



UNIVERSITY
OF WOLLONGONG
AUSTRALIA

University of Wollongong
Research Online

Faculty of Informatics - Papers (Archive)

Faculty of Engineering and Information Sciences

2012

Determinants of RFID Technology Adoption Intention in the Saudi Retail Industry: an Empirical Study

Salem Alqahtani

CBSS, University of Wollongong, sa429@uowmail.edu.au

S. F. Wamba

University of Wollongong, samuel.fosso.wamba@neoma-bs.fr

Publication Details

Alqahtani, S. and **Fosso Wamba, S.** (2012). Determinants of RFID Technology Adoption Intention in the Saudi Retail Industry: an Empirical Study. Proceedings of the 45th Hawaii International Conference on System Sciences (HICSS-45), Maui, Hawaii, January 4-7, 2012, IEEE Computer Society.

Research Online is the open access institutional repository for the University of Wollongong. For further information contact the UOW Library: research-pubs@uow.edu.au

Determinants of RFID Technology Adoption Intention in the Saudi Retail Industry: an Empirical Study

Abstract

Drawing both on innovation diffusion theory and Radio frequency identification (RFID) technology, this paper assesses the influence of a set of determinants on the intention of Saudi Arabian retail firms to adopt RFID technology. In this study, a two-phase, multi-method approach was used. In the first phase, an interview-based case study was used, while in the second phase, we conducted a survey to gather data from 7 large retailers in Saudi Arabia. Our findings indicate that while the RFID relative advantage, the top management support and information intensity do not have any influence on the intention of Saudi Arabia retail firms adoption for RFID technology, the firm technology competence, competitive pressure and social issues do impact on their adoption intention. The results of the study and related implications contribute to extend knowledge and ideas on the role of RFID technology in the retail industry, with a specific focus on the Kingdom of Saudi Arabia.

Keywords

RFID technology, Determinants of RFiD, Adoption Intention, Saudi Retail Industry, Empirical Study

Disciplines

Physical Sciences and Mathematics

Publication Details

Alqahtani, S. and **Fosso Wamba, S.** (2012). Determinants of RFID Technology Adoption Intention in the Saudi Retail Industry: an Empirical Study. Proceedings of the 45th Hawaii International Conference on System Sciences (HICSS-45), Maui, Hawaii, January 4-7, 2012, IEEE Computer Society.

Determinants of RFID Technology Adoption Intention in the Saudi Retail Industry: an Empirical Study

Salem Alqahtani, Ph.D. candidate
University of Wollongong, Wollongong, Australia
The Saudi Arabia Ministry of Defense, Saudi Arabia
sa429@uowmail.edu.au

Samuel Fosso Wamba, Ph.D.
University of Wollongong, Wollongong, Australia
Rouen Business School, Rouen, France
samuel@uow.edu.au

Abstract

Drawing both on innovation diffusion theory and Radio frequency identification (RFID) technology, this paper assesses the influence of a set of determinants on the intention of Saudi Arabian retail firms to adopt RFID technology. In this study, a two-phase, multi-method approach was used. In the first phase, an interview-based case study was used, while in the second phase, we conducted a survey to gather data from 7 large retailers in Saudi Arabia. Our findings indicate that while the RFID relative advantage, the top management support and information intensity do not have any influence on the intention of Saudi Arabia retail firms adoption for RFID technology, the firm technology competence, competitive pressure and social issues do impact on their adoption intention. The results of the study and related implications contribute to extend knowledge and ideas on the role of RFID technology in the retail industry, with a specific focus on the Kingdom of Saudi Arabia.

1. Introduction

Radio frequency identification (RFID), a wireless automatic identification and data capture (AIDC) technology [1] is emerging as a new wave of information technology (IT) that has the potential to radically transform end-to-end supply chain (SC) business processes [1, 2]. RFID technology uses radio waves to collect data and automatically identify objects moving through the SC [3]. Adoption and use of RFID within SC operation could lead to tremendous benefits including: real-time access to information, intra- and inter-business processes automation, tracking and tracing at the item level within the SC [1, 4], improved inventory management and decision making. Despite the high potential of RFID technology, very few studies have been conducted on its enabling role of transforming retail operations in Saudi Arabia. Therefore, this study is an initial effort towards bridging this knowledge gap in the literature. More specifically, this study draws on prior studies on RFID research agendas [2, 5], diffusion of innovation theory, as well as on the extant literature on RFID technology to examine the following research questions:

1. What is the level of RFID technology adoption by Saudi retail firms?
2. What are the key determinants of the intention of Saudi Arabian retail firms to adopt RFID technology?

The remainder of this paper is structured as follows: Section 2 introduces the background of the study; then Section 3 presents the conceptual model and our hypothesis, followed by Section 4 which describes our methodology, while Section 5 presents our results and discussions. Finally, Section 6 serves as a conclusion.

2. Background of the study

2.1 Diffusion of innovation theory

The diffusion of innovation (DOI) theory is used as the theoretical background of this research work. Indeed, this theory is recognized by many researchers as relevant to any study of the intention of potential adopters of a given innovation [6]. DOI is a theory of how, why, and at what rate new ideas and technologies spread through cultures. Early DOI studies have identified a number of factors affecting the diffusion and assimilation of IT innovations: innovation characteristics, organizational characteristics and environmental characteristics (e.g., [6-8]). For example, Rogers in his seminal work has postulated that five innovation characteristics may explicate the decision to adopt or not an innovation: “relative advantage” as the degree to which an innovation can bring benefits to an organization; “trialability” as the degree to which an innovation may be experimented with; “complexity” as the degree to which an innovation is difficult to use; “observability” as the degree to which the results of an innovation are visible to others; and “compatibility” as the degree to which an innovation is consistent with existing business processes, practices and value systems [6]. Therefore, if we consider RFID technology as a technological innovation, its relative advantage (e.g., multiple tags items reading, more data storage capability, no need of line of sight) -as compared to similar technologies (e.g., bare coding)- will positively influence the adoption intention decision. At the organizational

level, prior DOI studies have demonstrated that organizational characteristics such as organizational readiness (e.g., level of technical and financial resources available within the organization), organizational culture (e.g., centralization vs. decentralization), management support and organizational size will influence the adoption intention decision (e.g., [6-9]). For example, early adopters of RFID technology cited in the literature so far are mostly big organizations such as Wal-Mart and the United States Department of Defense [10]. In the end, a set of environmental characteristics has been acknowledged as being able to influence the firm's intention decision to adopt or not an innovation. This includes the intensity of competitive pressure (e.g., [7, 8]), standard and regulation [11], the nature of business relationship (e.g., partners pressure, trust) [11], and the nature of the sector/industry (e.g., information intensity) [12]. For example, Wal-Mart issued a mandate to its top suppliers to drive them to adopt RFID technology; such a measure was considered a catalyst for rekindling interest toward the technology, thus leading ultimately to its adoption by some of these suppliers [2].

2.2 Retail industry and RFID adoption and use in the sector

2.2.1. Retail industry in Saudi Arabia. The Kingdom of Saudi Arabia, also known as Saudi Arabia, is the largest Arab country of the Middle East. It has 2.25 million km² and a population of about 28 million. It is regarded as both the birth place of Islam –harboring the two Islam's holiest shrines in Mecca and Medina and a leading producer of oil and natural gas with still more than 20% of the world oil reserves. It is a conservative country, culturally and politically organized not only around Islamic and Arabic principles and cultural values, but also around the Shari'a law. Within the Arab region, the Kingdom of Saudi Arabia plays an important political and economic role, with social and cultural characteristics significantly different from those of the Western world. The government has introduced a policy of an extra 25% of salary to Saudi professionals who embrace IT throughout the Kingdom. For the broader IT market, Saudi Arabia is 3rd out of 22 Arab countries; yet there is a strong belief that this will be supported by a significant growth and movement in the next few years, mainly owing to high levels of e-commerce and e-government for competitive advantage [13, 14].

The Saudi Arabia Retail sales will grow from \$76 billion in 2009 to \$ 129 billion in 2014 [15]. The sector is characterized by the presence of huge stores/hypermarkets (e.g., up to 100,000 square feet and up to 60 checkout counters per hypermarket)[16], the absence of income taxes, the entrance of

international players (e.g., Géant and Carrefour) into the local market as well as the emergence of a strong local brand called Hyper Panda. In addition, Saudi retailers are constantly searching for new products, and often request support from suppliers for promotion and advertising. The sector plays an important social role. Indeed, supermarket shopping is considered one of the main forms of entertainment for Saudi families, and as a result, many supermarkets have to build large play areas for children surrounded by boutiques, cafés, barber shops and fast food restaurants.

2.2.2. RFID adoption and use in the retail industry. The retail industry is a big consumer of IT and web-based innovations: bar coding, electronic markets (e.g., Wal-Mart's Retail Link), enterprise information systems (e.g., Enterprise Resource Planning), electronic collaboration tools and concepts (e.g., Vendor Managed Inventory) [10], etc.. For example, the bar code technology is currently the most widespread technology in the retail industry worldwide, with an impressive 100% adoption rate by US retailers [17], in order to improve cycle time, inventory management and replenishment throughout the supply chain. However, the explosion of stock keeping units coupled with some of the weaknesses of bar coding (e.g., need of light of sight) have prompted some key players within the sector to explore new enabling technologies such as RFID technology, because of its unique characteristics: item and product level identification, no need of line of sight, multiple tags items reading, improved data storage capability and data read/write capabilities [18]. Through the use of RFID technology, the retailer can improve on customer relations, shop design, fitting rooms and customer amenities [19]. For example, RFID can bring about greater efficiency in the monitoring of stock when calling out for a product identity code, type, size, and color. All these markers of the product can be detected through radio signals from the RFID reader, which is useful and strategic, and should be adopted by the retail sector [20]. Some clothing design houses, such as Zara and Prada, use RFID to improve design, manufacturing, and stock availability, thanks to the additional monitoring capacities offered by such a technology. By using RFID technology, changing consumer demand can be attended to in a timely manner, thus improving productivity for these fashion labels [19]. At the SC level, the technology offers significant benefits for all SC stakeholders such as increased inventory accuracy, the reduction of manual processes and human-based errors by means of automation process, improved replenishment time, decreased lead time and improved end-to-end inventory management [1].

3. Conceptual model and hypothesis

From the emerging literature on RFID technology, retail industry and diffusion of innovation as well as our initial qualitative data analysis (see section 5.1.); a model based on the conceptual and empirical determinants of adoption intention is presented in Figure 1. The model analyzed the influence of relative advantage, technology competence, top management support, social issues, information intensity and competitive pressure on the intention of Saudi retailing firms to adopt RFID technology. The following sections present the conceptual and empirical arguments underpinning each of the hypotheses (H1, H2, H3, H4, H5 and H6).

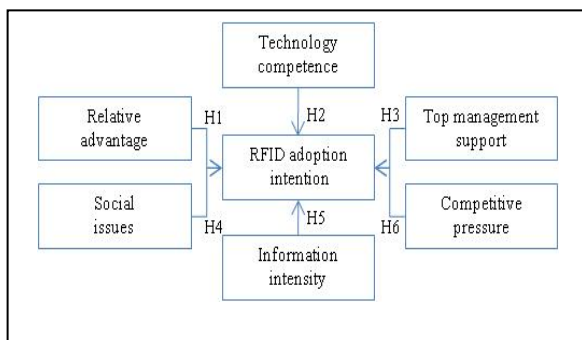


Figure 1. Conceptual model

3.1. Relative advantage

Relative advantage is defined as the degree to which an innovation can bring benefits to an organization compared to similar innovation [6]. It is understood that organizations can develop a focus and consider the advantages that arise from the adoption of innovation. As and when all goods eventually adopt the RFID tags, the location of the goods can be easily and automatically tracked through the entire supply chain, and therefore increase SC visibility, improve on inventory management, transform SC business processes, enhance efficiency and decision making [21, 22]. In short, SC stakeholders who perceive higher RFID technology relative advantages will likely tend to adopt the technology. Consequently, the following hypothesis is proposed: **H1. Relative advantage will have a significant positive effect on RFID adoption intention.**

3.2. Technology competence

Technology competence, or technological readiness, is based on IT infrastructure and the resources offered by IT professionals [11]. IT infrastructure is understood as those installed network technologies and enterprise systems, which

create a platform for the use of RFID applications. IT professionals are understood as having the necessary knowledge and skills for the implementation of RFID-related applications. Generally speaking, the implementation of RFID systems is still a novel and unique feature for many organizations [23]. The implementation of RFID applications is built on the provision of innovative IT skills, new IT components and the adapting of current information systems [24]. Hence, it is observed that those companies with greater technology competence will more willing to adopt and implement RFID technology. Accordingly, the following hypothesis was proposed: **H2. Technology competence will have a significant positive effect on intention of RFID adoption.**

3.3. Top management support

Top management is recognized as a critical determinant of IT adoption. Early DOI studies found top management support will positively influence the adoption intention decision [7, 8]. As RFID implementations require a high level of organizational transformation (e.g., business process reengineering, technological and organizational integration) to realize the full business benefits from RFID projects [21], the role of the top management becomes even more critical in terms of allocating the adequate resources (e.g., financial, humans, technological), promoting the project and manage the organizational change. Therefore, the following hypothesis was proposed: **H3. Top management support will have a significant positive effect on RFID adoption intention.**

3.4. Social issues

Social factors (e.g., privacy, security) have been recognized to explain the adoption decision of innovations by organizations [25]. For example, the privacy concerns are viewed as “a significant threat for the deployment of RFID technologies at the interface with the end customers” (p 439)[26]. This situation may be even worst in countries with strong traditional and religious cultures (e.g., Saudi Arabia). Accordingly, the following hypothesis is proposed: **H4. Social issues will have a significant negative effect on RFID adoption intention.**

3.5. Information intensity

Information intensity is simply the degree to which information is available on the product or service [27], with information-intensive products being more complicated to order, or to use, and therefore necessitating more additional information. The use of products through a strategic use of ITs [28] is seen as beneficial. Additionally, firms are

more likely to adopt innovative ITs if they operate in an information-intensive environment (e.g., retailing), as compared with those operating in less information-intensive environments [12]. Information intensity on products available in the business environment will therefore influence the adoption of an innovation [29-31]. Compared with the use of bar codes, RFID tags can easily handle and store greater amounts of information. Additionally, RFID is more able to handle updates and reads faster [32, 33]. Therefore, the following hypothesis was proposed: **H5. Information intensity will have a significant positive effect on intention of RFID adoption.**

3.6. Competitive pressure

The pressure of competition is a crucial element in the determination of IT adoption [7, 34]. As the level of market competition grows, companies increasingly seek to realize a competitive advantage through innovation. By adopting RFID, companies can benefit from greater inventory visibility, operational productivity, and increased accuracy in data collection [24, 35]. Thus, the following hypothesis was proposed: **H6. Competitive pressure will have a significant positive effect on intention of RFID adoption.**

4. Methodology

In this study, a two-phase, multi-method approach was used. More precisely, in the first phase, a case study using interview was used. This methodology involves a case study of 7 large-scale retailers in Saudi Arabia. Case study allows us to capture the dynamic interactions within Saudi retail sector and is considered as a relevant research approach to study emerging and complex phenomena. Therefore it induces theories in a research field where theories are at their early and formative stages [36]. In addition, case studies are well suited to answer research questions such as “why” and “how” things are done [37]. Multiple sources of evidence were used for data collection, including interviews, on-site observations and document analysis, which allowed us to increase our construct validity [37]. In the second phase a quantitative method was used via questionnaire survey administrated among 7 Saudi retailers. All construct measures in the study were based on existing instruments (see Appendix).

4.1. Research sites and data collection

Seven large-scale firms in Saudi Arabia participated in this study, namely: Panda, Al Othaim,

Al Sadhan, Al Tamimi, Al Danube, Carrefour, and Al Rabie. Data collection involved:

- Semi-structured interviews with managers and executive directors. Each interview lasted about half an hour and allowed open-ended probing. All data gathered during these interviews were recorded in a database for further analysis.
- On-sites observations in the seven research sites in order to understand the current dynamics within each site.
- A paper-based questionnaire administrated among the seven retailers in order to test our research hypotheses.
- Document analysis of industrial reports, government policy documents and internal company reports.

5. Results and discussion

5.1. Qualitative data analysis

Table 1 shows that all our respondents held a managerial position. In terms of the level of knowledge about RFID technology, 43% of respondents respectively had a “very good knowledge of RFID technology” and a “good knowledge of RFID technology”, while 14% had a “poor knowledge of RFID technology”. Overall, about 86% of the respondents had good knowledge of RFID technology. Also, the hypermarket was dominant as a business association (86%). The majority of respondents were aware of the relative advantage of RFID technology (86%) in terms of the improvement of supply chain, an increase in customer satisfaction, and a help in decision making. For example, the Al Tamimi store manager stated: “For me, the most important enablers for adopting RFID will include improved data accuracy and inventory management”. Some 71% of respondents also believed that social issues (e.g., privacy, culture) will play an important role during RFID technology adoption by Saudi retailers. Indeed, the Saudi culture is recognized as very traditional and conservative, therefore Saudi consumers may be opposed to the use of RFID technology. This would have a negative effect on the retailers’ adoption intention. This reminds us of the case of the retailer Benetton: this company had to cancel its RFID-enabled clothing tracking and tracing pilot projects because of consumers’ privacy concerns [38]. Finally, 71% of respondents agreed that competitive pressure will have a major effect on the adoption intention for RFID. Indeed, they believed that if any retail Saudi firm successfully starts implementing RFID within its operations, the rest of Saudi retailers will feel competition pressure and probably start their own RFID project. This is even more important in the Saudi Arabia context as people like to copy from

each other. This phenomenon, also called the “bandwagon effect”, is not unusual and has been observed during the adoption of IT innovations such as e-business, EDI and organizational website, where the “adoption decisions may have more to do with interorganizational isomorphic processes than rational intraorganizational criteria such as efficiency” (p. 620-621)[39]. For the manager of Hardware & Technology Support Department at Al Othiam, “top management support will be the key of any RFID-enabled retail project”. As for the executive manager of Al Danube, he believed that RFID technology will facilitate the “data availability & integrity and quick data access” within the sector. In conclusion, it appears that the vast majority of the dimensions discussed by the respondents are in line with the relative advantage of RFID technology, the importance of the top management support, the technology competence during the adoption decision process, and the social issues and competitive pressure that may influence the adoption or non-adoption of the technology.

Descriptive analyses of the sample are shown in Table 2. Among the respondents, 84% were working in Hypermarkets while 16% operated in the retail sector as business association. It is clear that our sample is dominated by the Hypermarket.

Also, regarding the level of RFID knowledge, 48% of participants were poor in knowledge, while 43% were good. Only 5% were very good, while 4% were very poor. That means the majority of participants had only heard about RFID technology without having any concrete knowledge of the technology.

From Table 2, we can observe that the majority of respondents had not yet participated in any RFID project. About 92.8% of participants did not work in any RFID project. But 3.6% worked with RFID for 2 to 5 years while 1.8% participated in RFID for less than 1 year. There were also those with more than 5 years’ experience with the technology. So it is clear that the majority of participants had not worked with any RFID project.

Table 1: Summary of the case study analysis

	Panda	Al Othiam	Al Sadhan	Al Tamimi	Al Danube	Carrefour	Al Rabie
Interviewer Position	Vice-President of supply chain	Manager of hardware & technology support	General Manager	Store Manager	Executive Manager	Manager	Human Resource Manager
Level of knowledge of RFID technology	Very good	Very good	Good	Very good	Poor	Good	Good
Business Association	Hyper-market	Hyper-market	Hyper-market	Hyper-market	Hyper-market	Hyper-market	Retailer
No. of employees	20,000	6,000	570	6,000	5,000	450	2,000
Advantages of RFID technology	SC improvement, Increase customer satisfaction	SC improvement	SC improvement	SC improvement	SC Improvement, improved decision making	Enabling technology	SC improvement
Challenges of RFID technology	Culture, unpopularity and cost	Privacy, tags cost	Privacy	Infrastructure and human skills	Privacy, culture, values and integration	Lack of information and size of firm	Complexity and human skills
Social issues	Yes	Yes	No	No	Yes	Yes	Yes
Competitive pressure	Yes	Yes	No	Yes	Yes	Yes	No

5.2. Quantitative data analysis

In this section, we present the findings of our quantitative study. For this study, a 51% response rate was achieved. Indeed, out of 110 questionnaires distributed, we received 56 useful responses.

In addition, participants were from organizations with headquarters in three different areas, namely Riyadh, Jeddah and Dammam. It can be seen that half of the interviewees were from Riyadh, 32% from Jeddah, and 18% from Dammam. This means that 28 respondents were from Riyadh, 18

respondents from Jeddah, and 10 respondents from Dammam.

Then, a logistic regression technique where all variables were entered in one step was used to test our research model. From this analysis the following observations can be made. The p-value of the Chi-square ($\chi^2=2.403$, $df=7$) is 0.943 and is statistically non-significant. Therefore, the p-value is large (0.943), indicating a good match, and the model is adequate. This analysis also determines Pseudo R² (0.4007). The p-value of the present hypothesized model is 0.0048, which is less than 0.01, indicating an excellent strength of fit. Therefore, the overall model fit is found to be adequate.

Table 3 shows how well the research model classified the adopters and non-adopters. The model correctly predicted 52.9% of adopters and 92.3% of non-adopters, for an overall accuracy rate of 80.4%. Therefore, as the accuracy ratio is higher than 50%, it indicates that the prediction model was more accurate than the random guessing.

The significance of the regression coefficients of the hypothesized predictors was examined using the Wald statistics to determine support for the hypotheses. As Table 4 shows, two factors (competitive pressure and social issue) were significant at the 0.05 level, and one factor (technology competence) was significant at the 0.01 level. However, the relative advantage, information intensity and top management support were found to be non-significant discriminators.

Table 2: Sample profile

Category	No.	%
Business association		
Hypermarket	47	84
Retailer	9	16
Level of RFID knowledge		
Very good	3	5
Good	24	43
Poor	27	48
Very poor	2	4
Involvement time in RFID project		
None	52	92.8
< 1 year	1	1.8
1<2 years	0	0
2<5 years	2	3.6
>5 years	1	1.8
Location of respondents' headquarter		
Riyadh	28	50
Jeddah	18	32
Dammam	10	18
RFID adoption		
Yes	5	9
No	51	91
Future intention of RFID adoption		
Yes	17	30
No	39	70

The sign of the regression coefficient (β) represents the positive or negative impact of independent variables on the organizational adoption of RFID. Therefore, it can be seen that (1) the relative advantage, competitive pressure, top management support and technology competence are positively related to organizational adoption intention of RFID, and (2) the information intensity and social issues are negatively related to the organizational likelihood to adopt RFID. Also, Table 5 summarizes the hypotheses results in this research.

Table 3: Classification table

Actual	Predicted		%Correct
	Non adopters	Adopters	
Non adopters	36	3	92.3
Adopters	8	9	52.9
Overall			80.4

Table 4: Results of the logistic regression analysis

Independent variables	β	Wald	P-value
Relative advantage	0.450	0.322	0.285
Technology competence	1.735	6.899	0.004**
Top management support	0.192	0.058	0.405
Competitive pressure	1.118	2.895	0.044*
Information intensity	-0.739	0.808	0.184
Social issues	-1.211	2.822	0.046*

* P<0.05, ** P<0.01, *** P<0.001

5.3. Discussion

This research has shown the importance of diffusion of innovation theory in the understanding of the adoption intention of an innovative technology—RFID technology. The research results have allowed us to identify a set of important determinants of the adoption intention process among Saudi Arabian retailers.

For example, RFID relative advantage doesn't appear to be an important discriminator of the adoption intention. This result is in line with early studies by [40, 41]. Indeed, [41] found that RFID relative advantage was not a "decisive influential factor" of the adoption intention of various New Zealand's supply chains, which include logistics service providers, manufacturing firms, distributors

and retailers. Similarly, [40] found that the relative advantage was not a significant determinant for RFID adoption intention in the manufacturing in Taiwan. However, early studies on IT adoption (e.g. [8, 11, 42]) and emerging literature on RFID technology adoption (e.g., [42]) showed that the relative advantage was a significant determinant of adoption.

Table 5: Summary of the hypotheses results

No	Hypothesis	Results
H1	Relative advantage will have a significant positive effect on intention of RFID adoption.	Not supported
H2	Technology competence will have a significant positive effect on intention of RFID adoption.	Supported
H3	Top management support will have a significant positive effect on intention of RFID adoption.	Not supported
H4	Social issues will have a significant negative effect on intention of RFID adoption.	Supported
H5	Information intensity will have a significant positive effect on intention of RFID adoption.	Not supported
H6	Competitive pressure will have a significant positive effect on intention of RFID adoption	Supported

Technology competence was found to be a significant determinant of RFID adoption intention. This result is consistent with a study by [42], where the authors found that technology competence positively affected RFID adoption intention in the South African retail sector. However, [40] argued that technology competence was an insignificant determinant of RFID adoption intention in the Taiwan manufacturing sector.

In our study, top management support was found to be an insignificant determinant of RFID adoption intention. While this result is in line with a study by [40], it is not the case with [42] as they discovered that the top management support had a positive effect on RFID adoption intention in the South African retail sector, which is the main observation from early studies on IT adoption [43]. Indeed, [43] in their review of predictors of IT innovation adoption research found that “top management support was examined 7 times and found significant 7 times” (p. 7).

Additionally, social issues are found to be a significant determinant of RFID adoption intention by Saudi Arabia retailers. This result highlights the

importance of taking into consideration social issues during the adoption process of RFID technology in order to avoid the cancellation of RFID-enabled retail supply chain projects as a result of the consumers’ protestations as it was the case for the retailer Benetton [38].

Surprisingly, our study found that information intensity has a non-significant negative effect on RFID adoption intention by Saudi Arabia retailers. Indeed, we were expecting some significant effect since Saudi hypermarkets are huge and are more likely to process a high number of transactions daily, and that this may explode with RFID-enabled item tracking and tracing. Similarly, [40] found the information intensity to be a non-significant determinant of RFID adoption intention in the Taiwan manufacturing sector. However, early studies on IT adoption suggest that sectors operating in information-intensive environments (e.g., financial services) are more likely to adopt IT innovations [44].

Finally, the research results reveal that competitive pressure is a significant determinant of RFID adoption intention by Saudi Arabia retailers. This finding is consistent with some early study on RFID adoption (e.g., [40]). In fact, competitive pressure has been identified as one of the key adoption determinants by IT adoption researchers [43].

6. Conclusion

In this study, we used the DOI theory to assess factors that may affect RFID adoption intention. Our results show that relative advantage, top management support and information intensity are insignificant determinants of RFID adoption intention. In the context of Saudi retail industry, technology competence, social issues and competitive pressure were found to be significant determinants of RFID adoption intention. Some of the conflicting results were concerned with the emerging literatures on RFID adoption and the mainstream IT adoption, which suggest that further studies are required on the relative advantage, top management support and information intensity when assessing the RFID technology adoption intention within various sectors. This study extends knowledge and ideas on the role of RFID technology in the retail industry, with a specific focus on the Kingdom of Saudi Arabia.

Any empirical research has limitations. So goes with this study which has several limitations, though they also represent opportunities for future research. Firstly, the adopting intention of RFID in the retail industry in Saudi Arabia is completely new. On the other hand, this study is confined to RFID technology only. Secondly, this study was conducted in a particular country —Saudi Arabia—, and the data came from only the three largest cities of the country. Hence, it may not be sufficient to determine

the determinants of RFID adoption intention in the whole Saudi retail industry. Thirdly, the sample size is an important issue when generalizing from research issues. The sample for this research work is still small to represent the entire retail industry in Saudi Arabia. The sample of organizations was restricted to seven. Therefore, these firms might have resources and capabilities to be able to afford the RFID adoption. For this reason, the determinants of RFID adoption intention in our sample may not be exactly accurate to verify the major factors that can be considered as enablers of or obstacles to the adoption of this technology in the Saudi retail industry. Finally, the scope of the study largely depends on the field work, that is, interviews and on-site observations, but there are limitations since not all participants would want to be interviewed, or would be able to be contacted.

There are many opportunities for future research. Exploring the inter-organizational dimension of RFID technology, increasing the sample, looking for other factors such as the mimetic, normative and coercive factors can be interesting topics for future research.

References

- [1] S. F. Wamba, L. A. Lefebvre, Y. Bendavid, and E. Lefebvre, "Exploring the impact of RFID technology and the EPC network on mobile B2B eCommerce: a case study in the retail industry," *International Journal of Production Economics*, vol. 112, pp. 614-629, 2008.
- [2] E. W. T. Ngai, K. K. L. Moon, F. J. Riggins, and C. Y. Yi, "RFID research: An academic literature review (1995-2005) and future research directions," *International Journal of Production Economics*, vol. 112, pp. 510-520, 2008.
- [3] E. Bottani and A. Rizzi, "Economical assessment of the impact of RFID technology and EPC system on the fast-moving consumer goods supply chain," *International Journal of Production Economics*, vol. 112, pp. 548-569, 2008.
- [4] D. Delen, B. C. Hardgrave, and R. Sharda, "RFID for better supply chain management through enhanced information visibility," *Production and Operations Management*, vol. 16, pp. 613-624, 2007.
- [5] J. Curtin, R. Kauffman, and F. Riggins, "Making the 'MOST' out of RFID technology: a research agenda for the study of the adoption, usage and impact of RFID," *Information Technology and Management*, vol. 8, pp. 87-110, 2007.
- [6] E. M. Rogers, *Diffusion of Innovation*. New York: Free Press, 2003.
- [7] K. Zhu, K. Kraemer, and S. Xu, "Electronic business adoption by European firms: a cross-country assessment of the facilitators and inhibitors," *European Journal of Information Systems*, vol. 12, pp. 251-268, 2003.
- [8] R. G. Fichman, "The diffusion and assimilation of information technology innovations," in *Framing the domains of IT management: projecting the future through the past*, R. Zmud, Ed. Cincinnati, 2000.
- [9] C. L. Iacovou, I. Benbasat, and A. S. Dexter, "Electronic Data Interchange and Small Organizations: Adoption and Impact of Technology," *MIS Quarterly*, vol. 19, pp. 465-485, 1995.
- [10] S. Fosso Wamba, "Les impacts de la technologie RFID et du réseau EPC sur la gestion de chaîne d'approvisionnement: le cas de l'industrie du commerce de détail," in *Mathematics and Industrial Engineering*, PhD. Montreal: Polytechnic School of Montreal, 2009, p. 379.
- [11] K. Zhu, Dong, S., Xu, S. X., Kraemer, K. L. , "Innovation diffusion in global contexts: determinants of post-adoption digital transformation of European companies," *European Journal of Information Systems*, vol. 15, pp. 601-616, 2006.
- [12] C. S. Yap, "Distinguishing characteristics of organizations using computers," *Information & Management*, vol. 18, pp. 97-107, 1990.
- [13] CIA, "The World Factbook," 2010.
- [14] S. S. Al-Gahtani, "Computer technology acceptance success factors in Saudi Arabia: an exploratory study," *Journal of Global Information Technology Management*, vol. 7, pp. 5-29, 2004.
- [15] Business Monitoring International, "Saudi Arabia Retail Report Q2 2010," 2010.
- [16] H. Mousa, "Saudi Arabia's Retail Food Sector Annual Update 2009," 2009.
- [17] MARKETRESEARCH, "The future of food retailing in the United States," 2006.
- [18] Z. Asif and M. Mandviwalla, "Integrating the supply chain with RFID: a technical and business analysis," *Communications of the Association for Information Systems*, vol. 15, pp. 393-427, 2005.
- [19] C. E. Koh, H. J. Kim, and E. Y. Kim, "The impact of RFID in retail industry: issues and critical success factors," *Journal of Shopping Center Research*, vol. 13, pp. 101-117, 2006.
- [20] J. Hogan, "Fashion firm denies plan to track customers," *New Scientist*, vol. 178, pp. 11, 2003.
- [21] S. Fosso Wamba and A. T. Chatfield, "A contingency model for creating value from RFID supply chain network projects in logistics and manufacturing environments," *Eur J Inf Syst*, vol. 18, pp. 615-636, 2009.
- [22] N. C. Wu, M. A. Nystrom, T. R. Lin, and H. C. Yu, "Challenges to global RFID adoption," *Technovation*, vol. 26, pp. 1317-1323, 2006.

- [23] E. W. T. Ngai, T. C. E. Cheng, S. Au, and K.-h. Lai, "Mobile commerce integrated with RFID technology in a container depot," *Decision Support Systems*, vol. 43, pp. 62-76, 2007.
- [24] D. Simchi-Levi, "The Impact of RFID on Supply Chain Efficiency," in *RFID and Beyond: Growing Your Business through Real World Awareness*, C. Heinrich, Ed. Indianapolis, India: Wiley Publishing, 2005, pp. 209-220.
- [25] E. W. T. Ngai and A. Gunasekaran, "RFID adoption: issues and challenges," *International Journal of Enterprise Information Systems*, vol. 5, pp. 1-8, 2009.
- [26] A. U. Smart, R. Bunduchi, and M. Gerst, "The costs of adoption of RFID technologies in supply networks," *International Journal of Operations & Production Management*, vol. 30, pp. 423-447, 2010.
- [27] J. Thong, Y. L. , "An integrated model of information systems adoption in small businesses," *Journal of Management Information System*, vol. 15, pp. 187-214, 1999.
- [28] M. Porter and V. Millar, "How information gives you firm-level value," *Harvard Business Review*, vol. 63, pp. 149-160, 1985.
- [29] V. Grover, "An Empirically Derived Model for the Adoption of Customer-based Interorganizational Systems," *Decision Sciences*, vol. 24, pp. 603-640, 1993.
- [30] M. K. O. Lee, "Internet-based financial EDI: Towards a theory of its organizational adoption," *Computer networks and ISDN systems*, vol. 30, pp. 1579-1588, 1998.
- [31] J. Y. L. Thong and C. S. Yap, "CEO characteristics, organizational characteristics and information technology adoption in small businesses," *Omega-International Journal of Management Science*, vol. 23, pp. 429-442, 1995.
- [32] C. E. Heinrich, *RFID and beyond : growing your business through real world awareness*. Indianapolis, India.: Wiley Publishing, 2005.
- [33] K. Mayfield, " Radio ID tags: beyond bar codes," *Wired News*, 2002.
- [34] K. K. Y. Kuan and P. Y. K. Chau, "A perception based model for EDI adoption in small businesses using a technology-organization-environment framework," *Information & Management*, vol. 38, pp. 507-521, 2001.
- [35] C.-C. Chao, J.-M. Yang, and W.-Y. Jen, "Determining technology trends and forecasts of RFID by a historical review and bibliometric analysis from 1991 to 2005," *Technovation*, vol. 27, pp. 268-279, 2007.
- [36] I. Benbasat, D. K. Goldstein, and M. Mead, "The case research strategy in studies of information systems," *MIS Quarterly*, vol. 11, pp. 369-386, 1987.
- [37] R. K. Yin, *Case Study Research: Design and Methods*. Newbury Park, CA: Sage, 1994.
- [38] A. U. Smart, Bunduchi, R., "The costs of adoption of RFID technologies in supply networks," *International Journal of Operations & Production Management*, vol. 30, pp. 423-447, 2010.
- [39] J. Flanagan, "Social pressures on organizational website adoption," *Human Communication Research*, vol. 26, pp. 618-646, 2000.
- [40] Y.-M. Wang, Y.-S. Wang, and Y.-F. Yang, "Understanding the determinants of RFID adoption in the manufacturing industry," *Technological Forecasting and Social Change*, vol. 77, pp. 803-815.
- [41] C. B. Soon and J. A. Gutiérrez, "RFID Technology Adoption in New Zealand's Supply Chains: A Case Study Approach," *Pacific Asia Journal of the Association for Information Systems*, vol. 2, pp. 43-66, 2010.
- [42] I. Brown and J. Russell, "Radio frequency identification technology: An exploratory study on adoption in the South African retail sector," *International Journal of Information Management*, vol. 27, pp. 250-265, 2007.
- [43] A. Jeyaraj, J. W. Rottman, and M. C. Lacity, "A review of the predictors, linkages, and biases in IT innovation adoption research," *Journal of Information Technology*, vol. 21, pp. 1-23, 2006.
- [44] C. S. Yap, "Distinguishing characteristics of organizations using computers," *Information and Management*, vol. 18, pp. 97-107, 1990.

Appendix: Measurement items of the independent variables

Variables	Measurement items	Scale	Source
Relative advantage	R1. RFID improves accuracy	5-point likert scale where	
	R2. RFID improves company image	1= "Strongly disagree"	(wang et al. 2010)
	R3. RFID improves data capacity	5= "Strongly agree"	(Tasi et al. 2010)
	R4. RFID improves data capture and analysis		(Fosso Wamba et al. 2009)
	R5. RFID improves lower inventory cost		
	R6. RFID improves cost efficiency		
	R7. RFID improves inventory replenishment		
	R8. RFID improves product security		
	R9. RFID improves reduce paperwork		
Technology Competence	TC1. The technology infrastructure of my company is available for support RFID-related application.	5-point likert scale where	(wang et al. 2010)
	TC2. My company is decided to ensuring that employees are familiar with RFID-related technology	1= "Strongly disagree" 5= "Strongly agree"	
	TC3. My company contains a high level of RFID-related knowledge		
Top Management Support	TMS1. Top management willingness to take the risk (financial and organizational) involved in adopting RFID technology drives RFID adoption and diffusion	5-point likert scale where	(wang et al. 2010)
	TMS2. Top management support during the implementation of RFID technology drives the success of RFID adoption and diffusion	1= "Strongly disagree" 5= "Strongly agree"	
	TMS3. Top management is likely to be interested in adopting RFID application in order to gain competitive advantage		
	TMS4. Top management is likely to in consider the adoption of the RFID application as strategically important.		
Social Issues	SI1. The partners request for RFID adoption.	5-point likert scale where	(Cheng et al. 2010)
	SI2. Threat the privacy and security	1= "Strongly disagree"	
	SI3. Culture will resist this technology	5= "Strongly agree"	
	SI4. My company may use RFID in the future		
Information Intensity	I1. The high intensity of competition among supply chain players drives RFID adoption and diffusion	5-point likert scale where	(wang et al. 2010)
	I2. The product/service in retailer industry generally requires a lot of information to sell	1= "Strongly disagree" 5= "Strongly agree"	
	I3. The product/service in retail industry is complicated or complex to understand or use		
Competitive Pressure	CP1. My company experienced competitive pressure to implement RFID	5-point likert scale where	(wang et al. 2010)
	CP2. My company would have experienced a competitive disadvantage if RFID had not adopted.	1= "Strongly disagree" 5= "Strongly agree"	(Cheng et al. 2010)
	CP3. Other competitors use RFID		