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Reverse Logistics: Opportunity to Reduce Costs by Integrated Value Chain Management

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ABSTRACT: The article discusses an aspect of logistics that is taking on increasing importance for companies. While traditional logistics deals with the outflow of products, reverse logistics is concerned with the return of products, materials and parts to the company's productive process. Due to stricter environmental legislation and greater environmental awareness among consumers, companies are not only using more recycled materials, but also having to worry more about ecologically correct disposal of their products at the end of their life cycle. Besides this, many firms have been making reverse logistics a strategic part of their business planning. All this is prompting the development of reverse logistics in companies. In the Brazilian case, according to reverse logistics specialists, this area is now considered an important element in strategic planning, for compliance with current environmental legislation. This work discusses opportunities for firms to reduce costs through value-chain management, with the involvement of all components. The method used is a case study of a soft drink bottler.

Keywords: logistics, reverse logistics, strategic cost management.

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1. INTRODUCTION

Logistics, according to the Brazilian Association of Logistics, is defined as:

> *The process of planning, implementing and controlling the efficient flow and storage of raw materials, products undergoing processing, finished products and related information from the point of origin to that of consumption, with the objective of meeting customer demands.*

Reverse logistics encompasses all the processes described above, but in the reverse order. For Rogers and Tibben-Lembke (1999), reverse logistics is:

> *The process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements.*

Reverse logistics is a very general term. In its broadest sense, it means all the operations involving the reuse of products and materials. Reverse logistics refers to all the logistics activities to collect, disassemble and process used products and/or materials and parts, to assure sustainable recovery (environmentally friendly). (REVLOG: 2002). As a logistical procedure, it involves the flow of materials back to a company for some reason (returns from customers, return of packaging, return of products and/or materials to satisfy legislation). Since it is an area that normally does not involve profit (instead only costs), many companies do not give it the same attention as to the normal outflow of products. Even the technical literature on logistics has only recently begun to address the theme.

This work is divided into two parts. In the first, basically theoretical, we start by situating reverse logistics as one of the topics dealt with by product recovery management. We then explain the strategic and cost motives that lead companies to focus increasingly on reverse logistics, and end with a discussion of supply chain management and its importance in the full implementation of a reverse logistics system. In the second part we present a case study that covers all the items touched on earlier and suggests possibilities for gains, if the company studied applies them in developing a good reverse logistics system.

2. PRODUCT RECOVERY MANAGEMENT (PRM)

Management of the operations that compose the reverse flow is part of product recovery management (PRM). PRM is defined as "*the management of all used and discarded products, components and materials for which a manufacturing company is legally, contractually or otherwise held responsible*". (Thierry et al., cited in Krikke: 1998, p. 9). Some of its activities are, in part, similar to those that occur in the case of internal returns of defective items due to faulty production processes. PRM faces a series of administrative problems, among them reverse logistics. The six main areas of PRM are: (Thierry et al., cited in Krikke: 1998, pp. 11-20).

Technology: This area includes product design, recovery technology and adaptation of primary processes.

Marketing: This involves the creation of good market conditions for those who are discarding the product and for secondary markets.

Information: This involves forecasting supply and demand, as well as adaptation of information systems in companies.

Organization: This involves distribution of tasks to the various actors according to their position in the supply chain and business strategies.

Finance: This includes the financing of supply chain activities and evaluation of the return flows.

Reverse logistics and administration of operations: This is the focus of this work, and it will be examined in more detail below.

The objective of PRM is to recover, as much as possible, the economic and ecological value of products, components and materials. Krikke (1998, pp. 33-35) establishes four levels at which returned products can be recovered: products; modules; parts; and materials. Recycling is recuperation at the materials level, this being the lowest level.

Table 1 below describes the recovery options:

Table 1: Summary of product recovery options (Adapted from Krikke, 1998, p. 35)

PRM Option	Level	Quality Requirements	Resulting Product
Repair	Product	Restore the product to full operation	Some parts are repaired or replaced
Refurbishment	Module	Inspect and update critical modules	Some modules are repaired or replaced
Remanufacture	Part	Inspect all modules/parts and update	Used and new modules/parts in a new product
Cannibalization	Selective recovery of parts	Depends on use in other PRM options	Some parts are reused, others discarded or recycled
Recycling	Material	Depends on use in remanufacturing	Materials used in new products

Different companies use one or more PRM options. Consequently, their reverse logistics systems must be designed according to the PRM option(s) employed. The correct planning and organization of reverse logistics is fundamental for PRM to go smoothly.

3. IMPORTANCE OF REVERSE LOGISTICS

Lambert et al (1998, pp. 13-19) relate the following activities as part of a company's logistics management: customer service; order processing; distribution communications; inventory control; demand forecasting; traffic and transport; storage and stocking; location of factories and warehouses/deposits; movement of materials and supplies; support for replacement parts and services; packaging; reuse and removal of waste/rejects; and administration of returns. Of all these activities, reverse logistics includes reuse and removal of waste/rejects and administration of returns.

The reuse and removal of waste/rejects involves the way the byproducts of the productive process will be disposed of or reincorporated in the process. Due to increasingly strict environmental laws and regulations, the manufacturer's responsibility over the product is expanding. Besides the refuse generated in the productive process itself, the maker is being held liable for the product until the end of its useful life. This has been expanding an activity that previously was restricted in its premises.

Traditionally, manufacturers did not feel responsible for their products after consumption. Most used products were thrown out or incinerated, causing considerable harm to the environment. Currently, more demanding legislation and consumers who are more environmentally concerned are causing companies to rethink their responsibility for their products after use. European legislation, particularly in Germany, is pioneering on the matter of disposal and/or recycling of consumed products (Rogers and Tibben-Lembke, 1999). Administration of returns (which is called reverse logistics by Lambert et al.) involves the return of products to the vendor because of defect, excess, incorrect items received or other reasons (Lambert et al., 1998, p. 19).

Here we consider reverse logistics to be both the activities described above (reuse and removal of refuse and management of returns), not just the second one, as Lambert et al. (1998) do. Various studies and works show the importance of paying attention to this side of logistics. Caldwell (1999) conducted interviews in various companies and showed how a small investment in reverse logistics management can result in substantial savings. He cites an executive of Sears who says that "reverse logistics is the last frontier for reducing costs."

The main problem indicated by Caldwell (1999) is the lack of computerized systems to enable integration of reverse logistics with the normal distribution flow. For this reason, many companies develop proprietary systems or outsource this task to specialized firms that are better prepared to deal with the process.

All the authors consulted in this study show the savings related to good reverse logistics management. Rogers and Tibben-Lembke (1999) studied a retail company that obtained 25% of its profits from better management of its reverse logistics. Caldwell (1999), among other cases, specifically mentions Esteé Lauder Corporation, which managed savings of US$ 30 million because of products it no longer threw out (cutting disposal in half) after implementing its reverse logistics program (whose in-house development cost US$ 1.3 million, recovered in one year just with the savings in labor costs for product returns). Other authors (Terry, 2000; Quinn, 2001) also mention large savings by companies that implemented reverse flow control.

There are no exact data on how much the costs of reverse logistics represent to the Brazilian economy. Considering the estimates for the American market and extrapolating to Brazil, the costs of reverse logistics represent approximately 4% of the total logistics costs, which according to the Brazilian Association of Shipment and Logistics was US$ 153 billion in 1998.[2] These numbers have certainly increased, as reverse logistics has grown in importance since that estimation.

Although many companies realize the importance of reverse flow, the majority of them have difficulties or disinterest in implementing reverse logistics management. The lack of off-the-shelf computer systems that integrate with the existing systems for managing traditional logistics (Caldwell, 1999), the difficulty of measuring the impact of returns of products and/or materials, with the consequent lack of knowledge of the need to control them (Rogers and Tibben-Lembke, 1999), the fact that the reverse flow does not represent revenues, but costs instead, as such receiving less or no priority (Quinn, 2001), are some of the reasons suggested why companies fail to implement reverse logistics systems.

For example, the attention that beverage companies pay to returnable bottles and packing crates would benefit hugely from good reverse logistics. Caldwell reports big savings by a Coca-Cola bottler in Mexico after implementing a reverse logistics management system.

These gains ranged from better coordination between promotions and peaks expected in bottle returns, reducing the need to produce new bottles, to reduction in output of plastic

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[2] Cited by *Guia de Logística*, at http://www.guialog.com.br/estatistica-log.htm. Accessed on April 16, 2002.

non-returnable bottles because of better control of glass ones, which had already been paid for. In the case of Brazil, recycling of aluminum cans has been generating excellent results from an ecological and financial standpoint, since it is considerably reducing the amount of raw materials imported, putting the sector among the greatest recyclers of aluminum in the world.

Lambert et al. (1998, pp. 28-30) point out that logistics plays an important role in strategic planning and as a marketing tool of companies. Those with good logistics systems achieve a considerable competitive advantage over those without one. Its big contribution is in expanding customer service, satisfying demands and expectations. The authors researched are unanimous in placing reverse logistics as a fundamental part of companies' logistics systems. Nowadays a logistics system cannot be complete without incorporating reverse logistics.

So, it is just a question of time until reverse logistics occupies a position of honor within companies. Those that are faster will have a greater competitive advantage over those that are tardy to implement reverse flow management, an advantage that can translate into lower costs or better customer service. An integrated supply chain will also be necessary. The reverse flow of products must be considered in the logistics coordination between companies.

4. REVERSE LOGISTICS: REASONS AND CAUSES

According to the RevLog Group (an international working group for the study of reverse logistics, involving researchers at various universities worldwide under the coordination of Erasmus University of Rotterdam, Holland), the main reasons causing firms to make bigger efforts to improve reverse logistics are:

(1) Environmental legislation, which forces companies to take back their products and take proper care in their treatment;
(2) Economic benefits of using products that return to the production process, instead of the high costs of correct disposal of trash;
(3) Growing public environmental awareness.

Besides these reasons, Rogers and Tibben-Lembke (1999) also point to strategic motives, such as:

(1) Competitive reasons – differentiated by service;
(2) Clearing the distribution channel;
(3) Protection of profit margins;
(4) Recapture of value and recovery of assets.

Whatever the reasons may be that lead companies to worry about the return of their products and/or materials and to try to manage this flow scientifically, the end result is reverse logistics. According to Bowersox et al. (1986, pp. 15-16), the logistical process is a system that links the firm to its customers and suppliers (Figure 1). The logistics process is presented in terms of two interrelated forces: the flow of added-value stocks and the information flow needs.

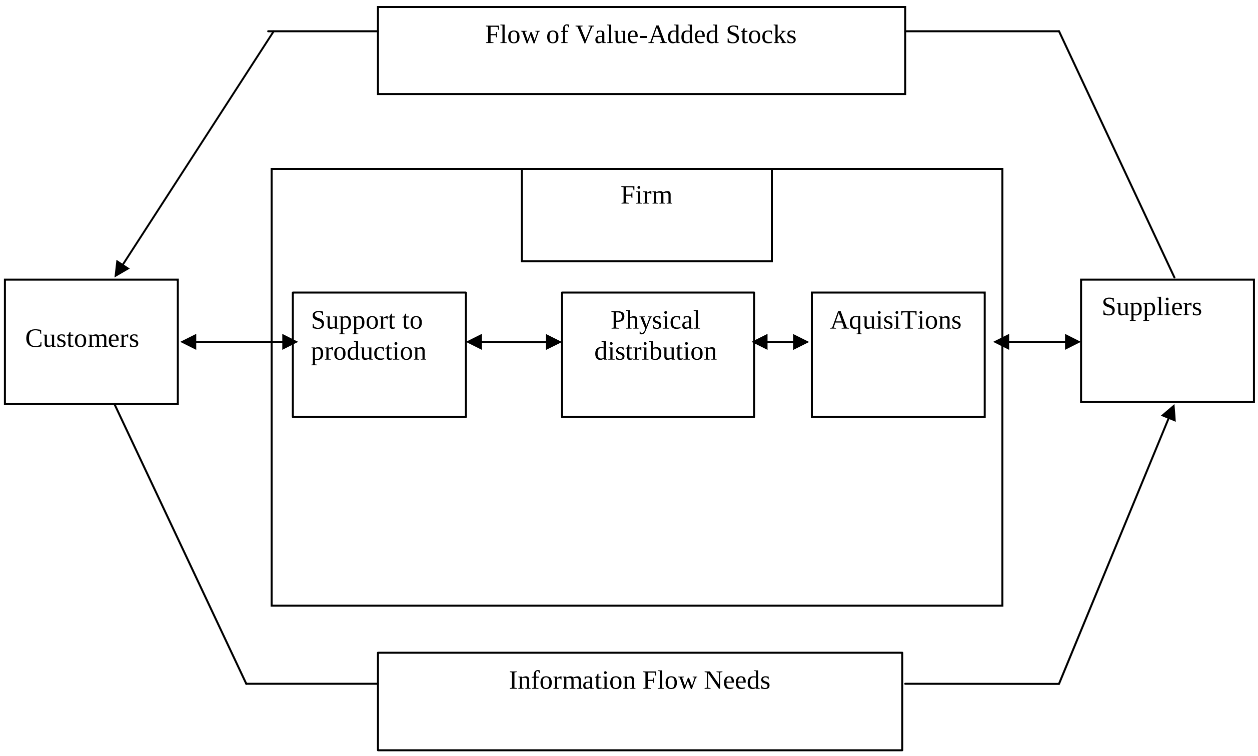

Figure 1. Logistics System – Bowersox et al (1986, p. 16)

Although logistical planning often only prioritizes the study of the product flow in the company-customer direction, Bowersox et al. (1986) also places importance on the reverse flow. Whether this is due to recalls made by the company itself, products that have passed their sell-by dates, responsibility for correct disposal of hazardous products after use, defective products returned in exchange, customers who change their minds, or legislation, the fact is that reverse flow is a common factor.

> *[...] Reverse logistics does not necessarily serve to improve logistical productivity. However, reverse movement is justified on a social basis and must be accommodated in logistical system design. [...] The important point is that logistical strategy cannot be formulated without careful consideration of reverse logistical requirements.* (Bowersox et al, 1986, p. 16).

In logistical terms, when we add the reverse logistics system to the outflow of merchandise, we have an integral supply chain (Krikke, 1998, p. 1). The integral supply chain (ISC) is based on the product life cycle. During its life cycle, the product moves through its normal supply chain. What is added in the ISC is the steps of disposal, recovery and reapplication, permitting the material to reenter the supply chain flow (Krikke, 1998, p. 4).

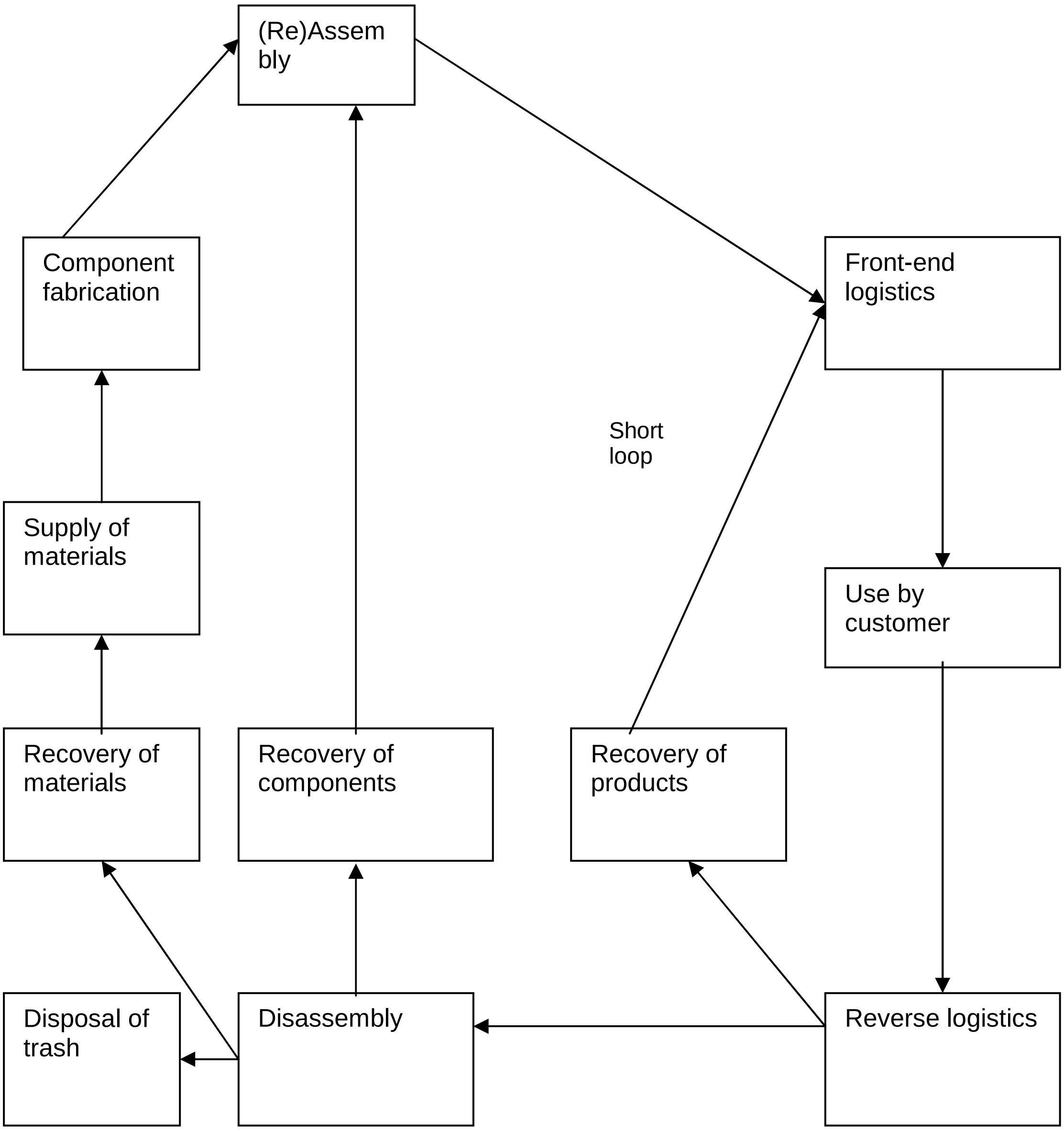

Figure 2: Life-cycle loops in the manufacture of durable goods (Ferrer, in Krikke: 1998, p. 10)

Figure 2 shows the loops in the life cycle of recovery for fabrication of durable goods (Ferrer, cited in Krikke: 1998, p.10).

Reverse logistics planning involves practically the same elements as conventional logistics: service level, storage, transport, inventory level, flow of materials and information system.

The service level is part of the company's overall strategy. If the sales strategy includes something like "satisfaction guaranteed or your money back" or "guaranteed exchange in case of defect", the logistics system must be prepared for the reverse flow, and any failure in this respect can jeopardize the company's image. Once the volume and characteristics of the reverse flow are determined, storage locations have to be established along with the stock levels, type of transport to be used and at what phase there will be reentry in the normal product flow.

Bowersox et al (1986, p. 267) says that "[t]he fundamental managerial objective is to achieve integration of all components in the logistical system". This integration must be sought at three levels: first, the integration of the components of the areas of physical distribution, manufacturing support and procurement on a total cost basis. Afterwards, these three steps have to be coordinated in a single logistics effort. And finally, the company's logistics policy has be to consistent with its overall objectives and give support to other areas in seeking these objectives. How to integrate reverse logistics in companies' overall logistics policy is today one of the biggest challenges facing the logistics manager.

According to Krikke (1998), there are four differences between the normal flow and reverse flow logistics systems:

> *"Firstly, forward logistic systems are pull systems, while in reverse logistics it is a combination of push and pull due to the fact that there are clients on both sides of the chain, namely the disposer and the reuser. [...] As a result of extended producer responsibility, the amount of waste supplied to the reverse logistic system (the push) cannot be influenced in the long run and has to be matched with demand (the pull). Of course, disposal can serve as an escape route for unwanted waste, but the amount of disposal is limited by legislation[...]. Secondly, forward logistic models usually deal with divergent networks, while reverse flows can be strongly divergent and convergent at the same time. Thirdly, return flows follow a predefined processing graph in which discarded products are transformed into secondary products, components and materials. In forward logistics, this transformation takes place in a production unit, which serves as a source in the network. Fourthly, in reverse logistics, transformation processes tend to be incorporated in the distribution network, covering the entire 'production' process from supply (=disposal) to demand (=reuse)".* Krikke (1998, p. 154).

Another important point is that reverse flows are imbued with a considerable level of uncertainty. In defining a reverse logistics system, the uncertainty about quantity and quality are very relevant.

All these factors lead us to conclude that a reverse logistics system, although it involves the same basic elements as a traditional logistics system, must be planned and executed separately and as an independent activity. Some authors (Rogers and Tibben-Lembke: 1999, Kim: 2001) discuss the advantages of outsourcing this area. But whether contracted out or not, the majority of authors believe that the teams responsible for traditional logistics and reverse logistics should be independent, since the characteristics of the two flows are very different.

Lacerda (2002) mentions six critical factors that influence the efficiency of the reverse logistics process: a) good entrance controls; b) mapped and formalized processes; c) reduced cycle time; d) information systems; e) planned logistics network; and f) collaborative relations between customers and suppliers. The better arranged these factors are, the better will be the performance of the logistics system. The authors believe that due to the process of globalization, where multinationals adopt common policies for all their branches and governments tend to enact stricter environmental laws in all countries, in a short time the same environmental practices adopted in Europe will be implemented in Brazil. Beyond this, we already have a very rigorous Consumer Defense Code that permits customers to change their minds and return their purchase within seven days, defines greater responsibilities of companies for the products they make and/or sell and establishes rules for recalls. Brazilian consumers have become very aware of their rights and the environmental responsibilities of companies. Furthermore, various companies (both retailers and manufacturers), for competitive reasons, are instituting more liberal product return policies. There is also the growing trend for companies to reutilize materials to lower costs. All this increases the reverse flow of products and materials in the distribution chain.

In a recent study, Silva and Fleury (2000) described the supply chain integration of food and beverage companies, with growing coordination of logistics operations (Figure 3). This integration is seen as one of the greatest opportunities for these companies to obtain productivity gains. In this study, the authors observe the degree of logistical organization among companies in this sector, finding that the greater the level of organization, the more flexible logistics will be in the companies. On this aspect, industrial firms have a certain superiority over commercial ones. Greater flexibility means a competitive edge. This study, however, only covered the normal aspect of logistics, i.e., considering the outflow of products.

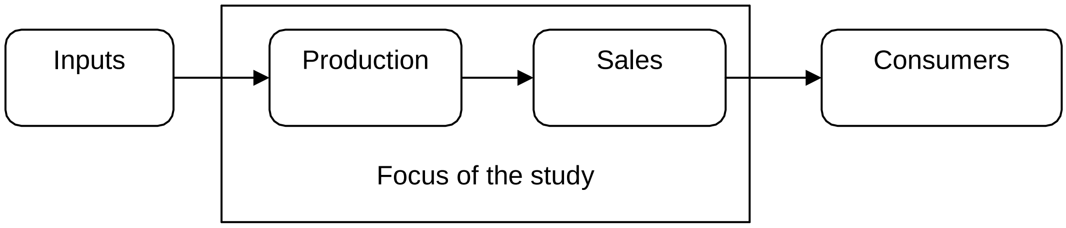

Figure 3: Supply chain in the food and beverages sector (Silva and Fleury, 2000)

We believe that a company with better conventional logistics has a better chance to manage reverse logistics, and consequently, to gain a competitive advantage.

5. REVERSE LOGISTICS COSTS

In reverse logistics, companies start taking responsibility for the return of the product, either for recycling or more adequate disposal. Their costing systems must therefore have a very comprehensive approach, as in the case of total life cycle costing. For Atkinson et al (2000, p. 676), this system enables managers to administer costs “from cradle to grave.” “*A product’s life cycle runs from the start of R&D until the end of customer support*” (Horngreen et al: 2000, p. 313). In reverse logistics, this cycle extends even further, covering as well the product’s return to the point of origin.

Horngreen et al. (2000, p. 315) point out three benefits provided by preparing a good product life cycle report: evidencing the entire set of revenues and expenses associated with each product; highlighting the percentage of total costs incurred in the first stages; and permitting the relations among cost categories of the activity to stand out.

The use of a total life cycle costing system dispenses with the traditional systems, such as target costing, Kaizen costing, activities based costing (ABC) or costing by process. What it provides is the visibility of costs over the entire product life cycle. Total life cycle costing takes in the others, depending on the phase in which the product is found, as shown in Figure 4.

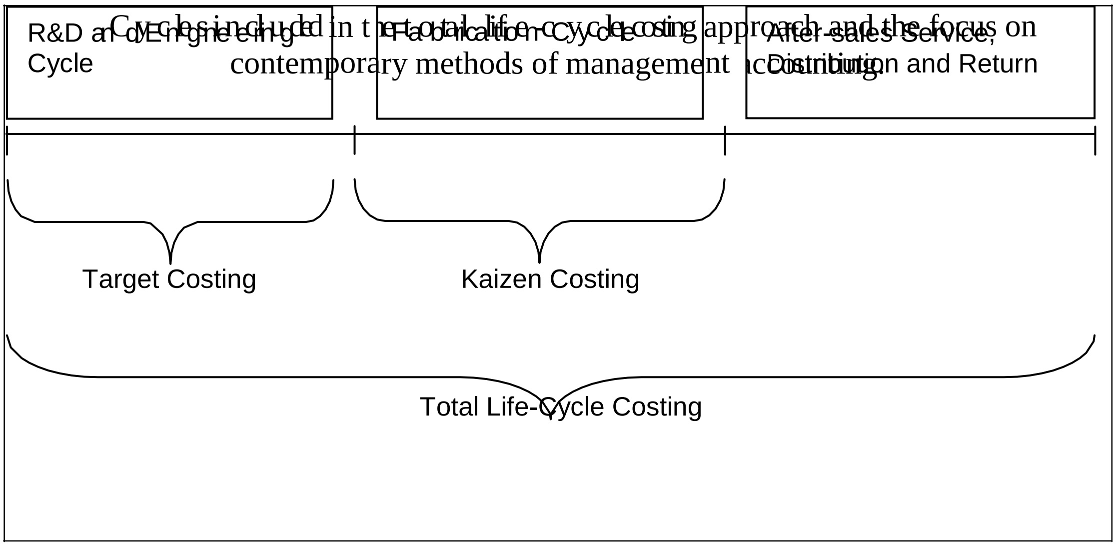

Figure 4: Adapted from Atkinson et al. (2000, p. 675)

As can be observed in Figure 4 above, a type of costing can be used in each phase, and total life cycle costing encompasses all of them. What must be borne in mind is the entire life cycle from the R&D phase, so that the product can generate revenues during its life cycle that allow return of costs. With the inclusion of product return, there is one more factor to be considered.

The importance of knowing where the product is in its life cycle and the different costs incurred at each phase is highlighted in a simple graph, which shows the costs of carrying inventories at each step of a product's life cycle (Rogers and Tibben-Lembke: 1999).

As the figure above shows, at the initial phase the storage costs are relatively low, but they tend to increase sharply as the product advances in its life cycle. Failing to consider all the phases leads to incorrect assessment of total costs.

Tibben-Lembke (2000) and De Brito et al. (2002), in speaking about product life cycle and reverse logistics, relate the importance, even in the development phase, of considering how the product or its parts will be discarded or reutilized at the end of its life cycle. Auto makers, along with high-tech companies such as IBM and Xerox, are mentioned as examples of companies that design their products already thinking of the last step.

5.1. Designing a Management Information System

In defining a product by the materials that will be used, in the initial R&D phase, possible recycling should be considered. The establishment of collection posts permits products to return to the point of origin or suitable disposal locations. The reverse logistics system can be used, or the normal logistics system can be employed. For Krikke (1998), the best is for two distinct systems to be planned, due to the differences inherent in the two

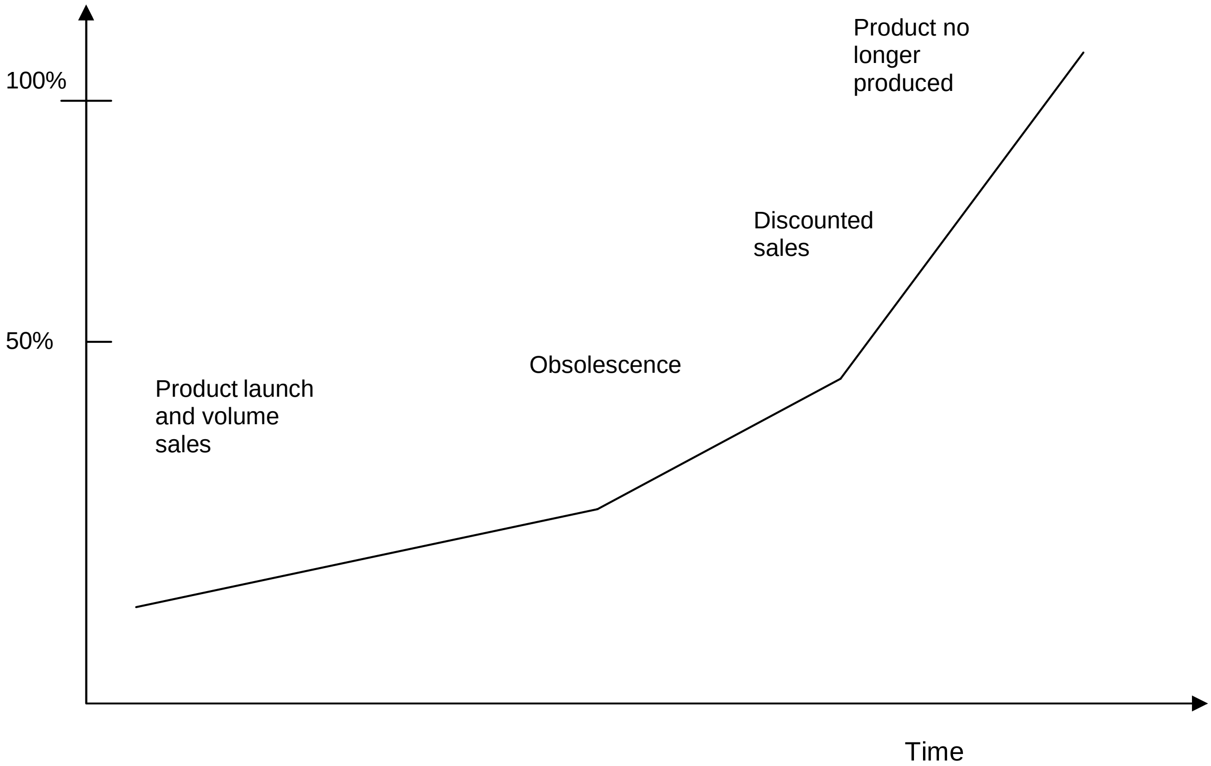

Figure 5: Inventory Carrying Costs. Adapted from Rogers and Tibben-Lembke (1999)

processes, as commented above. All this indicates the importance of greater control of product costs.

In some cases, however, as in the beverage industry, the reverse system uses the normal transportation logistics network. In others, as in the case of cellular telephone batteries (and various others as well, such as aluminum can recycling[3]), the planning should be totally distinct. The reason is simple: in the beverage industry, the empty glass bottles are collected from the same places where they are delivered full and involve the same actors, facilitating control and use of the same structure utilized in normal logistics, while in the case of used batteries the return always occurs in linear form. The batteries (or aluminum cans) are sold as part of another product and not only by the same manufacturer. The return or disposal occur a considerable time after sale and through very different channels. Rogers and Tibben-Lembke

[3] On the specific matter of whether or not recycling can be considered a reverse logistics activity, there is still much disagreement among the authors consulted. Tibben-Lembke (2002) raises doubts whether recycling can be considered part of reverse logistics, since for him the channel used by recycling companies does not involve a reverse product flow, but rather a normal channel, although its principal supplier is the final consumer who throws away the material to be recycled. In contrast, De Brito et al (2002) and Jahre (1995) hold trash collection and recycling to be reverse logistics activities.

(1999) propose the utilization of only specialized centers to manage these returns, since the return characteristics, being distinct from the normal flow, require a very different control system.

The role of reverse logistics in a company's structure is what will define the type of management information system that will be developed. The greatest problem is the lack of off-the-shelf systems and the need to develop them in house (Rogers and Tibben-Lembke: 1999). Perhaps due to the recent nature of the need, companies try to make use of the existing logistics structure to implement the controls necessary for good development of reverse logistics. The types of control, however, are quite different, as are the two processes. Some reasons are indicated in the case study below, such as the need to have an agile system and the fear that separate controls might delay the logistics process as a whole.

6. SUPPLY CHAIN MANAGEMENT

Supply Chain Management (SCM) involves the management of materials, information and money throughout the entire supply chain, from components suppliers, through assemblers, distributors (wholesalers and retailers), to the final consumer (Johnson and Pyke: 1999). Full knowledge of the chain to which a company belongs offers opportunities to enhance competitive advantages throughout the chain (Porter: 1985).

The correct implementation of a reverse logistics system leads to the need to analyze the supply chain as a whole. Knowledge of the supply chain and its correct planning can lead to important gains for all participants, principally regarding reducing logistics costs.

The costing system indicated as ideal in all the literature studied[4] is activity based costing. Among the advantages presented by the authors, we call specific attention to one of them: the possibility that the method can be extended throughout the supply chain and with this reduce total costs of reverse logistics. Goldsby and Closs (2000) in their article mention that the presentation of the data obtained in their study of the beer and soft drink supply chain led the actors of the chain to outsource the entire process of collection and return for recycling of the used packaging, allowing an annual savings of more than US$ 11.4 million. According to the authors, the correct implementation of the ABC method in the supply chain will enable reduction of overall costs if the participants work in unison.

7. THE CASE OF THE SOFT DRINK SECTOR[5]

The soft drink sector is interesting to the study of reverse logistics due to the return of empty bottles to the producer, and especially for the return of pallets and wood partitions. Until the arrival of bottles made of polyethylene terephthalate (PET), the returnable glass bottles represented a strong entry barrier. The logistics costs were high due to the need for industries to work with large enough inventories of bottles for the system to function correctly. There was also the need for the bottling companies to have a larger number of plants, so they could be nearer their customers, enabling better control of bottle inventories.

These bottles cost more than the product inside, inhibiting impulse buying and keeping retailers dependent on the companies whose stocks they were already carrying. Another important factor is the high profit margin provided by these returnable bottles, albeit today they represent less than 4% of sales. With the arrival of disposable PET bottles, at the start of the 1990s, all these barriers came tumbling down, providing space for a large number

[4] Among other authors who deal directly with costing systems in logistics and reverse logistics, we can mention Lima (1998), Goldsby and Closs (2000) and Lin et al (2001).

[5] This case study was conducted inside a Coca-Cola franchise under the condition it would not be identified.

of off-brands to arise. The market share of these smaller companies grew from 9% in 1988 to 33% in 1999, according to a report of the Secretariat of Economic Oversight (SEAE), part of the Ministry of Finance and one of the organs involved in investigating antitrust cases in Brazil (in the examination of the Brahma / Antartica merger that produced Ambev).

With disposable bottles, the main reverse logistics factor to be studied in this industry might at first glance appear to have disappeared. However, this sector still faces a very serious cost problem that appears far from being resolved. The traditional companies, mainly the franchises of Coca-Cola and Ambev, use pallets and wood partitions called *chapatex* to deliver their products. These wood partitions are placed vertically between the PET bottles or aluminum cans to prevent them from rubbing together, forming a honeycomb arrangement . These honeycombs are then placed on pallets and sent to customers. The need to use these partitions is greater the hotter the region is. Heat dilates the PET bottles, and without the wood partitions between them, they tend to burst if allowed to rub together. In the case of aluminum cans, the rubbing can produce micro-fissures, allowing the gas, or even the liquid, to escape. Leaking cans or burst bottles can result in return of all or some of the load by the customer, resulting in large losses and extra transport costs for the bottler.

All this packaging material (pallets and partitions) is expensive, representing 7% to 8% of the total product costs. They are usually the bottler's property and are supposed to be returned after delivery of the order to customers. A standard pallet costs around R$ 15.00 and a vertical partition R$ 3.00. Each shipment has at least two partitions and one pallet, depending on the type of product (aluminum cans or PET bottles).

Normally the production cycle in the soft drink industry is very dynamic. Often the truck makes two or three trips on the same day. On arriving back at the plant, it has to be inventoried quickly and reloaded for another trip. This leads to the establishment of normal and reverse logistics systems under the same person, generally in the transport sector. This sector performs the count with the driver, controls the packaging material that should be returned and dispatches the new load. The orientation given by the industry to the bottlers is to carry these pallets and partitions as assets on their books and depreciate them in function of a predetermined non-return rate. These materials are considered essential to production and their shortage can stop the whole process. It is estimated that at least 50% of these materials are lost because they are not returned to the plants. This loss means that they cannot be classified as assets and instead are booked as expenses. Numerical control, however, continues to be done.

From the customer standpoint, mainly large retail chains, these materials, after the products are placed on the shelves and bins, are considered scrap or trash, and are not treated with the care the soft drink industry would like. There is also an ample parallel market for these materials and a certain participation of employees of large chains who do not return them. To prevent undesired production stoppages, the bottler resorts to the parallel market to acquire pallets and partitions more quickly, since the main producers of these items are located in the state of São Paulo and thus there is a considerable interval between ordering and delivery. Since production is planned considering the return of the pallets and partitions for reuse, the failure of large retail chains to return them results in possible production stoppages due to shortage of materials. The best that can be hoped is that these materials that should be returned but are not will wind up being repurchased in the parallel market.

In an attempt to reduce the losses of these materials, the bottler already tried to issue loan invoices that would be charged if the return did not occur. But some hitches appeared. In the first place, the information system was not prepared to control this type of operation, and it would have been necessary to set up a parallel control structure. Then there was huge resistance from the large retail chains, who did not recognize the debit. Only roughly 30% of customers paid (mainly medium-size retailers), and this could only occur under a tacit agreement with the second largest competitor, which suffered from the same problem. In the end, the whole effort was dropped due to the high control cost and small return.

Perhaps the failure occurred mainly because of a lack of integrated controls, combined with the attribution of responsibility for collecting the debts for non-returns to the sales sector. Afraid of losing large customers, the sales sector is not prepared to face resistance in areas that traditionally do not represent its main product. Sales feels responsible for the final product and is pressured by sales quotas. Packaging materials get left by the wayside if they can interfere in big deals. Another attempt to overcome the problem was replacement of the standard pallets with disposable ones, costing one-third as much, and of the wood partitions with cardboard ones. The difference in quality of the pallets is glaring and obliged the firm to set up a small carpentry shop within its grounds just to repair the disposable pallets that were returned. Worse still, the replacement of wood by cardboard dividers is very questionable.

Soft drinks leave the production line chilled and are bottled as such. Then the natural condensation on the bottles moistens all the packing material. With wood partitions this is no big problem, since wood does not greatly suffer from the moisture. But the cardboard dividers deteriorate, leaving the load very insecure. This can cause the cargo to fall over, since the delivery trucks are open-sided. Friction between bottles is also greater with use of cardboard. So, the wooden dividers continue to be used for shipments outside a 40-km radius of the bottling plant, and cardboard ones within this range. The final result is that this firm decided to increase the price of its product to incorporate the total cost of these packing materials, in principle returnable, passing through the losses along the supply chain to its customers. The costs of these types of materials represent the second largest distribution cost to the bottler, behind only fuel.

All this shows the great opportunities for improvement of the process. In the case of the company studied, the losses from pallets and wood partitions reach more than R$ 2 million annually. Considering that this is just one bottler and that the same problem afflicts virtually the entire industry (with the exception of regional off-brands that normally only distribute within short distances of their plants and therefore do not use this type of shipping packing), the overall amounts at stake can be huge, since they represent nearly 2% of the company’s gross turnover. In a market that moves 11 billion liters a year, with nearly 70% of the market held by the large players (which have this specific problem), and with a sale price to retailers of approximately R$ 1.00 per liter, simple multiplication gives an idea of the overall numbers involved.

The establishment of some working agreements among the main competitors to address this problem in unison shows that it is possible to increase the integration of the entire productive chain. The involvement of another actor (large retailers) and the development of better reverse logistics management controls are necessary and highly attractive, since the costs are passed on through the entire chain.

8. FINAL CONSIDERATIONS

This work first showed the development of reverse logistics and its deployment as part of materials recovery management. We then examined its strategic importance and role in reducing costs, the reason reverse logistics is taking on increasing importance for companies, although still incipient.

Next we discussed logistical costs, and found that the inclusion of a reverse logistics system needs a total life cycle costing approach, since the return of products and materials to companies, for any reason, makes them responsible for their products until the end of the useful life cycles. We also showed that there are few information systems already developed specifically to deal with reverse logistics, hence the need for internal development of these systems.

Supply chain management is another fundamental point for reverse logistics. A detailed knowledge of the whole chain in which the company is inserted and the active and aware participation of all the actors are critical points for full development of reverse logistics, without which all can be lost. We ended with a case study of a soft drink bottler, where all these topics were presented. This case shows there is ample room for implementing a reverse logistics system, where the participation of all the members of the supply chain is critical. The case study presents possibilities for achieving considerable cost savings by establishing a good reverse logistics system.

REFERENCES

ANTHONY, R N and GOVINDARAJAN, V, 2001, ***Sistemas de Controle Gerencial*** – São Paulo: Ed. Atlas

ATKINSON, A A, BANKER, R D, KAPLAN, R S and YOUNG, S M, 2000, ***Contabilidade Gerencial*** – São Paulo: Ed. Atlas.

BALLOU, R H., 1985, ***Business Logistics Management: Planning and control*** – New Jersey: Prentice-Hall.

BOWERSOX, D J. et al., 1986, ***Logistical Management: A systems Integration of physical distribution, Manufacturing Support and Materials Procurement*** – New York: MacMillan.

CALDWELL, B,. 1999, ***Reverse Logistics.*** InformationWeek, April 12, 1999, at http://www.informationweek.com/729/logistics.htm. Accessed on 10/06/2001

_____ , 1999, ***The Web Can Reduce Returns.*** InformationWeek, April 12, 1999, in http://www.informationweek.com/729/logistic2.htm. Accessed on 10/06/2001

DE BRITO, M P, FLAPPER, S D P and DEKKER, R, 2002, ***Reverse Logistics: a review of case studies,*** Econometric Institute Report EI 2002-21, May.

FLEURY, P F. et al. 2000, ***Logística Empresarial : A perspectiva brasileira*** . São Paulo: Atlas.

GOLDSBY, T J and CLOSS, D J, 2000, ***Using activity-based costing to reengineer the reverse logistics channel,*** International Journal of Physical Distribution & Logistics Management, Vol. 30, Number 6, pp, 500-514.

HORNGREEN, C T, FOSTER, G and DATAR, S M, 2000, ***CONTABILIDADE DE CUSTOS,*** 9th Ed. Rio de Janeiro: LTC Editora.

JOHNSON, M E and PYKE, D F, 1999, ***Supply Chain Management***, Working Paper, The Tuck School of Business, Dartmouth College, Hanover, NH.

KIM, H. 2001, ***Manufacturers Profit by Managing Reverse Supply Chains.*** At http://www.manufacturing.net/index.asp?layout=articlePrint&articleID=CA73190.. Accessed on 10/14/2001.

KRIKKE, H. 1998, ***Recovery Strategies and Reverse Logistics Network Design*** – Holland: BETA – Institute for Business Engineering and Technology Application.

LACERDA, L. 2002, ***Logística Reversa - Uma visão sobre os conceitos básicos e as práticas operacionais.*** At http://www.coppead.ufrj.br/pesquisa/cel/new/fr-rev.htm. Accessed on 07/04/2002.

LAMBERT, D M. et al. 1998, ***Administração Estratégica da Logística*** – São Paulo : Vantine Consultoria.

LIMA, M P, 1998, ***Custos Logísticos – Uma Visão Gerencial,*** Centro de Estudos em Logística – COPPEAD, UFRJ, in http://www.coppead.ufrj.br/pesquisa/cel/new/fr-custo.htm. Accessed on 05/02/2003.

PORTER, M E, 1985, ***Competitive Advantage,*** The Free Press: New York.

QUINN, P, 2001, ***Don't Get Rear-Ended by Your Own Supply Chain.*** At http://www.idsystems.com/reader/2001/2001_01/comm0101/index.htm. Accessed on 10/06/2001.

REVLOG. Grupo de Estudos de Logística Reversa. 2002, At http://www.fbk.eur.nl/OZ/REVLOG/Introduction.htm. Accessed on 10/06/2001.

ROGERS, D S. and TIBBEN-LEMBKE, R S. 1999, ***Going Backwards: Reverse Logistics Trends and Practices.*** University of Nevada, Reno - Center for Logistics Management. At http://equinox.unr.edu/homepage/logis/reverse.pdf. Accessed on 09/30/2001.

SILVA, C R LAVALLE and FLEURY, P R. 2000, ***Avaliação da Organização Logística em Empresas da Cadeia de Suprimento de Alimentos – Indústria e Comércio. In Logística Empresarial.*** São Paulo: Atlas.

TIBBEN-LEMBKE, R S, 2002, ***Life after death: reverse logistics and the product life cycle,*** International Journal of Physical Distribution & Logistics Management, Vol. 32, Number 3, pp. 223-244.