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Decision and information interoperability for improving performance of product recovery systems

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ABSTRACT

Enterprises around the world are employing product/resource recovery practices to overcome global competition, meet heightened environmental regulations, and seek additional profit making opportunities. These factors in addition to the inherent cost and complexity of recovery processes are due to multidimensional factors and relationships associated with the quality, variety, timeliness, demand changes, and logical processing of product returns. A Reverse Enterprise System (RES) perspective will give scope to develop a flexible system that can handle products with various options and greater return volumes and variability. It explores the various recovery functions and product lifecycle stages and suggests some key business and performance measurement strategies that can be employed to be successful in returns handling. We observed that different recovery nodes act in a relatively autonomous fashion to decide what type and level of flexibility to use, what and when the information is required to be shared for improving decision performance and obtaining benefits from the recovery process. Finally, this paper proposes a semi/partially and fully flexible decision model that facilitates decision and information interoperability functions from the perspective of an enterprise engaged in or planning to be engaged in product recovery processes.

1. Introduction

Efficiently designing and operating product recovery systems to handle reverse flows, have been gaining academic as well as practitioner's attention. This interest in product recovery, especially the broader concept, reverse logistics, is not surprising considering the hidden potential, i.e. improved customer image, input data for development initiatives, raw material and spare parts. Determining the requirements of synergy between decision and information systems is required to properly support product returns processes, but has been identified as a gap in theory by many researchers [2,17,23]. Studies have demonstrated a loss of information associated with a product after selling is one of the major obstacles for recovering value from returns [25]. Therefore, a systematic approach for modeling product recovery decisions, and in particular, the interoperable role of product information in improving the effectiveness of product recovery decisions, is essential [10,32]. The use of information technology with the emerging mail-order, online purchases and after-sales services, such as the maintenance of guaranteed products, has contributed to the increase of returns. Later with the growing consciousness on environmental issues, enterprises call for gradually reducing their consumption of resources and the amount of waste materials produced. Further, sustainability theories increasingly support the enterprise's role in extending the "end of used" or disposed products back to the producer, in a way of Extending the Producers Responsibility, i.e. EPR [19,32], leading to the need for conceptualization of a robust product recovery as an enterprise system.

Enterprises are now becoming aware of the importance of focusing their efforts on activities surrounding the return and processing of unused products. They seek to restructure, reorganize, support and plan these activities so as to make the present forward and reverse supply chain systems more flexible and efficient. With an adequate integration of flexible product recovery activities, in an economic or environmental context, organizations will be able to notice a double effect. First, while focusing efforts on the returns of products and their processing, competitive decision and information strategies can be set up which, at various levels, will contribute to a better performance of current activities in the supply chain, concentrated until now primarily on the distribution of new products. Secondly, an innovative flexible reverse enterprise system can improve the effectiveness of product recovery decisions under uncertainties. The aim of this innovative product recovery system is to ensure clean and adequate distribution of recovered products along with the normal operation of the forward flow of products as shown in Fig. 1. This figure depicts cyclic synergy between the individual forward and reverse flexibility contributing towards enterprise flexibility leading to improvement in overall enterprise performance. In contrast to the forward system, the Reverse Enterprise System (RES) supplies the means of efficient planning, managing and controlling relevant information from the consumption point to the

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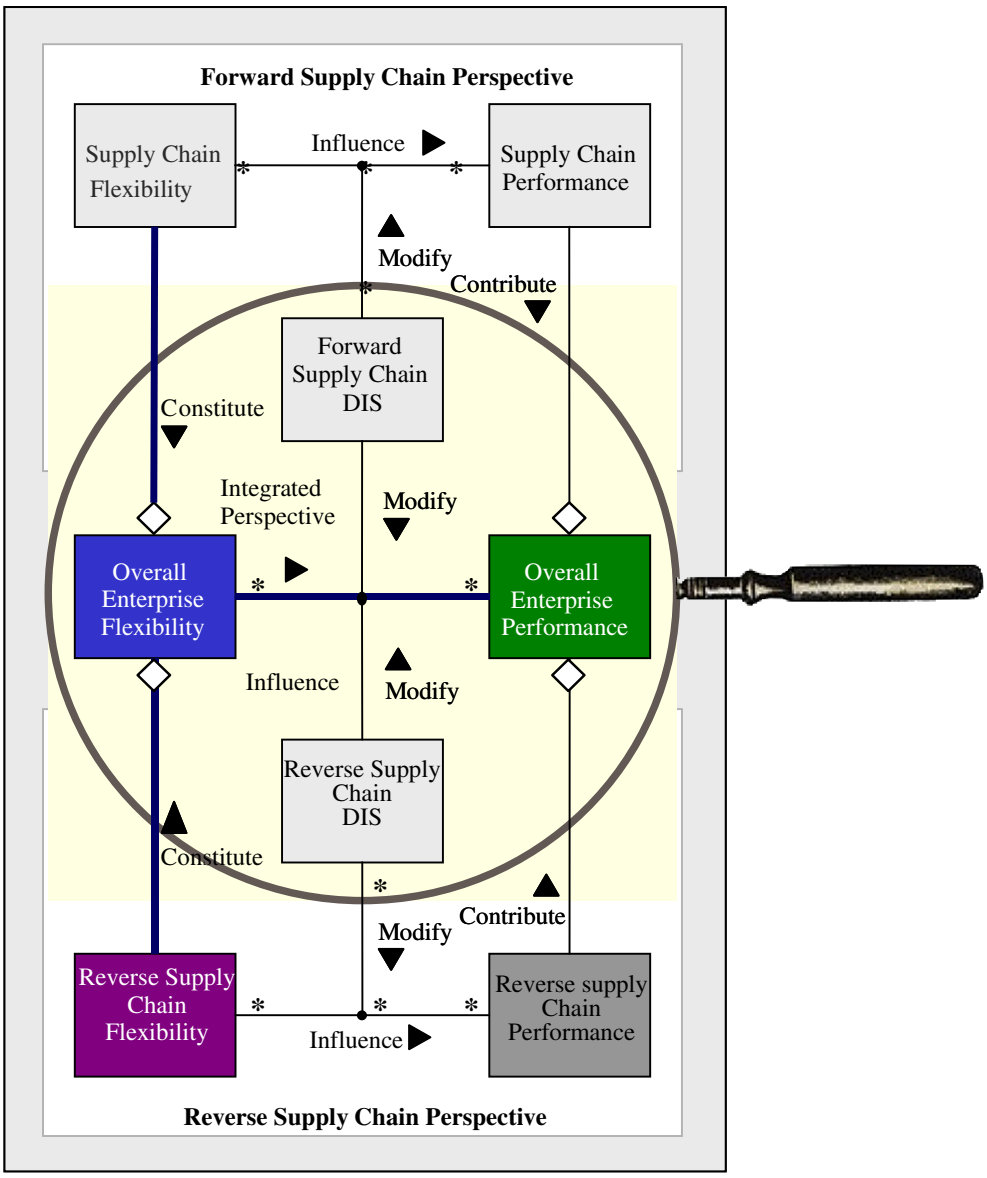

Fig. 1. Influence of information and decision flexibility on enterprise system performance.

starting point, so as to counter the overall production cost of the supply chain [5].

This study looks further and demonstrates a systematic interoperability approach for modeling product recovery decisions, and in particular, synergizes the role of product availability and quality information in improving the effectiveness of decisions in RES. Later a flexible product recovery model is proposed that can demonstrate the effectiveness of product information and decisions in RES under uncertainties [16,24,28].

On refinement these proposed strategies could further be used while choosing the recovery option for a returned product while designing a reverse enterprise system. Although this research focuses on product recovery decisions, it is noted that the models and methods developed can be applied to other decisions made during the forward flow.

2. Requirement for interoperable decision and information model for RES

One of the most serious problems that the enterprises face in the execution of a RES is the requirement of interoperable and robust decision and information systems [14]. RES is typically a boundary-spanning process taking care of returns between enterprises or of the same enterprise, thus proposing a model that has to work across system boundaries adds additional complexity to the problem. Therefore, flexible decision and information interoperability in a RES seems much more important. Returns information captured should be integrated with forward supply chain information to achieve optimum planning and reduction of costs. The whole support network can then be designed in a way that can serve both forward and reverse product/information flow efficiently. This is in line with the concept of designing an information system with an integrated product recovery decision system. The synergy of such information and decisions is the foundation and prerequisite for an RES that runs with high quality [4]. The aim of this section is to illustrate the motivation for an interoperable decision and information model to improve the performance of the product recovery system. The impact of information visibility is well manifested by the bullwhip effect in forward supply chains [13]. Similar to forward supply chains, if decisions are well synchronized with information, it can play an important role in effectiveness management and also in improving performance of the product recovery process [6,8,21].