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TOOLS AND TECHNIQUES USED FOR PERFORMANCE EVALUATION OF REVERSE LOGISTICS SYSTEMS

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Abstract: *This paper presents the main matters of Reverse Logistics as the modern tool used in enterprise management. It is very important to understand the power of Reverse Logistics, because nowadays traditional logistics are not enough in dealing with all the environmental problems companies are facing. Also, you will read about the contribution of Reverse Logistics and supply chain competitiveness, delivery and customer satisfaction, modern techniques and management strategy flows and functional integration within enterprises, and between enterprises. The purpose of quality management systems in Reverse Logistics is to systematically improve the quality of products and business operations through continuous refinement. A quality management system has been established and put into practice according to documented procedures, and based on practical results. In this manner is obtained the system effectiveness.*

Keywords: *reverse logistics, management, systems*

1. INTRODUCTION

Reverse Logistics is defined as "the set of logistics management skills and activities involved in reducing, managing, and disposing of hazardous waste from packaging and production", [4]. It includes reverse distribution, which causes goods and information to flow in the opposite direction compared to normal logistic activities. From a commercial perspective, Reverse Logistics is the process of moving products from their typical final destination to another point, for the purpose of capturing value otherwise unavailable, or for the proper disposal of the products.

The evolution of Reverse Logistics for manufactured products is developing proportionally with the rapid advancements in technology as well as with the subsequent product price erosion, as new and improved products enter the supply chain at a faster pace, [1, 3].

As technology and features improved, price and demand for aging products diminished, as did the ability to recoup costs from returns. Speed to return to market could be measured in resale value.

The strategic objectives in the field of quality are maintaining and continuing the improvement of the Quality Management System (QMS) in accordance with the ISO 9001:2008 quality standards requirements, in all domains of activity, [5]. The increasingly competitive environment requires companies to review, restructure and redirect activities in order to obtain the competitive advantage.

Reverse Logistics, through its activities, is vital in creating such an advantage. If it is seen as a strategic resource, not only as a simple task, it can positively influence the market share and enterprise profitability. Logistics must be seen in context of the evolution of the international business environment. As the awareness of the importance of logistics for a competent organization has increased, so did the need to acquire in-depth knowledge in the field of Reverse Logistics.

2. REVERSE LOGISTICS PROCESS

2.1 Returns planning process

Reverse Logistics, a fairly new concept in logistics, has gained increasing importance as a profitable and sustainable business strategy. The strategic factors consist of strategic costs, overall quality, customer service, environmental concerns, and legislative concerns. The operational factors consist of cost-benefit analysis, transportation, warehousing, supply management, remanufacturing and recycling, and packaging. Insights about these factors together form the state-of-the-art knowledge about the keys to successful design and use of Reverse Logistics systems.

Today, logistics have gone from the so-called traditional approach, focusing on targeting the point of consumption, to addressing the reverse flow and storage (Reverse Logistics) which arise at the point of consumption. The modern concept of logistics covers all activities in the supply- delivery chain until products return - Reverse Logistics. Reverse Logistics should receive increasing attention now that we see the increasing profitability of online purchases. Another aspect to be emphasized is the flow of information which needs to be integrated with the physical flows. Given the multitude of definitions and the experience of the successful firms, logistics, or logistics management, include the following activities: customer service; command process and batch delivery preparation; information distribution; supply forecasting; control and stocks inventory; transportation, storage, raw materials and services acquisition; aftermarket services, packaging, and goods return (Reverse Logistics), [4, 2].

Reverse Logistics is a process in which a manufacturer systematically accepts previously shipped products or parts from the point for consumption for possible recycling, remanufacturing, or disposal. A Reverse Logistics system incorporates a supply chain that has been redesigned to manage the flow of products or parts destined for remanufacturing, recycling, or disposal and to use resources effectively. Reverse Logistics has received a great deal of attention from operations managers and company executives. The effective use of Reverse Logistics can help a firm to compete in its industry, especially when confronting intense competition and low profit margins. The outputs of marketing logistics include not only the distribution (the movement of goods from factory to intermediaries, vendors, and ultimately, to customers), distribution of inputs (the movement of goods and materials from suppliers to the factory), but the reverse distribution (the movement of goods damaged, unwanted or excess, returned by customers or intermediaries). Regardless of whether the product is old or new, the customer will request either an exchange or a refund. An advantage of planned-returns is that it is much easier for the organization to know what is coming back. Developing a comprehensive and cost-effective approach to handling returns is a daunting challenge that reaches well beyond the operational level. Thus, a well-developed Reverse Logistics and management plan can be a vital strategic asset.

The management staff of any organization considers all aspects of Reverse Logistics, including (Figure 1):

- Returns management authorization;
- Collection of products;
- Defect screening;
- Re-flashing and reconfiguration;
- Track and traceability;
- Reassembly and repack;
- Supplier returns and credit.

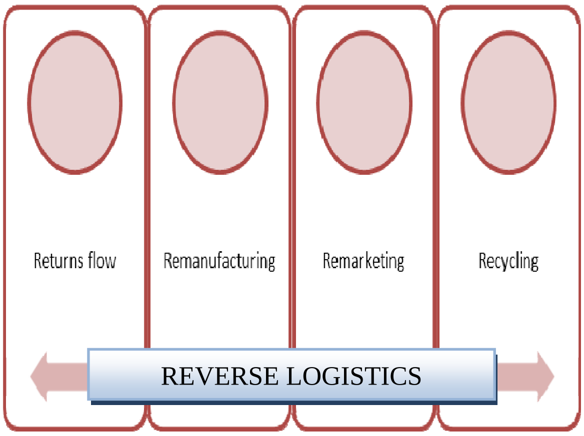

Fig. 1 Reverse logistics process

2.2 Reverse logistics cost. Reverse Logistics programs include: customer retention or satisfaction; container reuse, recycling, damaged materials returns, asset recovery or restock, downstream excess inventory, hazardous material programs, tracking obsolete equipment and recalls. The trade literature has especially touted Reverse Logistics as a primary method of improving efficiency and reducing costs in the for-profit arena.

Reverse Logistics strategy for end-of-life product take-back models were also developed to allow the user to determinate the optimal amount to spend on buy-back and the optimal unit cost of Reverse Logistics. Companies focusing on their core competencies are reluctant to pursue Reverse Logistics strategies and traditionally use third-party providers.

Many companies do not have an awareness of the current costs associated with Reverse Logistics. The reasons for this may include poorly defined processes and lack of system support. Due to the variable nature of returns, both processes and systems must maintain a degree of flexibility to manage the returns process.

In many companies, the cost of logistics activities reaches and exceeds 20% of the total cost of production, fact which could transform logistics into important source of costs. Logistics costs reduction can be made only by ensuring an effective and efficient relation between the service level for consumers and costs. The goal is to create logistics supply chains, namely physical flows of materials and finished products to end users, with low-cost, knowing that these companies' share in total product cost is 30-40% for processed products, [4].

Leading companies today are recognizing the damage that hidden costs of Reverse Logistics are having on their profitability. Increased profits and excellence in the returns management process is found once companies focus on Reverse Logistics. With a logistics team ''thinking in reverse'' and the process automated at the industrial level, an effective Reverse Logistics operation offers a significant opportunity to recover returned goods and money that can dramatically impact the bottom-line of a company of any size and structure.

The areas of hidden labor cost include: customer relations, customer service, finance, traffic and shipping, receiving and warehousing and asset management.
Descriptive statistics were collected for two response variables: average inventories and lost sales. These two response variables are chosen as performance measures for cost, and therefore simplifying the need for a cost objective function. The assumption is that significant reduction in average inventory is a reduction in holding costs and a significant reduction in lost sales also represents a reduction in the lost sales cost. Economic incentives to stimulate/enforce the acquisition or withdrawal of products for recovery are:

Buy back options. Numerous examples of buy back options for unused products are presented in literature. At the moment when a product is sold, the buyer is offered the possibility to sell the product to the seller for a preset price when the product meets some preset requirements at the moment of return which either is based on the use of the product, like kilometers driven, or based on expected possibilities for selling the returned product via a preset last moment of return, for which the option holds.

Costs. This value is paid when a person delivers a product for recovery. Usually the cost depends on the condition and configuration of the product delivered, but sometimes also on the moment when a product is delivered because this may determine the possibilities to reuse it. Well-know examples of companies using fees to simulate the acquisition of products for recovery are car brokers and ’’second hand’’ shops. Some retailers may take advantage by returning goods to manufacturers for credit in order to enhance their cash flow position. Customer returns are driven by customers taking goods back for exchange, credit or refund.

Reduced new price. A buyer gets a reduction on a similar or different product when he or she delivers a used product fulfilling certain requirements during a certain period of time. A well known example are car dealers, offering a higher refund depending on what is delivered and what is asked for by other potential customers of the dealer. The majority of the transportation costs incurred result from transporting the goods back to suppliers. At a store level, there is no budget to deal with an operation based on the level of sales and therefore there is a potential dysfunctional effect associated with returns since no allowance is made for dealing with return.

2.3 Quality management systems in reverse logistics. A company that holds ISO 9001:2008 certifications tells its customers and the world that it has a top QMS and is totally committed to quality products and services, [5]. Companies that go through the process find that profits increase thanks to opening up market opportunities. Moreover, costs decrease due to improved efficiency. The control operation of the materials flow and information from the retailer back to the warehouse is an essential process for any organization. The supply chain system according to ISO 9001 will improve the quality services to customers. The quality management system (QMS) is ensuring, in detail, that all work required for concept design, development (application consultancy), structural design, procurement, production, sales, delivery, service, and disposal is correctly put on record and carried out in compliance with the given stipulations. As is shown in detail in the ISO 9001:2008 requirements for implementing an efficient and effective quality management system, mainly refer to a range of issues such as purchasing, production, delivery, post-delivery, service.

A QMS for any organization is more vital than a customer’s perception of quality because of the intimate relationship it has to every aspect of the business, yet it is constantly given second class treatment with external and manufacturing processes taking precedent in a crowded environment of scarce resource.

3. REVERSE LOGISTICS SYSTEMS EVALUATION

Performance evaluation of a Reverse Logistics systems based on a series of tools and methods that aim to:

- Minimize the total logistics cost;
- A more accurate approximation of the delivery process during the estimated time;
- Monitor and minimize the costs of returns processing;
- Cost reduction of acquisition and transportation for returns product;
- Minimize the total recycling time;
- Total resale revenue; Profitable fees for processing;
- High level of customer satisfaction.

In the following subchapters are detailed several methods used for Reverse Logistics systems evaluation.

3.1 Sensitivity analysis. Sensitivity analysis, which refers to the study of how important results change with changes in estimates, is a "what-if" technique that looks at how a result will be hanged if assumptions change or original estimates are not achieved. It is applicable in any analytical technique involving uncertainty in their underlying assumptions. It is recognized as an aid for validating the model and for identifying model improvement possibilities. Sensitivity analysis may be carried out numerically or by differentiation.

Numerical sensitivity analysis can either be displayed as an absolute amount, or as a percentage of changes from the base estimates, or both. Sensitivity analysis is a method that aims to assess how the output of the model is influenced by changes in input variables. "Sensitivity" or model response to different levels of variability of input variables is emphasized, usually by two graphical methods, namely: "Spider" diagram; "Tornado" diagram.

For *"spider" diagram* it consider first the change in values for each random variable x_i, with λ a certain ratio in minus, and in addition to the nominal values, the variation that can be expressed as a percentage.

The matrix follows the variation of input values, like (1), (2), (3). A "Spider" diagram is obtained by a linear graph representing the values matrix *VF*. Figure 1 is a "spider" diagram in which $\lambda = 10\%$ and $l = 5$. One has therefore obtained a variation of the values of the input variables of $\pm 50\%, \pm 40\%, \pm 30\%, \pm 20\%, \pm 10\%$ compared to nominal values (100%).

From Figure 1 one can see that the variables with the increasing trend (V2 and V1) have a direct impact (or a positive impact) on the final variable of the model, meaning their increase determines the increase of the value of the final variable, where the variables with the decreasing values (V4 and V3) have an indirect impact (or negative impact) on the final variable of the model, meaning their increase determined the decrease of the values of the final variable, in vice-versa. At the same time, one can notice a higher, direct impact of variable V1 and the accentuated, indirect impact of variable V3.

$$VI = \begin{bmatrix} l(1-\lambda)v_{k+1} & (l-1)(1-\lambda)v_{k+1} & \dots & (1-\lambda)v_{k+1} & v_{k+1} & (1+\lambda)v_{k+1} & \dots & (l-1)(1+\lambda)v_{k+1} & l(1+\lambda)v_{k+1} \\ l(1-\lambda)v_{k+2} & (l-1)(1-\lambda)v_{k+2} & \dots & (1-\lambda)v_{k+2} & v_{k+2} & (1+\lambda)v_{k+2} & \dots & (l-1)(1+\lambda)v_{k+2} & l(1+\lambda)v_{k+2} \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots \\ l(1-\lambda)v_n & (l-1)(1-\lambda)v_n & \dots & (1-\lambda)v_n & v_n & (1+\lambda)v_n & \dots & (l-1)(1+\lambda)v_n & l(1+\lambda)v_n \end{bmatrix} \quad (1)$$

$$VF = \begin{bmatrix} vf_{k+1;l(1-\lambda)} & vf_{k+1;(l-1)(1-\lambda)} & \dots & vf_{k+1;(1-\lambda)} & vf & vf_{k+1;(1+\lambda)} & \dots & vf_{k+1;(l-1)(1+\lambda)} & vf_{k+1;l(1+\lambda)} \\ vf_{k+2;l(1-\lambda)} & vf_{k+2;(l-1)(1-\lambda)} & \dots & vf_{k+2;(1-\lambda)} & vf & vf_{k+2;(1+\lambda)} & \dots & vf_{k+2;(l-1)(1+\lambda)} & vf_{k+2;l(1+\lambda)} \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots \\ vf_{n;l(1-\lambda)} & vf_{n;(l-1)(1-\lambda)} & \dots & vf_{n;(1-\lambda)} & vf & vf_{n;(1+\lambda)} & \dots & vf_{n;(l-1)(1+\lambda)} & vf_{n;l(1+\lambda)} \end{bmatrix} \quad (2)$$

$$vf_{j;(l-i)(1\pm\lambda)} = F(v_1, \dots, v_k, v_{k+1}, \dots, (l-i)(1\pm\lambda)v_j, \dots, v_n),\ i = 0,1,2,\dots \quad (3)$$

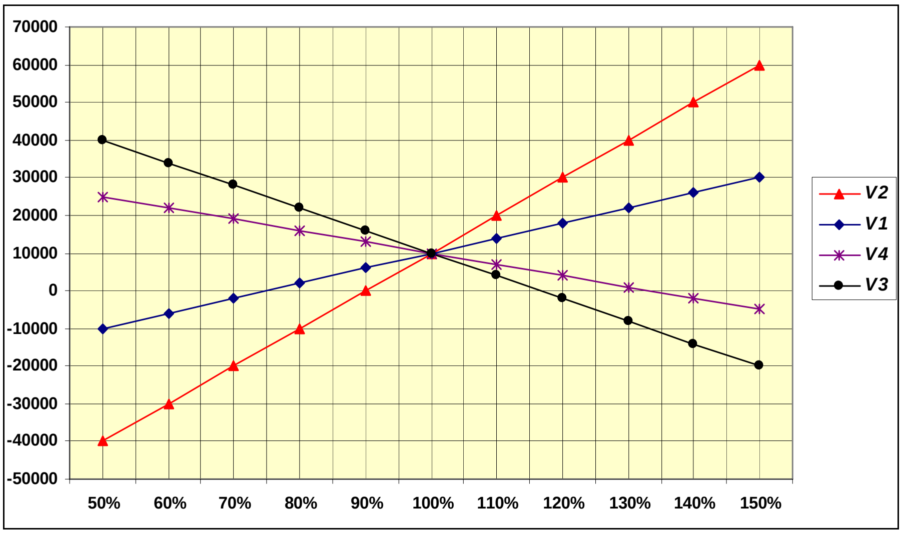

Fig. 2“Spider” diagram

4. CONCLUSIONS

The Reverse Logistics process can have a significant bottom line impact for an organization, and the ability to take advantage of these opportunities may depend on implementation of a proper QMS. Reverse Logistics process presents a lot of advantages, amongst them: a very proper customers service planning; bottom line profits; competitive advantages.

The modern role of Reverse Logistics and materials management requires: qualified collaborators, an efficient integration into the organization’s flow chart, and an interested management team. The process of product return and recycle is efficient when it succeeds in satisfying the customer’s expectations, no matter if we talk about the productive department of the organization or about the end user in a commercial organization. A qualified supply brings an important contribution to the company’s benefits and places the organization’s strategy among its competences.

Organizations have developed such coordination in their logistic chain and reverse logistic system, and they have become models for many managers, willing to improve their organization’s performance and profitability.

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