Simulation of Inventory Control System in a Supply Chain Using RFID

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ABSTRACT

This paper employs a simulation model in a Supply Chain Management (SCM) system. This study is one of the first to present simulation model of inventory control system in supply chain management using barcode and Radio Frequency Identification (RFID). The main objective of this model is to compare two inventory systems in a supply chain, one using RFID, versus the barcode. The model will help company to consider moving from a barcode system to the RFID application. A quantitative analysis based on a simulation model is developed. The model runs for both systems using ARENA simulation software with a comparison between the two systems. Furthermore, the simulation model is tested by applying three different types of demand for both scenarios. The results have shown that regardless of demand distribution pattern and customer order rate, the outcomes of the model are consistent and provide promising RFID technology adoption to improve inventory control of the entire supply chain system. The installation and unit cost of RFID implementation were estimated and considered to be the main barrier. Such model can offer the policymakers insight into how RFID might improve SCM system performance. Additional test has been conducted for demand with normal and triangular distributions using real data provided by ABC-Dubai Company. The results obtained from running the two models for these distributions are consistent with the original results.

Keywords: Inventory Cost Systems, RFID, Simulation, Supply Chain Management

INTRODUCTION

Globalization encourages businesses to make large investments in Supply Chain Management (SCM) applications. The advent of telecommunications and transportation technologies has motivated continuous development of supply chain applications. However, automated data capture and information tracking in real-time have created a major bottleneck, affecting the ability of organizations to optimize their investments in supply chain systems. RFID technology has received considerable attention for its ability to help in the tracking of items through the whole

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supply chain system. This technology is different from barcode technology in two ways: firstly, it does not require a line-of-sight, and secondly, RFID tags have unique codes. The RFID system consists of tags, readers and radio waves to communicate with all chains in the organization system. RFID is able to identify and deliver a whole range of benefits across a variety of supply chains, the main ones being the following: supplier; manufacturer; distributor; retailer and end user (customer), Al Khudairi (2007).

Many pioneer organizations and companies, such as Wal-Mart, Tesco and the United States Department of Defense, have invested in RFID technology. The potential benefits arise from an increase in supply chain visibility, an increase in efficiency and a decrease in total costs. Thus, RFID promises to have a major impact on supply chains, allowing trading partners to collaborate more effectively and achieve new levels of efficiency and responsiveness. Among many proposed applications of RFID, inventory management in manufacturer-retail stores has been commonly identified as an imperative application, Min et al. (2002). Although business consultants and academic researchers are highly interested in the estimation and assessment of the benefits and values of RFID as deployed in retail stores, most of their figures and claims are based on certain simple assumptions rather than on numerical simulation models, Al Kattan and Al Khudairi (2007).

RFID as an emerging technology has generated an enormous amount of interest in the supply chain as stated by Lee et al. (2005). Inventory accuracy is significantly affected when RFID technology is not employed. Without this accuracy, the supply chain has incorrect information which in turn affects the whole network. Inventory cost also has a great impact on the supply chain inventory. The sharing of inventory information between suppliers and retailers not only improves the supply chain fill rate but also reduces inventory levels. The RFID technology enhanced the information system of the inventory to be tracked more accurately in real-time. More considerably, the complete integration of inventory data throughout the whole supply chain drivers, from the manufacturer’s shop-floor to warehouses to retail stores, brings prospects for improvement in reducing processing time and labor cost.

The main focus of this research is to compare the benefits of using RFID on total inventory cost throughout the entire supply chain for two systems—one with Barcode as most company currently practicing, and the other with RFID technology. A quantitative analysis based on a simulation model will be presented, and a comparison between the two systems based on simulation results will be discussed. To achieve a good system comparison, two scenarios are modeled and simulated in such a way as to give output that offers a significant change in total inventory cost throughout the entire supply chain. The objective of this research is to focus on a simulation model that will be analyzed for both systems, and to find the effect of total inventory cost by using RFID technology. The data for this quantitative model is obtained by having a company called “ABC-Dubai Company,” and simulation results will be compared between two systems using the same data. The difference between them is that one uses RFID technology and the other use barcode. Simulation block diagrams for all Supply Chain (SC) locations will also be implemented, Al Khudairi (2007). The main components of RFID are: a tag, a reader, and data processing equipment, as illustrated in Figure 1, Maloni (2006).

An introduction to the research is presented in this section. A supportive literature review is presented in section II. Section III discusses design of supply chain simulation models embedded with and without RFID. A proposed simulation model using ARENA with two the scenarios is explored in section IV. Analysis of the results with the application of the ABC-Dubai Company using numerical values is presented in section V. Finally the conclusion and future work are summarized in section VI.
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