FlexRFID Middleware in the Supply Chain:
Strategic Values and Challenges

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ABSTRACT

Radio Frequency Identification (RFID) has been used since the Second World War to identify “friend or foe” aircrafts. It has become an enabling wireless technology that is widely used in a number of application areas, such as product tracking through manufacturing and assembly, inventory control, and supply chain management (SCM). By 2006, Wal-Mart used RFID for all of its suppliers. The use of RFID in supply chain networks has allowed Wal-Mart to create value through greater visibility in its networks, higher product velocity, reduce human error and labor cost, and more efficient inventory management, which led to the achievement of Quick Response (QR) and improved Customer Relationship Management (CRM) in the supply chain. However, RFID system challenges and uncertain Return-On-Investment (ROI) must be overcome to fully achieve these objectives. This paper introduces RFID technology and its key components and concepts, and presents an RFID middleware solution called FlexRFID that achieves the maximum benefits of RFID technology independently of the interested backend applications. This paper illustrates how RFID technology is used to solve the main problems in SCM, the advantages and key issues when implementing RFID in SCM networks, and the relationship between RFID and the main SCM processes.

Keywords: CRM, FlexRFID, Inventory Control Middleware, Policy, ROI, SCM, Supply Chain

INTRODUCTION

Radio Frequency Identification (RFID) is one of the Automatic Identification and Data Capture (AIDC) techniques (Ishikawa et al., 2003). RFID uses low-power, and radio waves to automatically identify people or objects, and to provide radically enhanced data handling capabilities (Tektronix, 2004). It is convenient, easy to use, and well suited for automatic operations (ADC Technologies Group, 2002). RFID technology can be used to track objects in a manner similar to using barcode based systems (Ishikawa et al., 2003) and Optical Character Recognition (OCR) systems (Phoenix Software International, 2006), but RFID also combines...
additional advantages not available in these technologies. RFID does not require line of sight readings, can function under a variety of environmental conditions, can read multiple tags simultaneously, store large amounts of data in addition to the ID of the object tracked, and provide a high level of data integrity (ADC Technologies Group, 2002; Ajana et al., 2009).

While existing for decades as an enabling technology, RFID does not provide much value on its own, however the creation of RFID based applications is the key that creates value for the companies. Although RFID can be a complicated and costly business technology, it appears that RFID will overcome the implementation obstacles and become a breakthrough technology throughout the supply chain for manufacturing, packaging, logistics, distributions, and retailing (Chuang & Shaw, 2007).

A supply chain is “a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers”. The complexity of supply chain varies greatly from industry to industry (Ganeshan & Harrison, 1995). The supply chain starts and ends with the customer, and is made up of several elements that are linked by the movement of products along it. The supply chain consists of the following elements: customer, planning, purchasing, inventory, production, and transportation (Murray, 2010).

Supply Chain Management is the “management and control of all materials and information in the logistics process from acquisition of raw materials to delivery to the end user” (Michael & McCathie, 2005). Companies have adopted SCM processes and associated technology in order to ensure that the supply chain is operating as efficient as possible and generating the highest level of customer satisfaction at the lowest possible price (Murray, 2010).

RFID technology has the potential of helping retailers provide the right product at the right place at the right time, thus maximizing sales and profits. The integration of RFID technology in the SCM systems has helped in optimizing inventory management, reducing losses, increasing ROI and information accuracy, and improving visibility in various stages of SCM (Sheng et al., 2008). RFID offers item-level data visibility; a revolutionary advance that can improve product availability and reduce losses associated with shrinkage and product obsolescence (IBM Global Business Services, 2005).

Mandating RFID, Wal-Mart and other companies believe that it benefits their own supply chains as well as their suppliers. However, not all these possible benefits are fully achieved. Uncertainty exists about how RFID will affect supply chains and what benefits and risks it will bring, and evidence suggests that companies will not be able to see RFID ROI for the first two or three years (Chuang & Shaw, 2007). RFID integration in the SCM happens in stages; therefore its benefits accrue in phases throughout the supply chaining activities.

The paper is organized as follows. We talk briefly about RFID system components, and then we present FlexRFID middleware architecture. We show how RFID technology is used for supply chain management networks, its benefits and risks, and its integration stages in SCM. Then we showcase the relationship between RFID and SCM processes. Finally we describe how an SCM application for inventory control can be developed based on the FlexRFID middleware architecture, followed by conclusions and future work in the last section.

RFID SYSTEM COMPONENTS

RFID systems consist basically of three main components: a tag/transponder, a reader, and a middleware running at a host computer. RFID Tags are the data carrier part of the RFID system; they store information about the object being tracked. Specific object data is stored in the memory of the tag and is accessed via the radio signal of the reader (Knowledgeleader, 2006). Data stored in RFID tags can consist of serial numbers, security codes, product codes and other object specific data. Various types
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