) allows trading partners to exchange information electronically in a very compact, concise and precise way and it provides different transaction sets for various types of business activities. The "180 transaction set" is, in principle, the transaction set that supports some aspects of reverse logistics. However, in practice, it is seldom used. [4] contains a very detailed presentation on this topic. EDI applications are based on structured protocols, pre-established arrangements and bilateral information exchange; thus, a transaction supporting software is really necessary. Conventional EDI has been criticized for being expensive in terms of initial investment on infrastructure, software and training. Furthermore, because of its structure, this arrangement establishes and supports continuous relationships between known trading partners, thus creating a closed-club kind of electronic marketplace.

Addressing these technical impediments, the emerging standard XML/EDI provides the means for integrating EDI applications with the Web. Benefits resulting from this arrangement include lower costs, easier introduction of new trading partners and increasing commercial activity. From a reverse logistics viewpoint, there is the added benefit that XML/EDI can be the tool for interacting IT systems specifically designed for reverse logistics and legacy EDI systems that are still in use in the forward supply chain. Concluding, many different types and platforms of systems may co-exist to serve different business needs, as shown in Figure 2.

![Fig. 2: IT systems for forward and reverse logistics](image)

Figure 2 presents three levels of networking infrastructure. Firewalls may be implemented to provide secure systems. Access originating from an organization outside the protected area can be denied if it violates security authorizations, whereas communication with trading partners (organizations that are located in the same ring) is supported through the networking structure.

4.3 Emerging IT Paradigms for Reverse Logistics:

It is interesting to point out that some existing Internet applications, although not directly related to reverse logistics, have quite promising potentials for this area, as well. For example, several Internet-based applications support aspects of mass customization in the sense that they provide interactivity to potential customers who are
interested in purchasing products that are configured based on their own specifications (i.e. buying a computer from www.dell.com). From a reverse logistics point of view, it is interesting to note how easily accurate information can be collected from an E-commerce application regarding current customers’ needs on specialized, high-value products and their future influence on the reverse supply chain; albeit privacy protecting should also be ensured.

Moreover, there is a class of existing Internet-based applications (i.e. www.firefly.com) that capture data on their members’ behavior to classify their clientele into groups of customers with similar preferences. Upon an event of interest (i.e. purchase of certain products by any member of a group), the relevant data may also be used to promote the same items to the rest of the group with an expected high degree of acceptance. From a reverse logistics perspective, such mechanisms enable interested parties to capture accurate information on different fragments of the market and identify possible trends or price changes.

4.4 E-Commerce and Reverse Logistics:

In the shadow of reverse logistics, e-commerce is developing as business products and parts used including marketing, purchase, sales and after-sales support and information technology can support from e-commerce activities by integrated and rapid data. The general aspects of E-commerce for Reverse Logistics are summarized in Table 2.

Table 2: E-commerce relation to reverse Logistics

<table>
<thead>
<tr>
<th>E-Commerce Applications</th>
<th>Reverse Logistics Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marketing</td>
<td>Advertisement of available used</td>
</tr>
<tr>
<td></td>
<td>Products, parts or material.</td>
</tr>
<tr>
<td>Purchasing</td>
<td>Search for suppliers/customers</td>
</tr>
<tr>
<td></td>
<td>Making purchasing commitments</td>
</tr>
<tr>
<td></td>
<td>Receive information of expected delivery</td>
</tr>
<tr>
<td></td>
<td>Respond to request for sought used products, parts or materials</td>
</tr>
<tr>
<td>Sales</td>
<td>Price setting (i.e. fixed, negotiations, auction)</td>
</tr>
<tr>
<td></td>
<td>Order processing</td>
</tr>
<tr>
<td></td>
<td>Tracking and tracing orders</td>
</tr>
<tr>
<td></td>
<td>Customer invoicing, collection and payment</td>
</tr>
<tr>
<td>Post Sales/Service</td>
<td>Product tracking</td>
</tr>
<tr>
<td></td>
<td>Customer support</td>
</tr>
<tr>
<td></td>
<td>Customer / product monitoring</td>
</tr>
</tbody>
</table>

4.5 The new e-business models in reverse logistics:

Based on general e-business models, three e-business models that relate to reverse logistics is presented. These reverse logistics e-business models, namely returns aggregators, specialty locators and integrated solution providers are classified according to three characteristics: their degree of integration for reverse logistics activities, the level of control exercised upon their trading partners and the kind of added value they offer [13]. Figure 3 outlines their rating with respect to these parameters.

![Diagram](image)

Fig. 3: Characteristics of E-business models
4.5.1 Returns aggregators:

Returns aggregators bring together suppliers and customers; automate the procurement of returns and createvalue through high throughput and minimal transaction costs. A returns aggregator differs from consolidating returns channel in that they handle returns from many different OEMs, without owning products. There are returns aggregators for different returns flows, that is:

- production waste (www.metalsite.com),
- commercial returns (www.qxl.com),
- end-of-use products (www.ebay.com), or
- their combination like www.180commerce.com).

4.5.2 Specialty locators:

Whereas returns aggregators emerge in markets with commodity-like returns, specialty locators are focused inniche markets. Specialty locators are vertical portals, which focus on highly specialized used parts or products. Such electronic marketplaces can serve the need for authentic antiques, exact replicas parts or equipment in historic restoration projects or the maintenance process for vehicles and industrial equipment.

4.5.3 Integrated Solution Providers:

The integrated solutions providers go a step beyond facilitating and matching demand and supply of returns. They capitalize on their distinctive expertise and use Web technology as an enabler to provide unique services. Furthermore, they actually become the owners of the returns instead of implementing a brokering mechanism as the previous two models. This model aims to forge strong relationships with long-lasting customers in industries where the cost of a return itself may not be high.

4.6 Challenges of e-businesses in reverse logistics:

Returns aggregators have low entry barriers, so, it is likely that they will face an increased number of competitors in the long run. Therefore, implementing value-added services for returns aggregators would contribute to their competitive advantage. From an IT perspective, such services include the use of product coding and representation, the extension of the single attribute (price only) e-auction into a multi-attribute e-auction (service, warranties, financing services, etc.) and the dynamic matching algorithms to smooth peaks and valleys of supply and demand. In addition to technical features, to address customer satisfaction, a regulatory infrastructure or legislation may apply. For example, the Aucnet system[14] provides a standardized rating system for the quality of items featured in this marketplace. New hyper mediators can be associated with the returns-matching-requests model to address conflicts between buyer and seller (e.g., if the goods delivered do not meet the specifications). Finally, new policies for customer satisfaction should be crafted to manage the returns of new products in the case of unsatisfactory transactions.

Specialty locators offer higher added value in markets with relatively expensive or complicated returns wherein they create and promote standards for trading these kinds of returns. Mapping customer decision-making parameters in this model is a crucial success factor. Specialty locators can benefit both by the direct outcome of their sales and by the capitalization of their customer base; namely, by means of operation specialty locators have contributed to the formation of a digital community with special interests in a very well defined market segment. This information has high value for all players in this market segment.

An integrated solution provider for reverse logistics could be a niche market by itself. Recent developments with IBM and Dell substantiate this point. IBM promotes integrated solutions for reverse logistics currently in the intra-organizational level, only. Based on press announcements, IBM plans to launch within 2001 its Information Database Warehouse which will provide unified view of like parts across IBM's divisions and the PELM (Product End-of-Life Management Service) which will enable large customers to turn in old PC and PC parts paying a small per unit disposal fee. Dell also plans to launch a pilot program to bring online their reverse logistics program and make it accessible to customers by ordering new systems and giving away old ones in a one stopway.

Conclusion:

Use the information technology and electronic commerce for reverse logistics is an area that is rapidly developing. Remove the returning speculators, direct contact with customers, reduce costs of returning, increase customer satisfaction, more access and accurate data related with returning customer and fast information transfer to Customers and suppliers are the main advantages of e-commerce for reverse logistics. On the other hand, the possibility of comparing and evaluating returning products to make better decisions towards the purchase of new products and giving away old ones to vendors (respectively) expands the web markets.

A significant challenge of e-commerce in the field of reverse logistics is the returns uncertainty and information related with it that makes difficult to accurate evaluating, comparing and determining mechanisms for the price and sales returns in electronic markets. One of the essential approaches to overcome challenges is...
standardization of information on reverse logistics processes, providing effective environmental indicators and use multi-criteria decision-making approaches to increase the utility of pricing mechanism and cost accounting in the web markets.

REFERENCES