We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900
Open access books available

185,000
International authors and editors

200M
Downloads

Our authors are among the

154
Countries delivered to

TOP 1%
most cited scientists

12.2%
Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com



2

Commercial and Implementation Issues Relating to the Widespread Acceptance and Adoption of Radio Frequency Identification Technology

Mark J. Rodrigues[1] and Kieran James[2]
[1]*Master of E-Business Graduate, Murdoch University*
School of Business, Murdoch University,
[2]*Senior Lecturer in Accounting, School of Accounting, Economics & Finance, Faculty of Business,University of Southern Queensland,*
Australia

1. Introduction

The adoption of Radio Frequency Identification Technology (RFID) is giving rise to major improvements for consumer goods manufacturers. RFID technology offers a huge spectrum of applications, through increased flexibility, transparency, and performance in supply chain management and warehouse execution systems. As a result of the expansion, marketing research companies have invaded the consumer market by predicting million-dollar investment, and unrealistic applications for today. They have caused attention to focus upon consumer privacy concerns that have reduced the adoption of the technology. Managers of large companies are encouraged to block out the hype and exploit the technology for its ability to increase return on investment in the supply chain.

RFID can be thought of as *Smart Labels* or *Silent Commerce*. RFID are the new-generation computer tags attached to an item and containing full product information which, when activated, transmit information to an RFID reader as the customer leaves the store with the product (Turban et al., 2006). This technology is most likely to replace the standard barcode in supermarkets and department stores (Turban et al., 2006, p.294) if the adoption process follows the standardized model suggested in Rogers (1995) and the adoption rate reaches 100% or close to 100%. The demand for RFID has been increasing over the past few years. The hype in the market-place and in some consumer circles suggesting everything will be tracked' is rapidly becoming a reality.

This chapter examines the perceptions of RFID among Australian RFID suppliers/integrators, and the role and importance that perceptions play in the actual adoption process. As the Chicago School of Sociology often proclaimed, perceptions are 'real in their consequences' (Thomas and Znaniecki, 1927, p.8, cited in Rogers, 1995, p.209). This project also examines how integrators' perceptions can act upon present expectations of RFID technology. An understanding of what leading integrators think at this moment may benefit vendors and others to create applications that will eventually secure more

widespread acceptance. The research study discussed in this chapter was undertaken using qualitative data collection methods, i.e. personal interviews with a sample of leading RFID suppliers/integrators located in Australia.

2. Theoretical framework

This theoretical framework examines issues pertaining to adoption and barriers to adoption of RFID technology and related perception issues. Questions posed to the respondents in the research study were derived from Thomas Ehrmann's Business Model theory and are now used to analyze the perceptions of industry managers regarding RFID adoption.
Two other theories are used. Firstly, we use Efraim Turban's theory (Turban et al., 2002; 2006) about how companies can adopt a systematic approach to discover their Electronic Commerce (EC) opportunities in the market-place. Secondly, we refer to Everett Rogers' (1995) adoption theory which deals with the process through which an individual or other decision maker unit passes from first knowledge of an innovation, to a decision to adopt or reject, and then finally (if the innovation is not rejected) to implementation of the new idea. According to Ehrmann (in Jones, 2003), the following outlines the 'Appraisal of a Business Model' theory: The way to appraise a business model or proposition is to evaluate each of the following: value proposition, innovation, content, structure, and governance.

2.1 Value proposition

According to Ehrmann (in Jones, 2003, p.720), 'value proposition' asks customers what value does the product have on the entire supply chain? This, in turn, focuses upon the business idea, economic role, and the value that the product yields to the customer. Integration is another component of value, i.e. how successfully can the product integrate with new systems?
Turban et al. (2006, p.596) suggest that companies may be 'Market-Driven', waiting to observe what the competitors in their industry are doing. 'When one or more competitors starts [*sic*] to use EC, and it seems that they are doing well, it is time to follow suit' (Turban et al., 2002, p.691). This can be linked to Rogers' theory of *Diffusion of Innovations* (see Rogers, 1995) which suggests that, at an awareness stage, 'the individual is exposed to the innovation but lacks complete information about it' (CIA Advertising, 1998). In terms of Rogers' (1995) diffusion model with RFID in Australia we already have 'innovators' and 'early adopters' using, or at least trialing, the technology in primarily niche applications. However, we have not yet reached 'critical mass' (Rogers, 1995, pp.313-330). The 'early majority', 'late majority' and 'laggards' are all yet to come on board. Critical mass is especially vital in what Rogers (1995, p.313) terms 'interactive innovations', i.e. innovations, such as the Internet and Facebook, where each new user increases the benefits of adoption for all past users (by giving them access to more people) and also for all future users. RFID is essentially interactive since the system will clearly work best when all suppliers and all customer companies (other than end-consumers) own both readers and tags. In order to evaluate the RFID industry in this chapter, the questions posed to interview respondents in the research study are interpreted within the context of the Ehrmann Business model, as well as Rogers' (1995) theory.

2.2 Innovation

According to Ehrmann (Jones, 2003, p.720), the process of 'innovation' is defined as reducing costs of producing or offering existing goods or services through a business

channel. Innovation deals with cost savings, and the consequent advantages these savings bestow upon the innovating firm relative to its competitors. As Rogers (1995, pp.413-414) makes clear, innovators and early adopters of a technology, such as the Iowa hybrid wheat farmers in the classic early diffusion study by Ryan and Gross (1943), typically reap windfall profits that are denied to more risk-averse later adopters. Innovation in the business model also considers production costs, and the market structures that are developed to support the product. This can be linked to Rogers' (1995) theory which suggests that, at the interest or information stage, 'the individual becomes interested in the new idea and seeks additional information about it' (CIA Advertising, 1998). Turban et al. (2006, p.596) suggest that innovation may be 'Problem-driven', i.e. 'Organizations have a problem such as inventory delays and deliveries. EC applications may be attempted in order to solve the problem' (Turban et al., 2002, p.691). Turban et al. (2002) also argue that much innovation occurs simply because organizations are fear and/or greed driven: 'Companies are either so scared that they are afraid that if they do not practice EC they will be big losers, or they think that they can make lots of money going EC' (Turban et al., 2002, p.691). Fear and greed are not specifically recognized in the Rogers' model but are consistent with Rogers' (1995) key argument that adoption of innovations is largely a social and psychological process. For her part, ethicist of new technology Cynthia K. West (2001, pp.124, 128) notes that fear of loss has been the major selling point used by retailers of biometric face, finger, and retina surveillance and identification technologies.

Rogers' (1995, Figure 7.2, p.262) theory views 'early adopters' as a group which comprises 13.5 percent of the total population. This group is comprised of highly educated and wealthy innovators who are highly visible and respected among their peers (Rogers, 1995, p.269). Early adopters play a key role in the adoption process for new technology, influencing very strongly the times when an innovation will be adopted by others. This category contains most of the 'opinion-leaders' who, largely through word-of-mouth among peer networks, extol the benefits of new technology to their less well-connected and influential peers (Rogers, 1995, p.264). Although Walmart, Gillette, and the United States of America (USA) Department of Defense are clearly innovators or early adopters of RFID they may be less able to function as opinion-leaders, hence slowing the rate of growth of the technology. Small businesses, foreign businesses, and those dealing in niche and/or luxury products may not necessarily have strong contacts at Walmart or be influenced significantly by what Walmart does. The same comment applies to Woolworths and Coles in Australia.

Early adopters in the manufacturing and technology sector have developed new methods to add RFID as a cost effective method. For example, a Motorola sponsored White Paper by IDC revealed that there has been a steady adoption of RFID technology. The highest rates of adoption are by: educational organizations (36%), followed by transport and logistics companies (33%) and then utilities (26%) (Motorola, 2010).

2.3 Content

According to Ehrmann (Jones, 2003, p.720), 'content' in the appraisal of business models refers to the goods and information that are being exchanged. This business model looks upon the individual capabilities required to enable exchanges in the supply chain. Content evaluates the information that is being exchanged in the supply chain, and examines new products. We can also reference Turban et al. (2002, p.691) where they state that '[t]echnology exists and the company is trying to use it. In doing so, the company may find

problems that no one knew existed'. When this occurs people may modify or stop using the technology. Rogers (1995, p.320) explains that, just as critical mass is added quickly, it can also rapidly fall away as people abandon an innovation in droves.

2.4 Structure

According to Ehrmann (Jones, 2003, p.720), 'structure' refers to the actors that are linked in the value chain. The structure model analyzes customers at both ends of the business. Structure refers to the underlying partners, and focuses on a specific network rather than dealing with the entire value chain.

Turban et al. (2006, p.596) state that companies are frequently 'Problem-driven'. If the problem is to reduce inventory errors, then the advantage of RFID is in the accurate tracking of information. Rogers' (1995) theory suggests that adoption goes through a trial stage, as 'the individual makes full use of the innovation' (CIA Advertising, 1998). Many companies are presently adopting, trialing, or considering adopting or trialing, RFID technology in the supply chain.

2.5 Governance

Ehrmann (Jones, 2003, p.720) mentions 'Governance' which deals with the way in which exchanges are executed. The model looks at property rights that are allocated between parties to the transaction. Also, governance deals with the set-up of market roles, operations, and strategic tasks. The commercial RFID literature has repeatedly viewed RFID in the context of consumer privacy issues. Rogers (1995, chap.11) agrees that not all innovations are socially desirable. He cites the examples of missionaries introducing the steel ax into an Australian aboriginal tribe (which undermined the entire traditional social structure of the tribe and lessened respect for elders) and the introduction of snowmobiles amongst Finnish Lap communities. Rogers (1995, chap.3) warns against the 'pro-innovation' bias of many diffusion scholars and the many profit-fixated corporations who sponsor diffusion studies. The *consequences* of adopting an innovation remain an under-researched area in diffusion studies. Furthermore, Rogers (1995, p.412) explains that consequences can be desirable or undesirable, direct or indirect, and anticipated or unanticipated. In similar vein, West (2001, p.140, emphasis added) puts forward the view that '[a] discussion of *values* and *ethics* is needed both within the information technology industry as well as in the communities in which they [the technologies] are deployed'.

3. Research study method

The interview dialogues for our research study are presented below. Questions were posed to each research study participant based upon Ehrmann's Appraisal of Business Model theory. Respondents were asked to express their perceptions of the RFID industry as it presently stands.

For this research study, the first-mentioned author contacted leading suppliers/integrators working for organizations which were (at the time of the initial contact) leading integrators of RFID technology within Australia. Respondents were selected by purposeful sampling rather than by random sampling. A semi-structured interview approach was used as the data collection method. A pre-prepared list of 14 interview questions was first e-mailed to all respondents. The actual interviews were all conducted by telephone because the interviewer was based in Perth whereas the respondents were based in Sydney, Brisbane,

and Melbourne. Length of interviews ranged from 30 minutes to 80 minutes. No tape-recorder was used. However, the interviewer took detailed shorthand notes. On the evening of each interview, the interviewer summarized responses and noted key themes that were emerging from the data. The first-mentioned author has 15 years of experience with RFID systems, including many years selling RFID systems for Paxar Canada to leading early adopters such as Walmart. Because of his industry experience, he was in a position to both carefully select the interviewees for the study and ask questions that were relevant and prescient from the practical industry perspective.

The 14 questions, sent to the interviewees in advance, were designed to meet the following objectives:

- Document the selected RFID integrator's perception on each issue; and
- Evaluate responses within the context of the RFID academic and commercial literature.

The five (5) interviewees were guaranteed strict confidentiality. Although interviews were conducted between July and December of 2004, informal conversations in late 2006 between the first-mentioned author and each of the interviewees confirmed that their views on the state of the RFID industry in Australia had not changed significantly between 2004 and 2006. None of the interviewees elected to modify, delete, or add to their original set of responses. Interviewees are denoted (A), (B), (C), (D), and (E) in the following Results section. We specifically incorporate new comments and references to bring our analysis up-to-date whilst still relying on our original results where they remain applicable.

4. Results for interviews

The respondents were provided with an opening vignette which appeared in the initial e-mail sent to the respondents above the list of interview questions. The vignette is as follows:
'RFID (Radio frequency identification) can be thought of as *Smart Labels* or *Silent Commerce*. The demand for RFID has increased over the past few years. The hype in the industry (that "everything will be tracked") is fast becoming a reality. At one end of the spectrum, RFID is viewed as a tracking and security device for enterprise application. At the other extreme, RFID is viewed as a true technological wonder that is going to transform the way that businesses will operate.'

In response to the 1st question 'What economic value will RFID Tags have on the business chain?' respondent (A) answers that economic value in the supply chain 'will amount to US$10 to US$100 million within 4 years [i.e. in Australia]'. (E) provides the longest response but he does not attempt to put a value on supply chain savings. He notes that '[i]t will have a big value. It will stop fraud and authenticate drugs, perfume and electronic goods. Read and write tags will make it database independent. Therefore, the cost of goods should come down in the supply chain'. (B) notes that a major positive feature of the technology, as compared to barcodes, is that '[a]ssuming enough read ranges, goods can be moved within the logistics without line of sight'. Barcodes are limited in that they cannot be read at a faster rate than 1 every 2 or 2.5 seconds. By contrast, an RFID reader reading 100 RFID tags per second is certainly possible. We conclude that the respondents have a realistic view of the impact of RFID on the supply chain, which can be compared to the more optimistic view (or 'hype') which has been frequently expressed within the commercial literature. For example, AIM Industry analyst firms predicted in 2003 that RFID would become a US$3 billion market globally by 2008 (AIM –RFID Connections, 2003). Recent research from IDTechEx reports that 'the next 10 years will see a rapid gain in market share of mainstream printed

and chipless RFID tags, and that the numbers sold globally will rise from 40 million in 2009 to 624 billion in 2019 (Das and Harrop, 2010). ABI Research sees continuing strong growth potential in RFID markets worldwide and forecasts a total market size of about US$4.6 billion by the end of this year for RFID systems (hardware, software, and services) (ABI, 2010).

In response to the 2nd question 'What economic value will Smart Labels have on the consumer?' (A) notes that '[i]n the supply chain 30% of the savings will pass on to the consumers. The rest will … [flow through as] stock and dividend profits which will be shared with consumers'. (C) comments that RFID will create '[m]ore choices for consumers. Easier to shop and locate products in store setting. Provide authentication of genuine goods.' In similar vein, (D) indicates that consumers will benefit from 'high security infrastructure, tracking the history of products'. (E) agrees, also emphasizing that RFID will ensure that '[p]roducts are not copies', i.e. there is 'an authentication guarantee'. Early implementations were lacking in several respects, and the technology influenced privacy advocates. Large-scale implementations stalled as a result of user apprehension and a declining economy. The benefits and cost savings of RFID seem real and significant but the technology must reach critical mass of adopters or the benefits may not fully materialize. For this to happen, costs of both readers and tags must come down (to be discussed shortly). In addition to this, we would expect supermarket customers would need to actively push for the technology to be introduced to replace barcodes which has not happened in Australia. Supermarket shoppers in Australia evidently do not yet feel the 'need' for faster check-out experiences. Rogers (1995, p.164) defines a 'need' as 'a state of dissatisfaction or frustration that occurs when one's desires outweigh one's actualities'. He notes that often a perceived need must precede adoption of an innovation, although, at times, an innovation is adopted without the prior perceived need. The need for RFID in the healthcare industry has been noted but not adopted on a large scale as at 2004.

Today, RFID in healthcare sector could significantly impact patient safety by decreasing medication errors and increasing efficiencies in locating hospital assets. Citing medication errors as a US$3.5 billion annual problem in the U.S.A., Young (2008) suggests that there is a need for uniform global healthcare standards.

In response to the 3rd question 'What is the RFID network size?' there is marked disagreement across respondents. Some respondents, i.e. (A), (C), (D) and (E), claim that the RFID network size is 'big'. For example, (E) states that '[i]t will have a big value. It will stop fraud and authenticate drugs, perfume and electronic goods'. (A) mentions the widespread use of RFID in animal tracking and the transport industry, while (E) refers to 'animal tracking and security applications' creating demand for RFID. Confirming his view that the industry will be 'big', (D) notes that '[i]t will require updating systems, and purchases of reader and writers. Microsoft involvement in new software will bring changes across the industry'. However, by contrast, (B) summarizes the industry as still being 'small, in its infancy, mainly propriety installations and pilot tests'. We conclude that, whilst the network size is *potentially* huge globally, in terms of actual realization the industry in Australia remains in its infancy at least in mainstream non-niche applications that involve the end-consumer. This is a reasonable conclusion given that neither Woolworths nor Coles (Australia's groceries duopoly) at the date of writing have actually implemented RFID systems (Mills, 2005; Walters, 2005).

A Woolworths' spokesperson has said that RFID adoption is not an immediate priority and that other project with 'more certain' patterns of perceived benefits will be pursued more

vigorously than RFID adoption (Mills, 2005; Walters, 2005). A study of Woolworths' and Coles 2006, 2007, and 2008 annual reports by the second-mentioned author (Coles is part of the Wesfarmers Limited group of companies for the 2008 and following financial years) reveals no further mention of RFID or RFID trials in these reports. Woolworths' Managing Director, Michael Luscombe, claims that, even without RFID adoption, '[b]y lowering our costs of doing business, we have created a world-class model of efficiency and logistical expertise' (Managing Director's Report, Woolworths Limited, 2008 Annual Report, p.6). Woolworths, the 25th largest retailer in the world according to the corporation, does seem profitable and efficient enough without RFID. The second-mentioned author has computed Return on Equity (ROE), Return on Assets (ROA), and Inventory Turnover Days of 28.11%, 10.98%, and 29.76 days, respectively, for Woolworths based on publicly available consolidated accounting data taken from the independently audited Woolworths Limited 2008 Annual Report. For its part, Coles has undertaken RFID pilot tests but has generally viewed the technology as too expensive when compared to barcodes (Walters, 2005).

However, according to Swedberg (2010), this year (2010) seems to indicate a psychological change in the market. Five years ago (2005), people came to integrators and vendors skeptical that RFID could solve their problems. Now, there is confidence in the technology, so end users want to discuss things like software integration (Swedberg, 2010).

In response to the 4th question 'Do you think there is a demand for RFID Technology?' there is again marked diversity in the responses. Each commentator focuses on different perceived benefits and user groups. (A) provides the most detailed and quantified response as follows: 'By 2012 bar codes and RFID tags will equal each other in usage. The conversion from legacy systems on a grand scale will happen. By 2020, 20% of the supply chain will be used by bar codes, which becomes a niche market'. In terms of willingness to offer detailed projections of future developments, (A)'s response takes on Marxian proportions. His key dates for Australia are: 2012 (equal usage barcodes and RFID tags) and 2020 (barcodes a niche market; 20% barcodes; 80% RFID tags). While the projections are expressed in precise terms they indicate that market dominance for RFID tags (over 50% adoption rate) is still some years away. His predictions are simply that, predictions. Even the great philosopher Karl Marx, correct about so many things, was hopelessly wrong in his prediction of the worldwide triumph of communism. Future rates of adoption of RFID technology may surpass or underperform predictions. Rogers (1995) points out how new technologies often differ significantly in terms of the time it takes for the adoption rate to reach 100%. For example, in the education sphere in the USA, it took 50 years for kindergartens to be fully adopted, as opposed to 18 years for driver training, and only 5 years for modern math (Rogers, 1995, p.64). (D) is also optimistic, noting that '[t]he demand will depend upon the government, added security, fraud, and line of sight for identifying products. Also consumers are pushing the demand for cheaper and time saving retail experiences'. (C) is more circumspect, noting that whilst there is 'demand for information', '[t]he process is not in place with RFID tags'. He attempts to temper excessive enthusiasm by drawing upon history to note (correctly) that '[i]t took 20 years for bar codes to be accepted'. (B) also urges restraint and a wait-and-see approach: 'Only in niche industries at the moment [is there demand]; demand in retail will be led by large organizations such as Walmart, CML [Coles-Myer Limited, now Coles] here in Australia'. Critical mass has most definitely not been reached in Australia outside niche applications. These are usually in settings not involving direct dealings with end-consumers.

There still is a demand for RFID technology, as compared to six years ago, from the early adopters like Walmart and the U.S. Department of Defense which made their first RFID announcements in 2003. Growth in demand for RFID tags has been driven in part by Walmart's apparel tagging initiative. This has driven expected RFID tag growth rate for the industry. RFID tag demand growth exceeded manufacturer expectations in other sectors including: transport, storage, logistics, electronic payment, tracking medical devices, food safety systems, and asset management. Around the world there are several important examples of the growth in demand. For example, India's demand for RFID is apparent with expected 600 million unique ID cards, 50 million e-passports, 100 million health cards, 50 million transport and ticketing cards and 50 million banking cards likely to be issued over the next seven years (Reinhardt, 2010).

In response to the 5th question 'Is the market structure established for RFID?' there is also a diversity of responses. Both (D) and (E) refer to structure established with respect to specific applications. (D) notes 'a structure [exists] for example [in] the government control of animal tracking', whilst (E) refers to the auto-parts industry where '40 million RFID [tags] are used in the [Australian] auto industry each year'. (A)'s measured response notes the privacy concerns that consumer groups have expressed regarding RFID: 'The market has been established but the privacy issue has given RFID a bad start. There seems to be some confusion in consumer perceptions'. End-consumers do not seem unduly concerned about privacy issues regarding RFID usage in auto-parts most likely because the end product is not a standard retail shopping-mall item and people rarely feel any psychological or emotional closeness to purchased auto-parts.

In response to the 6th question 'Have other users in the industry caused interest in RFID?' most respondents refer to Walmart mandating RFID use for their Top 100 suppliers since January 2005 (Business Week Online, 2004a, 2004b; Kaiser, 2004; Lundquist, 2003; Turban et al., 2006, p.77; Walters, 2005). Other major users globally are Gillette and the U.S.A. Department of Defense (Turban et al., 2006, p.410) although Gillette is yet to mandate its use for suppliers. (C) refers to the 'Brazilian government use of RFID tags to track animals'. (A) notes that '…since 1995 I have been influenced by when Australia Post became interested in tracking mail'. More generally (B) comments that '[c]ertainly Walmart's drive has created interest in the retail sector', whilst (D) is cynical and wary: 'Initially [users] got fired up but [before long they] did not care'. In Rogers' terminology, Walmart, Gillette, and the U.S.A. Department of Defense can be classified as innovators or as early adopters. Mr Con Colovos, CIO of the Australian early adopter Moraitas Fresh (a supplier of tomatoes to the major supermarkets), has stated that the Walmart mandate means that widespread adoption of RFID in Australia is now 'inevitable' (Walters, 2005). Innovators and early adopters do tend to be much more upbeat than others about the prospects of rapid diffusion of an innovation. We should note that Walmart giving its suppliers no choice in the adoption decision means that adoption by its suppliers is an 'authority innovation-decision' (Rogers, 1995, p.29). Therefore, it is different from the classic innovation problems such as hybrid wheat adoption by Iowa farmers as studied by Ryan and Gross (1943). RFID adoption in Australia is unlikely to follow the 'mandate model'.

Of key significance is the demand for RFID tags in retail, which demands 300 million RFID labels in 2010. Tickets used for transit demands 380 million tags in 2010 and tagging of animals (such as pigs, sheep and pets) amounts to178 million tags being used for this sector in 2010. This is happening in regions such as China and Australasia. In total, 2.31 billion tags will be sold in 2010 versus 1.98 billion in 2009 (IDTechEx Ltd, 2010).

In response to the 7th question 'How and who will manage the information of RFID Technology?' and the 8th question 'What goods and information will be exchanged in the RFID tag?' the respondents note that ownership of information should not be exclusive to any one industry or organization. All managers of Information Technology will own the content for each good. The commercial literature explains that an Object Name Service (ONS), such as UPC (companies will need to maintain ONS servers locally), will store information for quick retrieval. The ONS will keep track of data for every EPC-labeled object (Shankland, 2002). As (C) explains: 'IT managers within the company will manage the information for goods entering the company; same as barcode item numbering systems. Proprietorship of information on the tag will be allowed by the manufacturer, e.g. authentication of a refrigerator for the disposal of product'. (D) points out that '[t]he retail industry will not be able to write tags'. (E) stresses that databases do exist for some niche application areas such as 'NLIS [the government-mandated National Livestock Identification Scheme for Australian cattle] and the Automotive Industry database'. (E) goes on to add that: 'RFID will provide for the maintenance history of machinery to be recorded on the tag for the [benefit of the] services industry'. Barcodes do not and cannot include such detailed information.

The respondents note that the information on the tag will specify the manufacturer, factory program, maintenance for service, and personal information of the product. This view is similar to viewpoints expressed in the commercial literature which state that the RFID tags will let you trace a particular unit of product through its life-cycle. However, it is not true that an item can be traced to a particular person. Current applications in the U.S.A. allow consumers to choose to 'kill' (de-activate) the tag after they exit the check-out. The data will have business intelligence, such as inventory reduction and total asset visibility (Rossi, Sommerville, and Brown, 2003). This raises the related issues of data integrity and privacy (to be discussed shortly), two potentially important 'consequences of innovation'.

Another important issue is that the speeds of the networks for retrieving tag identifiers have not been tested for large volumes. Interestingly, none of our research study respondents discussed this concern in their responses. Overall, the commercial literature has emphasized this concern, and has 'hyped' both the privacy issue and the large volume of retail tag usage issue.

Proper RFID governance is necessary if RFID is to become like the new wave of development of the Internet. Eventually, billions of smart devices will be interconnected into a global network communication infrastructure and managing this information has not been evaluated.

In response to the 9th question, 'What price do you expect RFID tags to cost in the coming years?' all five respondents note that the tag price will go down from dollars to cents in the next few years. For example, (D) notes that the retail tag price now (i.e. second half 2004) is A$1 (US$0.82 at 10 April 2007 exchange rate) landed, and could go down to A$0.40 (US$0.33). As (A) explains, the '[p]rice of tags will go down due to economies of scale. The more users that implement RFID the less the tag/label cost per unit. Tag prices will definitely go down to a few cents US when RFID equals bar codes share'. All respondents note that packing will be the costly item. The commercial literature states that tag costs in volume now (2004) 'could be in the range of (US) 18 to 35 cents each'. However, these costs depend on the type of product the tag is applied to and the kind of adhesive used to secure it to a package (Brewin, 2004).

Market research firm IDTechEx predicts that in 2019, the average price of an item level tag will be 1 cent, but chipless versions will cost less than that and especially when printed directly onto packaging (IDTechEx 2011). Despite the push from large retailers, analysts have predicted the demand for tags growing at double digit rates and 5¢ tags to come in the near future. Frost and Sullivan (2011) found that the total RFID market earned revenues of US$600-$800 million in 2009 and estimates this to be over US$2.0 billion by 2016, growing at a compound annual growth rate (CAGR) of 17.7 percent (Frost and Sullivan, 2011).

We conclude that the respondents perceive the tag pricing similarly to the commercial literature. Tag prices must come down for their usage to be more widespread which creates something of the 'chicken and egg' scenario that diffusion scholars are well aware of. Critical mass must be reached but this is by no means assured. Many people will adopt if costs come down but costs only come down as more people adopt.

In regards the crucial 11th question (we skip responses to Questions 10 and 12-14 for space reasons), 'Are you concerned with the privacy issues posed by RFID technology?' all integrators unanimously respond that they are 'not concerned' [(D) and (E)] and that there is 'no problem' (C). (A) offers the most detailed reply. As he explains: 'There has been bad publicity of RFID when it comes to privacy. As business integrators its does not matter, as all technologies have some negatives. Privacy will not pose an issue because consumers will be educated on the plan and usage of the product'. (C) is more specific in directly attempting to address consumers' *known concerns* as follows: 'Items do not get attached to the person so the retailer does not know who purchased the item'. In other words, the tags allow a product to be traced through its life cycle. However, the tag is not 'connected' to the buyer in any way that does not already occur under the barcode system.

Commercial articles (see, for example, Ferguson, 2002; Wired, 2004) have emphasized that there is a perception among privacy groups that RFID is a real threat to consumer privacy. For example, the mid-2000s announcement by Benetton of its planned adoption of RFID led to an immediate call by the U.S.A.-based Consumers against Super-market Privacy Invasion and Numbering (CASPIN) organization for a worldwide boycott of Benetton stores. The impact of this boycott caused the implementation of low-cost RFID systems in the retail market to be re-considered by some within the sector. We feel that this outlook is based upon two misconceptions: (a) that the tags contain personal information about the consumer (they do not), and (b) that tags can be read by a nearby reader *after* the consumer has taken the product back to home or office.

Recent articles suggest that privacy concerns were not high on the list for 2011. A few years ago retailers moved away from any mention of RFID because they feared adverse reactions from customers (Pleshek, 2011).

5. Summary and conclusions

We conclude that, despite the great potential of RFID, it is not as widely implemented as many would have predicted based upon the commercial literature around the year 2004. RFID has experienced many various roadblocks that have stunted the growth of the industry. Our interview-based research study, results for which have been discussed in this chapter, shows that integrators' perceptions can affect the adoption process. Integrator perceptions can act upon present expectations of RFID technology. Importantly, the interviewed industry integrators in 2004-2006 were generally more circumspect and realistic than the commercial literature of 2004 about the future prospects of RFID. In 2004-2006 they

did not perceive that the consumer privacy concerns were insurmountable as oftentimes concerns have been based upon two misconceptions: (a) that the tags contain personal information about the consumer (they do not), and (b) that tags can be read by a nearby reader after the consumer has taken the product back to home or office (they cannot be).
Also, to take further note, as at March 2011, the widespread adoption of RFID has been slow and one important reason for this delay has been the lack of uniform standards for network and data management. Cost and quality concerns have fractured the enthusiasm for RFID and reported high failure rates also exerted a dampening effect. In 2004 the suppliers had to absorb the cost of becoming RFID-compliant so the cost of doing business was risky. Despite this, the RFID hype in the commercial literature of 2004 has today become more realistic as the convergence of three technologies - Wireless Networks, RFID and Global Positioning Systems (GPS) – has occurred. The reality today, seven years on, is beginning to approach the wildly optimistic RFID growth forecasts in the 2004 commercial literature. Although practical problems still abound in this industry, the immediate future for consumer goods remains fit for speculation. There are benefits associated with global traceability to manufacturers.

6. References

ABI (2011). 'ABI Research: Item level retail tagging will drive double-digit growth for RFID in 2011'. Obtained through the internet:http://rfid24-7.com/rfidtalk/?cat=51. [accessed 03/11/ 2011].

AIM-RFID Connections (2003).Obtained through the internet:http://www.aimglobal.org/technologies/fid/resources/articles/nov03/industry.htl, [accessed 7/7/2004].

Brewin, B. (2004). 'No QuickROI from RFID, say Manufacturers',*Computerworld*. Obtained through the internet:http://www.computerweekly.com/Articl129677.htm, [accessed 12/8/2004].

Business Week Online. (2004a) 'Like it or not, RFID is coming', *Business Week Online*, 18 March, Obtained through the internet:http://www.businessweek.com/technology/content/mar2004/tc20040318_7698_tc121.htm, [accessed 17/2/2005].

Business Week Online. (2004b) 'Talking RFID with Wal-Mart's CIO', *Business Week Online*, 4 February.Obtained through the internet: http://www.businessweek.com/technoloy/content/feb2004/tc2004024_3168_tc15.htm, [accessed 12/2/2005].

CIA Advertising. (1998)'Diffusion of Innovation'. Obtainedthrough the internet: http://www.ciadvertising.org/studies/stdent/98_fall/theory/hornor/paper1.html,[accessed 21/2/2004].

Das R.and Dr. Harrop P. (2010) 'Printed and Chipless RFID Forecasts, Technologies & Players 2009-2019'.Obtained through the internet: http://www.idtechex.com/research/reports/printed_and_chipless_rfid_forecasts_technologies_and_players_2009_2019_000225.asp.[accessed 11March 2011]. http://www.idtechex.com/research/reports/printed_and_chipless_rfid_forecasts_technologies_and_players_2009_2019_000225.asp

Ferguson, G. (2002) 'Have yourObjects call my Objects', *HarvardBusiness Review*, June, pp.138-144.

Fishman, C. (2006) The Wal-MartEffect: How an Out-of-town SuperstoreBecame a Superpower, New York: AllenLane.

IDTechEx Ltd, (2010) 'RFID Forecasts, Players and Opportunities 2011-2021' Obtained through the internet:http://www.reportlinker.com/p0149567/RFID-Forecasts-Players-and-Opportunities.html, [accessed 11 March 2011].

Jones D. (Ed.) (2003) *The New Economy Handbook*, San Diego: Elsevier Science.

Kaiser, E. (2004) 'Wal-MartStarts RFID test', *Forbes.com*, 30 April.Obtained through the internet: http://www.forbes.com/home/newswire004/04/30/rtr1355059.html, [accessed23/2/2005].

Kinsella, B. (2003) 'Wal-Mart Factor',*Industrial Engineer*, November.

Lundquist, E. (2003) 'Wal-Mart gets itRight', *E-Week*, 14 July.

Mills, K. (2005) 'Radio Daze', *The Australian IT Business*, 19 July, p.1.

Mishra, D. (2004) 'Get Readyfor RFID'. Obtained through the internet: http://medialinenews.com/articles/publich/printer_518.shtml, [accessed12 July 2004].

Motorola (2010) 'Trends 2011: RFID takes off'. Obtained through the internet: http://www.gadget.co.za/pebble.asp?relid=2475, [accessed 11 March 2011].

Pleshek J.(2011) 'With privacy issues waning, RFID begins ramp up' Obtained through the internet: http://wistechnology.com/articles/8261/, [accessed 11 March 2011].

Reinhardt, S. (2010) Huge Demand in India for RFID Products'. Obtainedthrough the internet: http://rfidtechnews.wordpress.com/2010/03/07/huge-demand-in-india-for-rfid-products/, [accessed 03/12/ 2011].

Rogers, E. (1995) *Diffusion ofInnovations* (4th ed.), New York: TheFree Press.

Rossi, A., Sommerville, C. and Brown,O. (2003) 'RFID, The Growing Technology'. Obtained through the internet: http://www.personal.psu.edu/users/o/f/ob101/conclusion.htm, [accessed14/8/2004].

Ryan, B. and Gross, N. (1943) 'The Diffusion of Hybrid Seed Corn in TwoIowa Communities', *Rural* Sociology, Vol. 8, pp.15-24.

Shankland, S. (2002) 'Digital Dog Tags: Would you wear one?' Obtained through the internet: http://news.com.com/2100-1001833379.html?tag=nl, [accessed 17 June2004].

Spivey-Overby, C. (2004) 'RFID at what Cost? What Wal-Mart Compliancereally means', Forr Tel (webcast plustelephone), Forrester Research, 25 May.

Thomas, W. and Znaniecki, F. (1927)*The Polish Peasant in Europe* andAmerica, New York: Knopf.

Turban, E, King, D., Lee, J., Warkentin, M., Chung, H. and Chung, M. (2002) *Electronic Commerce: A Managerial Perspective*, Upper Saddle River: Prentice-Hall.

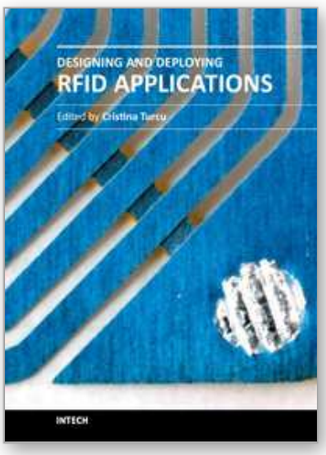
Turban, E., King, D., Viehland, D. andLee, J. (2006) *Electronic Commerce: AManagerial Perspective*, (Revisededition), Upper Saddle River: Prentice Hall.

Walters, K. (2005) 'Beyond the Barcode', *Business Review Weekly (Australia)*, 14-20 April, p.53.

West, C. (2001) *Techno-Human Mesh: The Growing Power of Information Technologies*, Westport:Quorum West.

Wired (2004) 'American Passports to get Chipped', 21 October.Obtained through the internet: http://www.wired.com/news/0,1294.6512.00.html, [accessed 22/10/2004].

Young, L. (2008) 'RFID: The Dialogue Continues', 01 October.Obtained through the internet: http://www.aimglobal.org/members/news/templates/template.aspx?articleid=3339&zoneid=24. [Accessed 11 March 2011].



Designing and Deploying RFID Applications

Edited by Dr. Cristina Turcu

ISBN 978-953-307-265-4
Hard cover, 384 pages
Publisher InTech
Published online 15, June, 2011
Published in print edition June, 2011

Radio Frequency Identification (RFID), a method of remotely storing and receiving data using devices called RFID tags, brings many real business benefits to today world's organizations. Over the years, RFID research has resulted in many concrete achievements and also contributed to the creation of communities that bring scientists and engineers together with users. This book includes valuable research studies of the experienced scientists in the field of RFID, including most recent developments. The book offers new insights, solutions and ideas for the design of efficient RFID architectures and applications. While not pretending to be comprehensive, its wide coverage may be appropriate not only for RFID novices, but also for engineers, researchers, industry personnel, and all possible candidates to produce new and valuable results in RFID domain.

How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

Mark J. Rodrigues and Kieran James (2011). Commercial and Implementation Issues Relating to the Widespread Acceptance and Adoption of Radio Frequency Identification Technology, Designing and Deploying RFID Applications, Dr. Cristina Turcu (Ed.), ISBN: 978-953-307-265-4, InTech, Available from: http://www.intechopen.com/books/designing-and-deploying-rfid-applications/commercial-and-implementation-issues-relating-to-the-widespread-acceptance-and-adoption-of-radio-fre

INTECH
open science | open minds

InTech Europe
University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
Fax: +385 (51) 686 166
www.intechopen.com

InTech China
Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
Fax: +86-21-62489821

© 2011 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike-3.0 License, which permits use, distribution and reproduction for non-commercial purposes, provided the original is properly cited and derivative works building on this content are distributed under the same license.

IntechOpen

IntechOpen