EFFICIENCY OF RFID IN SUPPLY CHAIN MANAGEMENT: STRATEGIC BENEFITS AND CHALLENGES

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ABSTRACT

We examine the appropriate business processes to apply RFID, required planning and testing for successful implementation as well as the many potential impacts on effectiveness and efficiency of supply chain management. In particular, we highlight the many potential strategic business benefits that can be gained by implementing RFID by first addressing RFID as part of a comprehensive supply chain strategy. We used an existing supply chain framework, surveyed managers on RFID use in their firms, and present the current stage of RFID development in firms. The survey shows that RFID can be used in various functions in firms and that all firms that were surveyed are looking at RFID in their SCM efforts

Keywords: RFID, Supply Chain Management, Efficiency, Strategic Benefits, Challenges

INTRODUCTION

Radio Frequency Identification (RFID) is one of the newly emerging wireless technologies that has great potential in improving efficiencies and effectiveness in supply chain solving problems. The application of RFID ranges from manufacturing and distribution of physical goods such as automobiles and its various components to minting bank notes, oil exploration, shipping and port operations and pharmaceutical package processes, among others [1]. RFID is a type of Automatic Identification and Data Collection (AIDC) technology. The AIDC technology has been constant part of our daily business and personal lives. Smart cards, electronic toll road tags, toll collection devices, proximity-access security cards, etc. are all examples of RFID technology. RFID has the potential to transform an industry and fully prepare firms to accelerate business performance and build market leadership. While the RFID technology has been in the market for some time, its widespread adoption to date has been a slow process due to insufficiency in supply chain infrastructure. Because of the volume of information

transmitted by RFID readers and tags, an enterprise needs to do considerable upfront planning and testing, and to enhance existing operations and build a framework for integrated, adaptive supply networks to support RFID in order to successfully implement and integrate the technology.

Historically, the drive toward adopting RFID is being enhanced by mandates from large retailers such as Wal-Mart and Target, and the US Department of Defense, who require all suppliers to implement this technology within the next few years. Initial savings and benefits estimated to accrue to Wal-Mart include $6.7 billion in reduced labor costs (no bar-code scanning required), $600 million in out-of-stock supply chain cost reduction, $575 million in theft reduction, $300 million in improved tracking through warehousing and distribution centers, $180 million in reduced inventory holding and carrying costs [2]. The U.S. Department of Defense, with 43,000 suppliers is planning to overhaul its entire supply chain because it believes that RFID will reduce losses due to lack of information. The General Accounting Office substantiated the need in a December 2003 report that showed a $ 1.2 billion discrepancy between the material shipped and the material received in Iraq by the Army [6].

In this study, we examine the appropriate business processes to apply the technology, required planning and testing for successful implementation as well as many potential impacts on effectiveness and efficiency of supply chain management. In particular, we will highlight the many potential strategic business benefits that can be gained by implementing RFID by first addressing RFID as part of a comprehensive supply chain strategy.

SUPPLY CHAIN INFRASTRUCTURE AND RFID TECHNOLOGY

Supply chain management is recognized as an effective practice that will take a business organization to higher levels of performance.

Companies are searching for all the hidden values that had eluded them and their partners across the extended supply chain. Supply chain management can be viewed in a sequence of highly visible initiatives that have led to better performance, lower costs, higher profits and a greater measure of customer satisfaction.

Supply chain is viewed as a process management concept [7]. Companies have developed and presented various supply chains to serve their strategic alliances and partnership with upstream and downstream companies. In essence, no two companies' supply chains look alike. There are many supply chain models, and these models only effectively deliver on their promise when aligned with their strategic plan and the company wants to go to market. Furthermore, most companies don't merely have one chain. They have many, and several of them are actually networks. Based on AMR's research, there are 16 basic forms of supply chains/networks in use

According to a survey conducted among supply chain professionals from 142 companies by Computer Sciences Corporation and Supply Chain Management Review, the supply chain evolution progress can be divided into five levels [5]. In general, business enterprises move through five levels of evolution on its way to the most advanced stage of supply chain management, as illustrated in Figure 1. In the first two levels of the evolution, businesses require breaking down their traditional functional and business unit silos. They can achieve high levels of efficiency across the internal supply chain process by getting the house in order. During the third level, businesses need to enhance their relationships with a few trusted suppliers and moving together toward their attracting targeted customers with a network business model. Based on the survey, most of the companies today are somewhere between levels II and III. They simply haven't been able to get through the big cultural wall that exists between
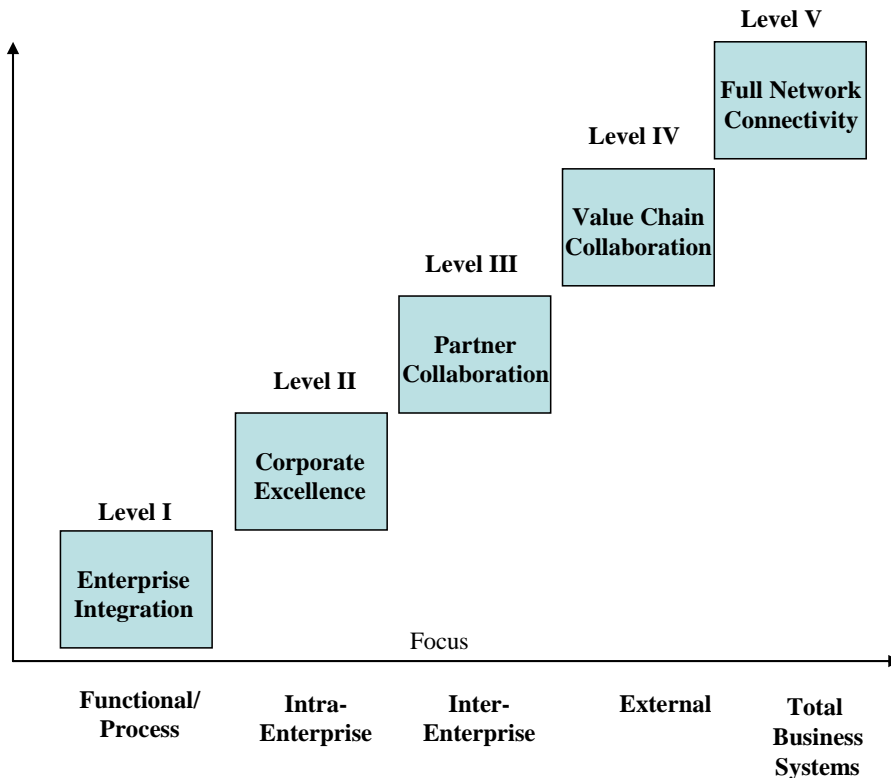

Figure 1. Five levels of SCM evolution

today [3] and each one brings relative strengths and weaknesses and they are varying degrees of complexity.

these two levels. In the fourth level, businesses partners begin collaborating with each other to enhance the value chain. They start to leverage e-commerce, the Internet, etc. in order to gain advantage in communication, online inventory

visibility, cycle time, and optimized processing. In the last level of supply chain evolution, full network connectivity is established, and an industry or market advantages is built. This is achieved by integrating systems in a way that all the supply chain partners are benefited. We need to examine how RFID will fit into the existing supply chain infrastructure and how companies should use it, from the introduction of the technology to more mature deployments.

CURRENT STAGE OF DEVELOPMENT IN FIRMS

We used this framework of SCM evolution to test current position of RFID implementation in firms. In order to evaluate the current position of RFID development in firms, a survey with questions asking the respondents of what stage of RFID development their firms were positioned in three functional areas. The respondents include professionals who help with the evaluation of current supply chain technology usage and the level of integration of business applications. The solicitation was primarily through mail and email based on membership directories, mailing lists, and

individuals contacted, 151 participated in the study yielding a response rate of about 50%. Each participant completed one survey, and the survey captured the perceptions of their RFID development experience.

We used three functional applications to include 1) sales and customer service, 2) logistics, transportation, and warehousing, and 3) inventory and materials management. These functions and where they are positioned currently with respect to the five levels of evolutions is shown in Figure 2.

As seen in Figure 2, managers in various industries in USA use RFID at various levels for each functional use. Of particular interest is the full network connectivity where they feel that RFID can be used in all three functions equally. Another interesting result of the survey showed that all firms that were surveyed are looking at RFID in their SCM efforts.

POTENTIAL BUSINESS VALUE OF RFID IN SUPPLY CHAIN MANAGEMENT

As discussed earlier, RFID technology offers

Figure 2. Current Stage of Development for Each Type of Business Application
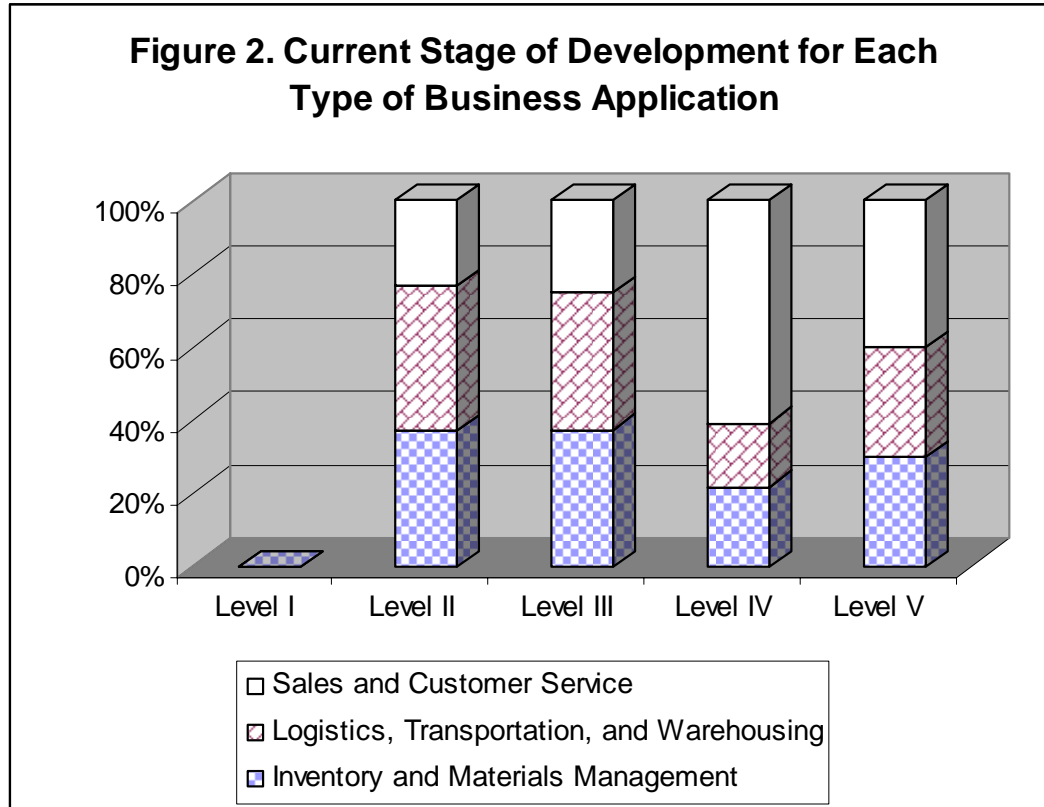
attendance at professional meetings. Out of 300

tremendous value potential for companies that

implement the appropriate business processes to leverage the data collection and integration for supply chain management. However, companies must look beyond mere compliance for ways to implement these initiatives into their total supply chain strategy and harness the true business value of the technology, hastening profits.

The ultimate benefit of RFID is not in doubt, just the timing. It represents a definite advance beyond today's ubiquitous bar codes. Some industry experts believe it's also the missing element in what has been a decades-long search for a way of actually squeezing excess inventory out of supply chains. As discussed earlier, RFID uses an antenna and a transceiver, which is often combined in a single unit, to read the RFID tag. The first advantage of RFID over bar coding is that RFID does not require direct contact or line-of-sight scanning. Secondly, RFID is not only a data collection technology, but also a technology to help businesses further streamline their production flow. Manual scanning and data entry at each step create an interrupted flow of process. The concept of interrupted flow applies not only to a manufacturing process but also to a distribution environment for a streamlined cross-docking process or a postponement operation that adds value to a product per the customer order. The use of RFID as a process automation tool would help data move together. It help eliminates much of the systems integration required today to direct assembly operations and collect quality and production output of the process. Thirdly, RFID helps eliminates the waste and inefficiency created from process noncompliance. There are business processes in every company in which the level of process discipline required is not achievable by human working in tandem with technology. Overcoming these limitations is difficult and expensive. While the option to create a totally automated process may be available, the normal course of action is to accept the waste and inefficiency created by noncompliance to process as a cost of doing business. This is where applying RFID has proven most effective, not by marginally improving an already well-disciplined and well-performing process, but by delivering a unique capability that overcomes the barriers commonly caused by an operating environment or material characteristics.

PROBLEMS AND ISSUES OF RFID

Despite the progress made in RFID research, development and implementations, there are still many problems existing which failed to further advance RFID adoption. First of all, the tag standard has not yet been finalized. Although some tag standards were announced, they were Version 1 standards that still need further development. Businesses will need to sort through competing and evolving tag standards, and these standards still face considerable risk of obsolescence. Secondly, the reliability of chips is still questionable. Based on the limited experience in the field, tags are only functional at 80% success rate. Thirdly, the cost of chips is still considerable high due the new technology. The Auto-ID Center recently published some data that assumes market volume of 30 billion units per year would result in a tag cost of 3 to 4 cents with a sale price of 5 cents. The chip itself would cost 1 penny and would be 3000 microns in size. However, the Electronic Product Code (EPC) Group is estimating the chips would be cost somewhere between 15 to 50 cents, which is very costly, over the next few years. Furthermore, this small chip has limitations in the amount of data that can be placed on it. More information can be placed on the chip, but it will cost additional money and require Object Name Service (ONS) to point to that data. Finally, there is a long list of hurdles each implementation must overcome, many involving the physics of radio frequency technology.

Due to the immaturity of the technology and all the problems discussed above, very few Consumer Packages Goods (CPG) manufacturers are actively implementing RFID and many are worried about complying with their customers' mandates. In addition, for many retailers and consumer goods manufacturers, RFID is a new comer on the scene, and it comes with more questions and problems than answers and results. For example, Schiff Nutrition International, a Salt Lake City-based maker of vitamins and nutritional supplements, is in the middle of an RFID pilot intended to help the midsize company deploy the technology in order to continue doing business with Wal-Mart [4].

RECOMMENDATIONS FOR RFID IMPLEMENTATION

Based on a survey that has been done by Consumer Goods Technology and AMR, almost

20 percent more companies than last year had made or would make investments in the RFID technology over the next three years. Meanwhile, many other companies would be tempted to hold back. A wait-and-see approach would hurt more than it would help. While there are no scientific or tested roadmaps to integration, companies can do some things to make the migration to RFID smoother.

First of all, companies should evaluate its business process and address a highly visible need or problem that has not been solved by other alternative approaches other than the RFID technology. Companies shouldn't force the RFID implementation. When making the decision of whether to implement the new technology, the Cost-Benefit-Analysis decision making model can be used. This can help managers make more informed decision by comparing the cost of implementation with the short-term and long-term benefits from the new technology. If the need of using RFID exists, the management team then should gain an understanding of the technology, as well as review and evaluate all commercially available technologies to be able to choose the one that fits their business needs.

Secondly, the management team should talk with RFID vendors and other end users to share experiences and information. This can help them better estimate the project costs, returns and the length of time of implementation. Meanwhile, an implementation plan should be formed with the implementation cost and benefit estimation for each period. To achieve the goals that the management team has, such as minimizing total costs during the implementation initial period, maximizing returns over the long term, etc., the Goal programming and Binary programming model would be used. These decision making models could help better decide critical decisions, such as which tasks should be undertaken during which implementation period, etc.

Thirdly, RFID technology has very little tolerance for change. Businesses should not deploy the project until all process, technical, and environmental variables are known and are under control. It would be very costly if part or the entire project requires rework. In addition, it is recommended to choose services partners that have hand-on experience with the RFID technology during the implantation. Also, businesses should be sure the technology has been developed with their business process and

environment in mind. This is to ensure that the new technology would fit the existing business process. Furthermore, application integration requirements should be minimized during the new technology adoption to eliminate additional costs and issues.

Finally, the RFID technology is becoming mature. Business should plan for and do risk analysis on the changes in standards and technology that will occur as RFID adoption grows. The business case needs to be built with an ROI for the short term while still accounting for long-term implications.

CONCLUSION

As outlined above, RFID offers tremendous value potential for companies. Companies that implement the appropriate business processes to leverage the data collected by RFID will accelerate these benefits. As companies develop their RFID strategies, they must look beyond mere compliance for ways to implement these initiatives into their total supply chain strategy and harness the true business value of the technology, hastening profits.

As the level 1 deployments of RFID are becoming mature, businesses could move forward with some things now while the technology progresses and the details get worked out. The physical limitations of RF technology will likely not go away. Therefore, it is necessary to work with an RFID expert to understand how to work around all the barriers during this technology adoption. With RFID being a new technology in many industries, a few consultants have solid experience in this area. However, they could help companies develop RFID strategies while providing real-world RFID expertise.

Although the technology is still immature, current application infrastructure can still be addressed now while waiting for the technology to mature. The ERP, supply chain, and warehouse applications of businesses will need to become RFID aware so they can provide data to the tagged pallet/case/carton, as well as leverage the information internally.

We plan to continue our efforts on RFID and SCM. Encouraged by the results of this initial survey, we plan to implement another survey with details of the RFID development efforts in each function and at all levels. We hope this

initial study on RFID brings much more attention to the SCM field as well as future empirical studies that will be useful to academicians and practitioners alike.

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