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Development of a Reverse Logistics Performance Measurement System for a battery manufacturer

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Abstract

In this contribution, the case of a leading Lead Acid Battery manufacturer in India is studied with respect to the essential reverse logistics operations of the company, due to the statutory requirements regarding toxic components in the product. The critical parameters are ascertained by a methodology interviews with the company's management and further consolidated using the taxonomy as suggested by the Balanced Scorecard approach. Then, a performance measurement system vis-à-vis the industry benchmark, over a sustained period, is proposed, using Fuzzy Analytical Hierarchical Process.

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1. Introduction

Reverse logistics deals with the recovery of products, systems, devices, material from the market by the seller of these products. Recovery of products encompasses the chain of buy back, transporting, warehousing and recycling. The origin of the term itself is difficult to trace as stated by De Brito(2002). It appears in the form of terms like Reverse Channels or Reverse Flow in the scientific literature of the seventies, but more in the scope of recycling (Guiltinan and Nwokoye, 1974; Ginter and Starling, 1978). Due to the rise in environmental awareness driven legal incumbencies, world over, in the late nineteen nineties and the increased acceptance of potential economic benefits of recovery operations (Guide and Wassenhove, 2001), the importance of reverse logistics as an important operation for producers themselves has grown. The Lead Battery Management and Handling Act, 2001 lays down rules for all members of the supply chain.

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However, for the manufacturer, it makes it legally binding in the schedule to recover 50% in the first year after legislation i.e. 2002, 70% in the second year and 90% in the third year onwards where all percentages are in the form of portions of new batteries sold. This is a challenging figure to achieve, given the very protean nature of the quantity recovered from the costumer. The establishment of germane factors that together subsume all the various facets of this operation is key. For this, this paper proposes an approach based on the Balanced Scorecard, put forth by Dr. Robert S. Kaplan and Dr. David P. Norton, widely used for forward (conventional) supply chains (Bhagwat and Sharma, 2007). In the following sections we aim to use the criteria so obtained to build a Performance Measurement (PM) solution for the producer using fuzzy AHP, on the lines proposed by Mohammed Shaik and Walid Abdul-Kader (2012) who used simple AHP techniques, but by exploring techniques suggested by Da Yong Chang et al (1996) to convert the ratings to triangular fuzzy numbers, and in-turn, performance scores.

2. Literature Review

Over the past few years, new outlooks towards the supply chain structures have been developing (Seuring and Muller,2008). The increased focus on environmental preservation has substantiated the need for integrating reverse logistics activities with forward supply chains. Reverse logistics is concerned with the management of equipments, products, components or technical systems being recovered (Marisa P de Brito and Rommert Dekker,2002).Thierry et al.(1995)outlines recovery options ranging from re-use to land filling and incorporating them within the supply chain. Carter and Ellram (1998) presented a model involving the drivers and constraints related to reverse logistics .Goggin and Browne(2000) proposed a classification for end-of-life recovery of products focusing on electronic and electrical equipments. The Reverse Logistics objective of retrieving returned products ,while harnessing the economic value within them, poses a daunting task (Ferrer& Whybark,2000,Guide& van Wassenhove,2003).Hence, a comprehensive performance measurement system needs to be developed to realize RL objectives. Various Performance Measurement frameworks have been stated in literature (Sharma et al.,2005).Reverse Logistics Performance Measurement frameworks however incorporate different criteria than those employed in Forward Supply Chain ,as RL chains are affected by different driving forces. Autry et al.,(2001) observed that sales volume affects the performance of reverse logistics significantly. Richey et al.,(2005) found that resource allocation towards the development of advanced capabilities for handling of returns can improve the RL performance. Ravi et al.(2005) provided a model to address the RL problem of computers while Yellepeddi et al.(2005) proposed a performance index for reverse supply chain in electronics industry using the BSC approach and ANP method. Mohammed Shaik et al.(2012)developed a comprehensive performance measurement system for reverse logistics of an enterprise using BSC approach and applying AHP to prioritize the performance criteria. This paper introduces a case study on the design of a performance measurement system for the reverse logistics of a leading battery manufacturing company, using the BSC approach and fuzzy AHP.

3. Research Methodology

3.1 Balanced Score Card

With the aim of developing a performance measurement system for the reverse logistics of the lead acid battery manufacturer, this investigation follows the approach of a balance scorecard as developed by Kaplan and Norton. The main objective behind the BSC is to form a limited set of indicators that form an interpretive framework of the reverse logistics chain, to give top management a quick and comprehensive overview of the system. The following four perspectives are considered:

Table 1: The four perspectives in a balanced scorecard (Kaplan and Norton, 1992)

Perspective	Mission
Financial (shareholder's view)	To succeed financially and deliver value to shareholders
Stakeholder(value addition view)	To achieve our vision by delivering value to the customer
Process	To promote efficiency and effectiveness of the business process
Learning and growth(future view)	To achieve our vision, by sustaining innovation and changecapabilities, and preparing for future challenges

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