A MIXED METHOD STUDY OF THE IMPACT OF RFID ON THE RETAIL VALUE CHAIN

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ABSTRACT

This paper seeks to provide a perspective of the immense potential of RFID in the retail sector, taking adoption drivers and implementation challenges into account. We use a mixed method approach to quantitatively analyze RFID adoption drivers, benefits, and implementation challenges. The combined results should provide insights and aid in drawing meaningful managerial conclusions.

Keywords: Delphi, content analysis, RFID, adoption

INTRODUCTION

Modern retail industry still faces a number of challenges. The introduction of technologies like barcodes has not eliminated many issues such as: 1) Out of stock and 2) Inventory inaccuracy According to (Gruen et al, 2002) average out-of stock level for the retail industry in US is about 8.3%. Another case study results with a US based retailer (Raman, 2000) claimed that there was inaccurate inventory for over 70% of the stock keeping units in the store.

Radio Frequency Identification (RFID) is an example of automatic identification technology which is much more advanced than the barcode technology and can address these issues effectively through reduced manual intervention and thus errors. In this regard, (Bagchi et al, 2007) have shown that RFID stochastically dominated barcodes. This research work deals with the usage of RFID technology across the retail value chain. RFID adoption rolled out with large retailers such as Wal-Mart, Tesco, Albertsons, Best Buy, Marks and Spencer, Sears, Home Depot, Metro and government agencies such as DOD (US department of defense) and FDA (Food and Drug Administration) mandating their suppliers to tag their products at a pallet or case level with the objective of streamlining their value chain processes. The widespread use of RFID could automate individual items or cases or pallets of products, as well as reusable assets throughout the value chain. Real-time visibility could be a reality with RFID which was not possible with the use of bar-code technology.

Although businesses have performed pilot tests that in turn have helped to identify the strengths and weaknesses of the technology, they are yet to proceed to a stage where they can actually compare the value chain performance resulting from using RFID from full-scale implementations. Given the early stage of RFID adoption, there is a lot of uncertainty regarding the actual value and return on investments (ROI) of the technology and the determinant factors

driving adoption decisions (Lee and Shim, 2007). This work seeks to improve the understanding of the potential benefits of adopting RFID. We intend to achieve it by providing a comprehensive discussion of factors that influence the adoption of RFID, the benefits that RFID can offer, and finally the challenges that must be overcome.

Although it has been claimed that RFID is going to revolutionize the way businesses are conducted today, the adoption rate of the technology has been relatively slow. This study takes an in-depth look between promise and reality. This work could guide decision makers and inform practitioners about relative importance of going forward for future adoption decisions.

To guide our investigation and analysis, we use the following research questions:
1. What are the significant adoption drivers for RFID in retail?

2. What are the benefits for RFID in retail?

3. What are the key challenges for RFID in retail?

In the next section we briefly present the research methodology. Then we discuss the analytical results and discussion followed by conclusions.

RESEARCH METHODOLOGY

Due to the fact that the use of RFID in retail sector for operational and value chain improvement is a rather new area it became clear during the research planning phase that the methodology must be suitable for the analysis of data. Therefore a combination of secondary and primary data sources provides data for this research work. Mixed method is appropriate since RFID research is still at its infancy and thus a combination of methodological techniques better assists in exploring the impact of the technology. The methodology is twofold. Content analysis is the first method that is used. Second, we used 'Delphi method' to cross check our findings as well as to unveil other pertinent issues that are deemed important. The two methods are well established scientific methods that are widely used in Information Science (IS) research and are suitable to meet our research objective.

Content analysis is a research technique for making valid inferences from texts or other meaningful matter to the contexts of their use (Krippendorf, 2004). It is defined as the detailed and systematic examination of the contents of a particular body of materials for the purpose of identifying patterns, themes or biases (Leedy and Ormrod 2005, p. 143). For this research work, we did our search for relevant articles between October 2006 – April 2009 and found 630 articles: 58 published journal articles, 54 conference proceedings, 90 academic magazines, 234 industry white papers, and 194 news releases. We made sure that we eliminated duplication.

Delphi technique is a method to combine the informed judgments from a panel of independent experts (Dalkey, 1969). This method is relevant when no or very little hard data or well-established theory is available, but experts have relevant information about the focus of the research. For this research, we obtained candidates from different sectors such as consulting,

academia (Faculty researchers), retail, and third party service providers in order to reduce bias from a group composed of candidates of similar backgrounds. This allowed achieving a broad overview and eliminating inherent bias within each sector.

The Delphi study was conducted online between December 2009 and January 2010. After the questionnaire was developed it was sent to around 240 experts in electronic format through email. We had a total of 74 expert candidates, including consultants (23; 31.1%), academics (17; 23%), retail practitioners (16; 21.6%), and third-party service providers (18; 24.3%). We also attempted to obtain the opinions of experts across the spectrum of management levels. Among our expert candidates, 28 (37.8%) held top management positions, 8 (10.8%) IT management positions, 19 (25.7%) were executives, and 19 (25.7%) held research positions.

The questionnaire guiding the Delphi study is generated primarily based on the results of the content analysis as well as under the guidance of the fundamental theories that serve as the premise of this work. We have adapted and amalgamated measures from previous studies for ensuring reliability of the study instrument (Premkumar and Roberts, 1999; Ranganathan and Jha, 2005; Sharma and Citurs, 2005). We also pilot tested the questionnaire with faculty and graduate student researchers to enhance clarity and question focus. The questions are designed as 5 point Likert scale (Strongly disagree (1) to Strongly agree (5)). The validity of the measures was established using Cronbach's alpha to establish inter-item reliability. The Cronbach's alphas were high and ranged from 0.706 to 0.927 (0.706 for drivers; 0.927 for benefits; 0.794 for challenges).

For details of how content analysis has been applied please refer to (Bhattacharya et al, 2007; 2008; 2009; 2010) and more detailed discussion of the Delphi research method can be obtained from (Bhattacharya et al, 2011).

ANALYTICAL RESULTS AND DISCUSSION

Major Drivers for RFID Adoption in Retail

From content analysis we found that the big box retailer mandate is the most dominant driver for RFID adoption. The next most important driver is the government mandate (DOD, FDA etc.), followed by anti-counterfeiting requirements and EPC global initiatives for standardization. Next are the decreasing cost of tags and readers and technological maturity. We found similar drivers for adoption in the Delphi study. However, the experts rated decreasing cost of tags and readers as the most significant adoption driver followed by RFID technological maturity and big box retailer mandates. Next were anti-counterfeiting requirements, government mandates, and EPC global initiatives for standardization.

Factor analysis of the initial 6 items of RFID drivers (From Delphi data) revealed two major categories of factors: 1) technological drivers and 2) environmental drivers. These factors accounted for 57.23% of the total variance. The data indicates that the experts regard

technological drivers as the more important determining factor driving RFID adoption in retail followed by environmental factors.

Retailer Benefits of Adopting RFID

From content analysis we found that improved customer service levels, security against theft/fraud/loss/counterfeiting, reduced out of stock, improved data accuracy, and real time visibility were the most important reported benefits that RFID provides. Delphi study rankings are not consistent with the reported ranking of benefits. Experts from the Delphi study suggested that improved data accuracy, reduced out of stock, reduced missing sales, real time visibility, and reduced shrinkage are the top benefits that could be obtained through RFID implementation.

Factor analysis of the initial 22 items of RFID benefits (Delphi data) revealed five factors with Eigen-values above 1.0 that account for about 70% of the total variance. Potential benefits of RFID consisted of (a) improved operational efficiency, (b) improved inventory management, (c) improved customer, supplier coordination, (d) improved visibility, and (e) improved security.

The improved operational efficiency dimension of benefits can be achieved by automating operational processes and thus reducing manual intervention and thus errors. Similarly improved inventory management is an informational effect that can be achieved by improving capabilities to collect, store, process, and disseminate information. The improved customer, supplier coordination factor is again an informational effect of RFID. Improved visibility is both an informational and transformational effect. It improves the informational capabilities of retailers and at the same time facilitates new process engineering through real time data capture. Finally improved security is an informational effect that can be achieved through improved information capture and sharing using RFID. As we can see most of the potential RFID benefits are informational in nature, however the real potential of the technology can be experienced only when the transformational effect is properly utilized to draw business benefits.

Major Challenges for RFID Adoption in Retail

From content analysis results privacy issues and high cost are the most dominant challenges that need to be addressed before RFID can penetrate deeper into the business world for the retail sector. Technical issues such as readability and data integration issues are also daunting as the amount of data generated by the typical RFID system is enormous and business processes need to be redesigned to generate useful information from the data. Other challenges that came out are unclear return on investment (ROI), multiple frequencies, employee resistance to change followed by lack of top management support, lack of technical expertise, and complexity of technology. From the Delphi study, it is verified that the adoption challenges identified during content analysis are significant. However the rankings of these challenges from the two methods came out to be somewhat different. The top three most significant challenges that emerged from the Delphi study are high cost, unclear ROI, and business process redesign.

Factor analysis of initial 12 challenge items (from Delphi data) revealed four factors with Eigen-values greater than 1.0 accounting for about 68% of the total variance. These factors are: (a) technical challenges (b) organizational challenges (c) fit challenges (Issues that capture the link between RIFD processes and the underlying business processes they are intended to support), and (d) business challenges. The data indicates that the experts regard technical challenges as the most daunting challenge for RFID implementation in retail followed by organizational challenges, fit challenges, and business challenges. The technical challenges are technological in nature and will gradually fade with technological advancements over time. The organizational factors were similar to the factors identified in the organizational adoption of technology. These were top management support, IT expertise, organizational size, and organizational readiness. Employee resistance to change reflected lack of organizational readiness; lack of top management support and lack of technical expertise are the same constructs as identified in literature. The fit challenges are technological and include business process redesign and complexity. The business challenges being privacy and cost are perceived to be the most important. These challenges are technological in nature because with technological advancements the cost will come down and the privacy issues can be handled with improved security features. However the business challenges have a lot to do with perception of businesses and consumers. With technological advancements, most of these challenges will eventually be overcome. However, privacy concerns require more than technological advancement and will remain a major challenge for retailers. A balance between the benefits consumers can get in terms of better service and savings and the impingement on privacy and increased awareness among consumers should be a top priority of retail sector.

CONCLUSIONS AND IMPLICATIONS

The results from this study provide deep insights and enhance the understanding of a wide variety of RFID implementation issues for retail sector. The detailed description of issues in this research will provide decision makers with adequate comprehensive knowledge for making RFID technology implementation decisions based on individual firm needs. This research work will fulfill practitioner's needs to understand the impact of RFID particularly for retailers. This research also shows that the research methods of content analysis and Delphi method could be used in a complementary fashion thus allowing the researcher to gain synergies, harmonize the weaknesses and assess the relative strengths of each individual method. Adopting two methodological perspectives provides an extended view of the phenomenon under investigation.

Overall we observe that there is consistency in the items identified as drivers of adoption, benefits, and challenges with respect to RFID in both the content analysis and the Delphi study. However, the relative importance of these various items within each of the three categories differs, often markedly. We believe that the experts, surveyed in December 2009 were drawing on direct experience and that this experience often reflected several years of RFID-related activities. On the other hand, the content analysis includes publications dating to 2006. Even though the content analysis included publications through April 2009, we believe that the discrepancy between content analysis rankings and Delphi expert rankings reflects much of the early hype associated with RFID. Our findings suggest that despite the expected impact of retailer and DOD mandates, it is still the technology costs that are driving adoption decisions.

With respect to benefits, the anticipated customer service benefits (From the content analysis) appear overshadowed by the more firm-centric inventory and visibility aspects of the technology. We observe that most of the benefits obtained from RFID are informational in nature. However the true strength of RFID lies in its transformational capabilities to trigger new and more effective business processes. Finally, with respect to challenges, our results point to the importance of cost and making the business case as the primary issues rather than the privacy concerns voiced in the content analysis. Overall, we believe that decision-makers are influenced by cost and by the difficulty in monetizing the benefits of the technology in the normal course of business.

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