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An analysis of integrated robust hybrid model for third-party reverse logistics partner selection under fuzzy environment

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ABSTRACT

Owing to environmental and waste disposal issues, enforced legislation and corporate social concern; companies are focusing on reverse logistics (RL) practices, especially in the present scenario dominated by intense competition, demanding customer and fast changing technologies. These practices are widely adopted by industries through reverse logistics partners. However, the evaluation and selection of the reverse logistics partner is a matter of concern which needs a very grave decision, involving complexity due to presence of numerous associated factors. In addition, it is hypothesized that the decision makers might be inconsistent to some extent in their views and preferences that affect other dominant constituents. Consequently, incomplete and inadequate sort of information may occur among various selection criteria, which is termed 'multi-criteria decision making' (MCDM) problem. The goal of the present study is to discuss an integrated model based on fuzzy analytic hierarchy process (FAHP) for evaluation and prioritization of selection criteria and fuzzy technique for order performance by similarity to ideal solution (FTOPSIS) for the selection and development of reverse logistics partner. This study is an attempt to present a genuine concern of Indian electronics industry using an integrated approach to demonstrate the application of the proposed framework as well. In this study two stage sensitivity analyses are performed to get further insight of evaluation and selection of RL partner and verification of robustness of the model. This study aims to provide a significant contribution to electronics organizations in evaluation and selection of third party RL partner while achieving efficiency and effectiveness in RL practices.

1. Introduction

To start with reverse logistics, it is equally important to know what reverse logistics is and how it functions. Council of Logistics Management describes 'reverse logistics' as "To achieve the purpose of recycle value and proper disposal, a process from the point of consumption to the starting point in efficient and economical way that plans, implements and controls raw materials, semi-finished inventory, finished goods and related information." In my point of view, it is a process that disseminates various products/goods and where the movement is from consumption/distribution or use-point to origin with related information. This process is further sub-divided into two heads namely, waste logistics and recover logistics. In today's modern era, due to rising customer requirements, fast changing technologies, shorter product life cycle and increasing waste; there have been a great emphasis on sustainability, to maintain the availability of resources for long time. An efficient reverse logistics (hereafter RL) program can support companies to make effective utilization of resources and retain equilibrium between environment and economy (Xiangru, 2008). Moreover, RL practices have been seen as a part of sustainable business practices (Prakash and Barua, 2015a,b). The advent of online shopping and post-sale service has increased the reverse flow of the products. And organizations have started to concentrate on recovery of used products because of growing ecological & waste removal concerns, imposed regulations and corporate citizenship (Fleischmann et al., 2000; Rogers and Tibben-Lembke, 2001). It has been observed that the product returns rate is high in case of electronics items, computers, cameras, mobile-phones, automobile, chemical and medical items. For some industries, product returns rate is very high and for some 50% of the sales (Senthil et al., 2014). Customers are expecting immediate resolution in case of defective products. Extended producer responsibilities and waste regulations are imposing pressures on manufacturers to take back and

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dispose products properly after useful life (Prahinski and Kocabasoglu, 2006). Managing reverse logistics operations are difficult and composite because of uncertain timing, quantities and the quality of returned products (Fleischmann et al., 1997). And each return requires various treatments depending on the condition of returned product apart from recovery options and proper disposal. Reverse logistics activities are more complex than traditional supply chain operations therefore; organizations require flexibility to deal with the operational issues. Effective return management practices can increase customer satisfaction and service level. However efficient return needs specialized infrastructure requirements, advance IT and tracking system, dedicated equipment for the processing of returns, and trained manpower and other value-added services. Therefore, many organizations those lack in resources and capabilities outsource their reverse logistics operations requirements to 3rd party logistics (Krumwiede and Sheu, 2002). Moreover if RL operations are not the part of organization core functions, RL activities might be outsourced to 3rd party. This 3rd party reverse logistics partner (3PRLP) provides benefits in terms of reduction in costs, improvement in performance, operational efficiency, organizational competitiveness and better corporate image. The 3PRL partner has to deal with flexible capacity of return products along with various activities like product acquisition/gate keeping, collection, inspection & sorting, storage, and processing. These activities require state-of-the-art infrastructure, warehousing facilities, dedicated transportation, material handling equipment's, skilled labor and customized information systems to monitor shipments, and data mining & support. Co-ordination and reliability of partner is very important aspect while outsourcing RL operations. Therefore, 3PRLP selection process has become a key strategic decision.

1.1. Research motives

Since previous studies show that many researchers have recognized the importance of the selection of 3PRLPs but very few studies suggested empirical analysis for the selection of the partner. Moreover, there is a limited literature on 3PRLP selection in developing countries context. Selection of 3PRLP needs flexible decision system that can elect the best alternative from multiple qualitative as well as quantitative factors approved by industrial experts. The presence of multiple criteria and the views from the experts will increase the complexity in the selection of the appropriate alternatives. Further, there are many gaps related to 3PRLP selection still to be explored; and particularly, it becomes important when firms are looking toward implementation of RL practices (Agrawal et al., 2015; Prakash and Barua, 2015a). Since partner selection is the first stage of the return management, it is a critical decision process affecting the consecutive stages toward achievement of efficient RL practices. Hence, the need arises to evaluate the 3rd party RL partner selection in order to ensure effective RL implementation in the business.

1.2. Research goals

This research work helps in achieving the goals, as follows:

- To identify, finalize and evaluate the 3rd party RL partner selection criteria.
- To support in selecting the best 3PRLP among available alternatives.
- To analyze the selected 3rd party RL partners.

Selection of the partner while considering different criteria is MCDM problem and involvement of fuzziness in decision makes decision structure flexible and handle the uncertainty associated with decision making process. And this fuzzy based flexible systematic decision support tool provides flexibility in the selection of the reverse logistics partner. This study used hybrid fuzzy analytic hierarchy process (FAHP) for evaluation of the selection criteria. The benefits of using FAHP over other methods (VIKOR, DEMATEL, PROMETHEE, etc.) can be understand by this, its shows the performance of a partner with respect to each sub-criteria and main criteria through structural dependency and as compared to the analytic network process (ANP), AHP is a linear assessment type of method (Harputlugil et al., 2011), Thus, it fosters the partner status on each criterion. Also, mathematically and philosophically, FAHP provides an easily understandable and defensible approach to practitioners. It allows practitioners to be involved in the analysis and actually to guide the decision more effectively. This managerial transparency and lack of complexity allow for greater acceptance by both researchers and practitioners. The application of FAHP has been seen in many MCDM problems. However integrating one hybrid model with other decision support system would improve decision making process.

The integrated hybrid approach with multi-faceted decision support systems would evolve which will mitigate the complexity of a real world decision process and it will provide a more practical, lucid, simple and effective solution in making decision as well. This study integrates FAHP with FTOPSIS hybrid model to build an intelligent decision support model and select the right RL partner. The integration of FAHP with other techniques may also be tied to its easy to understand mathematical basis, ease of use, and flexibility. The other reason for integration is that the individual techniques possess some unique advantages that allow for complementary contribution to the FAHP approach (Govindan et al., 2015).

Considering the highlighted significance of proposed integrated decision support framework, we opted to select and discuss a pragmatic example of electronics industry in Indian context. The case industry is seeking to analyze the 3PRLP selection criteria, and has a desire to build a structural model to select the best partner among alternatives for adoption of effective RL practices in business. Finally robustness of proposed integrated model is tested by performing extensive sensitivity analysis. For this, two stage sensitivity analyses are performed. In stage I; sensitiveness of the selection criteria has been checked. Second stage sensitivity analysis shows the variation in final ranking of 3PRL partners. This is done through exchanging the weightage of the highest weightage criterion among other criteria. And effect of this change has been seen on selection of 3PRLP. The unique contribution of this study can be understood by that, this kind of sensitivity analysis has not seen in any past studies.

The rest of this paper is planned as follows. Section 2 highlights the background of the research. Section 3 deals with the problem. Section 4 describes the methodology and application of the model for selection of the partner is given in Section 5. The results and discussions are presented in Section 6. Two stage sensitivity analyses are reported in Section 7. Managerial implications and concluding remarks with unique contribution of the study are given in Sections 8 and 9 respectively.

2. Background of the research

This section contains the literature on reverse logistics & supplier selection and modeling techniques used in RL supplier selection.

2.1. Reverse logistics & supplier selection

The studies on reverse logistics area got attention recently. Reverse logistics operations are also important like forward