

A pragmatic procedure for identifying need for reverse logistics implementation

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Abstract

According to studies, the e-waste management market in India is worth around half billion dollars and growing at the rate of 25 per cent. This signifies exhilarating growth for reverse logistics industry and emphasizing the need of OEM's to adopt reverse logistics to maximize their returns. Also government is focusing on sustainability which is an important factor for the development of reverse logistics market. Due to government regulations, organizations have started recognizing the importance of their contribution towards environment and also the benefits of adopting reverse logistics. But there are still unanswered questions, firstly whether it can be adopted by all product manufacturers / Industry and secondly whether the percentage saving achieved by adopting reverse logistics would really contribute for the success of the organization. This paper proposes a pragmatic procedure for the firm's management in India to decide the need of implementing reverse logistics that influences the decision making process.

Keywords: logistics, E-waste, Regulations

Introduction

Reverse logistics is the process of moving goods from their typical final destination for the purpose of capturing value, or proper disposal. Remanufacturing and refurbishing activities also may be included in the definition of reverse logistics. Reverse logistics is more than reusing containers and recycling packaging materials. Reverse logistics also includes processing returned merchandise due to damage, seasonal inventory, restock, salvage, recalls, and excess inventory. It also includes recycling programs, hazardous material programs, obsolete equipment disposition, and asset recovery.

Identification and Listing the Factors

An organization need to look into the following aspects to take the decision on adopting reverse logistics. The factors would be applicable to all kind of manufacturing industries and are identified based on the influences they have on a firm's success in the market.

Industry or nature of business

The first and foremost criteria that an organization need consider is about the nature of the industry in which the organization is into, as it plays a very important role in deciding whether adopting reverse logistics would be of any financial interest in that industry segment. Normally industries are classified based on the product produced but for the research scenario we need to include other criteria such as market segment or target market, life of the product ,environmental regulations in the country in which the firms manufacturing plant is located and the severity of the competition

Nature of the product manufactured

Commodity products like home appliances, computers and automotive products more commonly fall under the reusable category. Though most of electronics products also fall under the reusable category but whether the firm want to get them back and reuse them depends on the industry in which it is operating. If an industry is into automotive electronics products then it should think of the same but if it is into process industry or aerospace the feasibility of getting the products are very less. The situation is same even with products which would have reusable contents but end customer would not be in position to return it back either the cost or size of the product is negligible compared to an home appliances like microwave or a mixer.

Market segment or target market

Firm planning to adopt reverse logistics should ask their marketing team to answer the below question," Will the market or end customer would agree to buy a product that would have reused/recycled products in it even if the firm gives a particular warranty period". The answer may be no from the market segment for products used by the elite class and probable yes from middle class segment, so careful analysis and market feedback is required.

Life of the product

Products having very short span are the products best suited for reverse logistics as the reuse components are not obsolete and defining the logistics path is simple. Short life span products are easy to trace and volume estimation for reverse supply chain is much simpler as products sold would remain more or less with the same customer. There are various reasons for the short life span of a product; it may be the technology changing fast as in tablets, competitive environment as in mobile phones.

Country regulation

Firms in developed countries are forced to adopt recycling and reuse to take care of the environmental issues; so many multinational OEM's adopt reverse logistics and pass on the cost of recovering the products to the end customer. While in developing and

underdeveloped countries though the regulations are not in force, firms' started thinking about it for their own benefit of cost saving, increased competitiveness.

Competition

Another most important external factor that influences the decision on reverse logistics is competition. In a monopoly market or lesser competitive market the firm need not have to spend their time and money to build reverse logistics as it may not help unless the market irrespective of the monopoly status demands for the lower cost. In industries like automotive and consumer electronics which is highly competitive the firms need to have their reverse logistics established after looking into the below internal factors.

Volume

Volume of the product is another important factor to decide on reverse logistics. Higher the volume of product sold higher the chance that the firm should look at the reverse logistics. Having said this volume alone should not be looked at to take the decision; it needs to look at other like the percentage of reusable components in it, cost percentage of the reusable components within the product and so on.

Past product returns

Firms having the history of high returns should probably look at the feasibility of reusing the materials as it has already incurred to cost recover the product. Assumption made here is the returns do not fall under major quality issues but cannot be sold back to the same customer.

Percentage cost of material

The percentage of material cost of the sale price varies with the product. It is normally high in the case of automotive industry due to the highly competitive nature of the industry whereas the same would apply to certain extent in the electronics industry. Within the electronics industry low cost products would have higher percentage of material cost normally in the range of 60 to 70 percent while premium products would have around 50percent or even lower. Another factor that would influence the material cost is technology adopted to build the product. Newer technology means latest components and increased price resulting in higher material cost. The firms should look into these factors and decide in which category they would fall.

Logistics cost incurred

Higher the cost of logistics incurred lower should be the interest of the firm in adopting the reverse logistics assuming similar amount of time and money need to be spent in getting back the product sold. At this juncture the firm should start thinking of combining the forward and backward flow material so that the cost can be optimized to the benefit of the firm resulting in sale price reduction. As part of the factor, firm need to look at the import content of the material. Higher the import content, higher the cost which means the firm should look for reuse of these materials. Again if the products are sold locally then the recovery of products are much easier or cost effective but if they are exported to a larger extent then it becomes expensive to establish the reverse supply chain. So firm while looking at the logistics cost should look at the import material content ratio and as

well export market ratio.

Hazardous content in the product

Reuse of the components because difficult if the product contains hazardous materials. The firm would need to spend more time and money to employ right skilled labour to segregate the useable components.

Percentage of reusable material used

Not all the components in a product are normally reusable. It depends on the design of the product and the manufacturing /assembly process adopted to assemble the product. Even if it has high percent of reusable components and the cost of these components are only part of total material cost, i.e. the high cost components are not reusable then the scenario does not favor reverse logistics.

Categorize factors

For the ease of prioritizing the factors for the firms to focus only the factors that are strategic importance for their business we categorize them under three major driving factors of reverse logistics namely Profit / Cost benefit, Customer Satisfaction & Market sustainability and Environmental & Social factors.

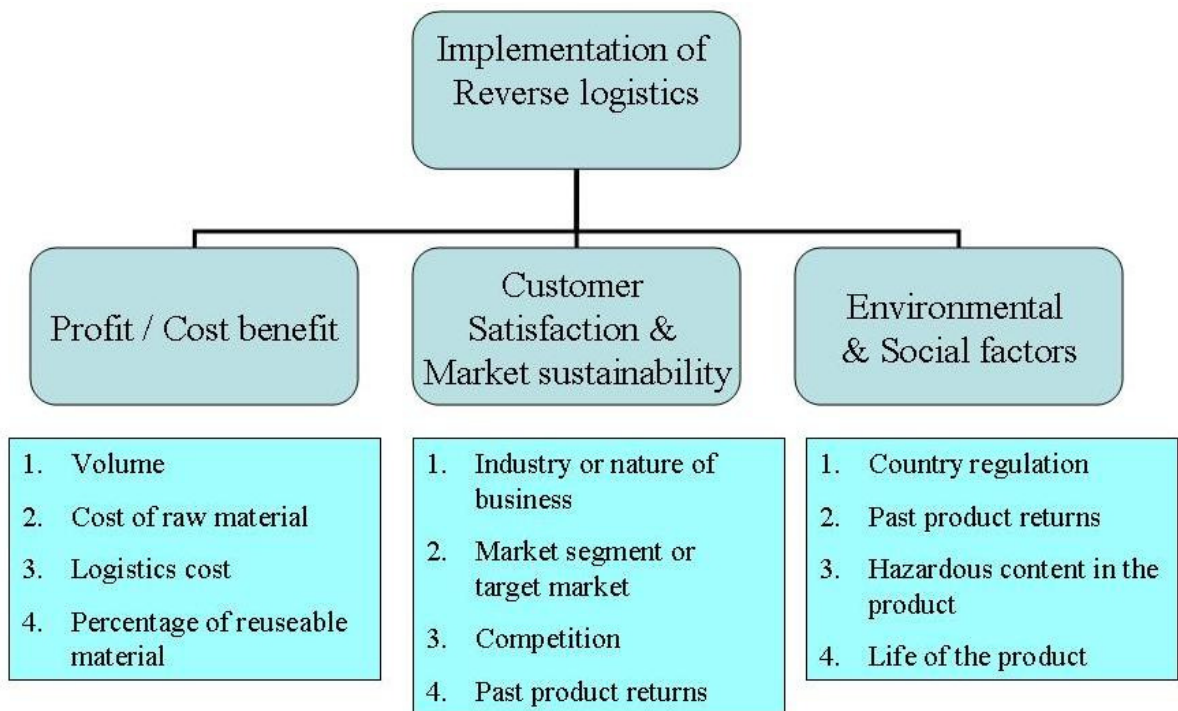


Figure 1 – Hierarchy Tree

Prioritize Factors

To prioritize the factors the general practices are to assign weightage to each factors based on individual experience. This method would lead to biased judgment based on each expert's opinion. To overcome this manual influence in this research paper we attempt to use AHP Analytic Hierarchy Process for prioritization. Rather than prescribing a "correct" decision, the AHP helps decision makers find one that best suits their goal and their understanding of the problem. It provides a comprehensive and rational framework for structuring a decision problem, for representing and quantifying its elements, for relating those elements to overall goals, and for evaluating alternative solutions. In Analytic Hierarchy Process information is decomposed into a hierarchy of alternatives and criteria, Information is then synthesized to determine relative ranking of alternatives. Both qualitative and quantitative information can be compared using informed judgments to derive weights and priorities.

Once the hierarchy is built, the decision makers systematically evaluate its various elements by comparing them to one another two at a time, with respect to their impact on an element above them in the hierarchy. In making the comparisons, the decision makers can use concrete data about the elements, but they typically use their judgments about the elements' relative meaning and importance. It is the essence of the AHP that human judgments, and not just the underlying information, can be used in performing the evaluations.

Figure 1 shows the hierarchy tree and as a first step we rank the level one hierarchy.AHP provides the below pair-wise relative importance to assign weightage to each factors in relation to the other factor.

[1: Equal, 3: Moderate, 5: Strong, 7: Very strong, 9: Extreme]

Table 1 – Ranking matrix for hierarchy level 1

	Profit / Cost benefit	Customer Satisfaction & Market sustainability	Environmental & Social factors
Profit / Cost benefit	1.0/1.0	1.0/2.0	3.0/1.0
Customer Satisfaction & Market sustainability	2.0/1.0	1.0/1.0	4.0/1.0
Environmental & Social factors	1.0/3.0	1.0/4.0	1.0/1.0

After assigning pair-wise relative importance as a next step we rank the factors,

Consider $[Ax = \lambda_{max}x]$ where

A is the comparison matrix of size $n \times n$, for n criteria, also called the priority matrix.

x is the Eigenvector of size $n \times 1$, also called the priority vector.

λ_{max} is the Eigenvalue, $\lambda_{max} \Re > n$.

To find the ranking of priorities, namely the Eigen Vector X :the steps are,

1. Normalize the column entries by dividing each entry by the sum of the column.
2. Take the overall row averages.

$$\begin{bmatrix} 1 & 0.5 & 3 \\ 2 & 1 & 4 \\ 0.333 & 0.25 & 1.0 \end{bmatrix} \xrightarrow{\text{squared}} \begin{bmatrix} 3.0 & 1.75 & 8.0 \\ 5.3332 & 3.0 & 14.0 \\ 1.1666 & 0.6667 & 3.0 \end{bmatrix}$$

Row sums

12.75
22.3332
4.8333
39.9165

Normalized Row sums

0.3194
0.5595
0.1211
1.0

From the normalized row sums the hierarchy is clear for firms in the order of Customer Satisfaction & Market sustainability (0.5595), Profit / Cost benefit (0.3194) and Environmental & Social factors (0.1211).

Extending the method to the sub categories of level 1 would result in the following matrix,

Sub category ranking for Customer Satisfaction & Market sustainability (0.5595)

Table 2 shows past product returns ranks the first followed by market segment or target market the firm caters.

Table 2 – Ranking matrix for customer satisfaction

	Industry or nature of business	Market segment or target market	Competition	Past product returns	Eigen vector
Industry or nature of business	1.0/1.0	1.0/4.0	4.0/1.0	1.0/6.0	0.1160
Market segment or target market	4.0/1.0	1.0/1.0	4.0/1.0	1.0/4.0	0.2470
Competition	1.0/4.0	1.0/4.0	1.0/1.0	1.0/5.0	0.0600
Past product returns	6.0/1.0	4.0/1.0	5.0/1.0	1.0/1.0	0.5770

Sub category ranking for Profit / Cost benefit (0.3194)

Table 3 shows logistics cost ranks the first followed by volume of the product sold by the firm.

Table 3 – Ranking matrix for Profit / Cost benefit

	Volume	Cost of raw material	Logistics cost	Percentage of reuseable material	Eigen vector
Volume	1.0/2.0	1.0/1.0	3.0/1.0	2.0/1.0	0.2900
Cost of raw material	1.0/1.0	1.0/2.0	4.0/1.0	1.0/1.0	0.2570

Logistics cost	1.0/1.0	2.0/1.0	5.0/1.0	1.0/1.0	0.3790
Percentage of reuseable material	1.0/1.0	1.0/2.0	4.0/1.0	1.0/1.0	0.0740

Sub category ranking for Environmental & Social factors (0.1211)

Table 4 shows country relation ranks the first followed by Hazardous material

Table 4 – Ranking matrix for Environmental and Social factors

	Country regulation	Hazardous content in the product	Life of the product	Past product returns	Eigen vector
Country regulation	1.0/1.0	2.0/1.0	5.0/1.0	1.0/1.0	0.3790
Hazardous content in the product	1.0/2.0	1.0/1.0	3.0/1.0	2.0/1.0	0.2900
Life of the product	1.0/5.0	1.0/3.0	1.0/1.0	1.0/4.0	0.0740
Past product returns	1.0/1.0	1.0/2.0	4.0/1.0	1.0/1.0	0.2570

The above matrix gives a ranking among various factors that influences the reverse logistics process and provides insights for the firm to take decision for implementing reverse logistics. The outcome of the method would vary with each firm based on what kind of product the firm is producing and also the expectation of the firm's top management in implementing the reverse logistics.

Conclusion

The multi-criteria AHP model adopted in this paper gives the firm a high-level decision for implementing reverse logistics based on the influencing factors. Most of the firms want to adopt reverse logistics to get benefited in terms of cost and by adopting this procedure as illustrated in the paper the firm would understand the order of priority of the factors. Future research can be carried out by further drilling down on each of the factor. For example, arriving at the eigenvector for each type of industry like automobile, electronic, process industry, etc. thus helping the firm to make decision to adopt reverse logistics or not. As further extension of the research the factors identified can be further taken down to level three or four based on the need of the firm to further refine the outcome of their decision making process.

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