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Threats to Silent Commerce: A Delphi Study

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Abstract

Radio Frequency Identification (RFID) tags enable a new dimension of commerce – termed "silent commerce" – by enabling object to object communication. Recent press headlines offer clear evidence of the furor this technology generates among companies and masses. RFID promises tremendous opportunities and benefits for the future. However, some reports are skeptical due to some of the threats associated with RFID. These threats must be sufficiently addressed before benefits are realized. Lack of a comprehensive list of threats and insufficient agreement on the threats hinders the adoption of this technology and also the research addressing the threats. This research attempts to identify the most significant threats to silent commerce by adopting a Delphi-based methodology. This approach enables us to produce a ranked list of significant threats. Furthermore, this work contributes to research by providing focus for research on mitigating risks and addressing threats so as to realize the full benefits of RFID. This research also contributes to practice by exposing threats that companies need to be aware of before implementing RFID to realize the benefits.

Keywords: RFID, Silent Commerce, ePC Code, Supply Chain, Radio Frequency Identification Tags

Introduction

Imagine walking into a grocery store and being welcomed by your name and also being recommended a certain brand of soap because it is a month since your last purchase. Whether you buy the soap or not, this unrealistic dream is almost reality today. Radio Frequency Identification Devices[1] have the potential to deliver unrealistic dreams and more.

RFID technology is already in use, from EZ- Pass when you cruise through toll-gates on highways to tracking cattle on a remote farm. This technology is based on object-to-object communication and is the natural evolution of simpler tracking and identification technologies such as anti-shoplifting devices clamped onto clothing in department stores for years. RFID technology advances are the result of devices becoming simpler, cheaper and more durable. These innovations, combined with a host of other developments, promise a revolutionary change in the way businesses operate. The technology paves way for the future where objects will have wide-ranging and deep conversations with other objects – via a process nicknamed "Silent Commerce" (Ferguson, 2002). Silent Commerce makes everyday objects intelligent and interactive (Accenture, 2002).

Just when one gets ecstatic about this technology, other business press headlines scream: "RFID may be a scary business", "Wal-Mart turns customers into RFID test rats", and "Blunder exposes dirty tricks in RFID War" (Mayfield, 2002; Palmer,

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[1] Henceforth referred as RFID

2004; Smith & Konsynski, 2003; Trustman & Meshako, 1999; Want, 2004). The RFID chip is also nicknamed "Spychip" by those opposed to its use. These headlines and nicknames demonstrate the mixed emotions that RFID technology generates.

In spite of the advances in the technology and a number of promising opportunities, Gartner Research predicts that by 2007 at least 50% of RFID projects will fail (O'Brien, 2004). Within three years, according to Gartner, many companies will burn through plenty of money testing the new technology (O'Brien, 2004). With these conflicting reports we can infer that there are some threats associated with the adoption of this technology that are overlooked. This research attempts to identify these significant threats to profitable adoption of this "Silent Commerce".

The paper is organized as follows: First, we explain the basic tenets and mechanics of RFID. Second, we discuss the various opportunities that this technology generates. Third, we discuss some of the potential threats associated with this technology. Fourth, we discuss the research methodology we adopt for this study and conclude with expected contributions of this study.

RFID Explained

Although RFID appears to be a futuristic radical innovation it has actually emerged evolutionarily. The first use of RFID dates back to the World War II, when the British used it to distinguish British planes from German. The first work exploring RFID devices is the paper by Harry Stockman, titled "Communication by Means of Reflected Power" in 1948.

The Universal Product Code (UPC) is the familiar technology that uniquely identifies products. RFID differs drastically from UPC as RFID sensors can read out-of-sight and out-of-contact objects. Furthermore, one kind of RFID tag can also transmit data, enabling us to have unique identifiers for every product on this planet (Smith & Konsynski, 2003). Thus any product on the planet can be read and traced from any corner of the world. This simple development has given rise to radical opportunities discussed in later sections of this paper.

As the name suggests, RFID uses radio frequency chips for tracing. RFID technology is composed of four major components (Agarwal, 2001):

1) **E-Tags**: These are tiny, lightweight electronic frequency tags embedded into product packing, clothing etc. These E-Tags mainly consist of two types. Passive tags contain product identification information alone and derive power from the reader. Active tags have their own battery power to contact the reader and can be read from a much larger distance than the passive tags.

2) **Electronic Product Code (EPC)**: If we need to identify all the objects on the planet, we require an unlimited naming system. This is achieved through the use of EPC based on newly developed universal standards. The new naming scheme is based on a 96-bit code. It enables the identification of 1.5 quintillion objects.

3) **Object name service (ONS)**: Each product, based on its EPC would be associated with a local server that matches e-tag EPC information with other information about the item such as features and location.

4) **Physical markup language (PML)**: PML is an XML-based language that is used to define data on objects

Low frequency RFID tags are commonly used for animal identification, beer keg tracking, anti-theft systems and in many other commonplace domains.   McCarren International Airport in Las Vegas has begun a $125 million project to RFID-enable its baggage-tracking systems with a goal of reducing baggage mishandling by 12-30 percent. Given that it costs more than $100 to route a lost bag, the potential savings on the 70,000 bags McCarren handles daily could be significant (Palmer, 2004).

Potential Opportunities of RFID

RFIDs are expected to impact supply chains the most. Supply chains are more efficient than before, but are still prone to many inefficiencies. There is no doubt businesses have come a long way in improving efficiencies. Moving from an era of visual recognition and manual counting which was prone to human errors and wasted labor hours, business moved on to bar code technology where human errors were reduced drastically and the process was speeded up multifold. Still, there is room to improve the efficiencies. The Yankee Group estimates that $40 billion (or 3.5%) of total sales are lost each year due to

supply chain information inefficiencies. Yankee Group also estimates that $6 billion was lost in 2002 due to out-of-stock products in super markets (Sullivan, 2004).

Much of the inefficiency occurs as each item is identified and counted multiple times in the chain. Every identification and count increases costs. RFID can make these two processes easier. RFID does not require any physical contact to identify and count and thus time can be saved; in turn money and velocity could be improved in supply chains. An example of this efficiency gain is a garment manufacturer that can accurately inventory 80,000 garments at once and at all times (RFID, 2004).

Apart from the above, there are a number of areas where RFID can make an impact, including:

1) **Efficiency**
   Inventory is a surrogate for inefficiency. RFID enables real time integration of information. No more does one need to scan each item or box to know the status of inventory or order. One sensor can gauge the whole inventory at once. This continuous and real time integration reduces the requirement to have high inventories by reducing the requirement for a buffer that is usually present for the same. Pete Abell, a research director at AMR Research, predicts "RFID may offer labor savings of 20 percent in the warehouse, reduce supply chain inventory by 25 percent and increase sales by three to four percent" (Reda, 2003).

2) **Transparency and Visibility**
   By using RFID technology, information visibility is improved across the supply chain enabling firms to ultimately reduce inventories. Bar codes may serve the same purpose, but RFID can provide all the features that bar codes provide and be more reliable. With bar codes there is always room for human errors as an item may be skipped by the scanner. With transparency, the entire supply chain process can be improved and streamlined **(Kaleido, 2002).**

3) **Business Activity Monitoring (BAM) and Real-time Integration**
   Gartner defines "BAM" as providing "real-time access to critical business performance indicators to improve the speed and effectiveness of business operations (McCoy, 2002). The availability of so much information, while challenging to administer, provides RFID users real-time integration capabilities not available with other inventory management solutions like bar coding. The result of RFID real-time visibility into stock levels and retail offerings is the ability to employ demand-based inventory management processes with greater effectiveness.

4) **Manufacturing and Distribution**
   RFID can be used to support quality control (QC) in the case of manufacturing and distribution. The components and subassemblies that are present can be queried instantly using RFIDs. Thus RFID can be used to directly check if the right items from the bill of materials are in the right place at the right time.

5) **Short-term Competitive Advantage**
   Large retailers and manufacturers are beginning to require top suppliers to develop and use RFID technology. Those that choose to implement RFID will win the larger share of business from these firms. Those that choose to not implement RFID immediately will see the demand for their products drop at these firms. Wal-Mart is imposing RFID use by its top 100 suppliers by the end of 2004. The next 200 suppliers will have to implement RFID by the end of 2005 and in the longer term, all suppliers to retail and large-scale manufacturing firms will probably be required to use RFID at some level (Hutchinson, Dunlap, Torre, Golinski, & Naal, 2003). Regardless of the size of the supplier, those choosing to adopt RFID in their supply chains earlier will be given favor by their customers.

From examining the above mentioned benefits it should follow that firms will rush to adopt this new and exciting technology. However, reality seems quite different from expectations. Along with providing opportunities, adoption of the technology presents many threats to an organization. The presence of these threats may be preventing the wholehearted adoption of this innovation. While some threats to the adoption of RFID have been recognized and expressed by various practitioners, there is no consensus on what constitutes the foremost threats. The next few pages and our research try to reach an understanding regarding some of the threats that concern managers while implementing RFID solutions.

Potential Threats of RFID

RFID adoption presents many innovative opportunities for success but the threats to it are no less overwhelming. The adoption process can succeed only when all threats are mitigated. We present below some common threats that can be identified by studying the literature and trade press.

1) **Privacy**
The primary threat to RFID adoption is the fear in the populace about privacy. This fear has kept pace with the hype which has followed RFID. So prevalent is the fear that some U.S. states have already proposed legislation limiting the scope of RFID chips (Kuchinskas 2003). While most of the fear is irrational, the pervasive nature of RFID does raise some valid concerns and any firm implementing an RFID based system must address the issues of privacy to prevent a backlash from the general stakeholders.

Research has shown that concerns about privacy have heightened amongst consumers with the advent of the internet and the last thing a firm wants is negative publicity during the introduction phase of a new technology. The privacy threat is real and has not been satisfactorily solved. Without a proper secure technique for transmitting RFID data, "the impending ubiquity of RFID tags…poses a potentially widespread threat to consumer privacy"(Juels, 2004). A major way of addressing this problem would be defining the scope of the technology. In other words, formulating and disseminating policies guiding the use of RFID's, e.g. making policies stating that retailers selling goods must disable RFID chips during checkout. While this kind of a process will reduce the functionality of the technology, it may result in better acceptance of the technology.

2) **Information overload**
The next biggest threat that RFID adoption presents is information overload, especially if the firm is not ready to manage the expected exponential increase in data flow. RFID technology is the most information intensive technology ever developed. It enables tracking of each and every single item produced by a firm. Firms accustomed to handing items by cases or even truckloads are suddenly confronted with item level data. Numerous researchers have pointed out the damaging effects of information overload on managerial decision making (Etzel, 1995; Zolkos, 2005) . If firms are not able to manage the information through the use of appropriate systems, decision making can come to a halt or at best lead to suboptimum decision making.

3) **Relevancy of information**
A related problem to information overload is the problem of relevancy of information. While RFID allows real-time tracking of information, the question that must be asked by firms is: what is the relevancy of information that is gained by tracking products on a real time, per unit basis. Perishable / expensive products might require a real time capability, but a similar benefit level (vis-à-vis costs) is uncertain for other products.
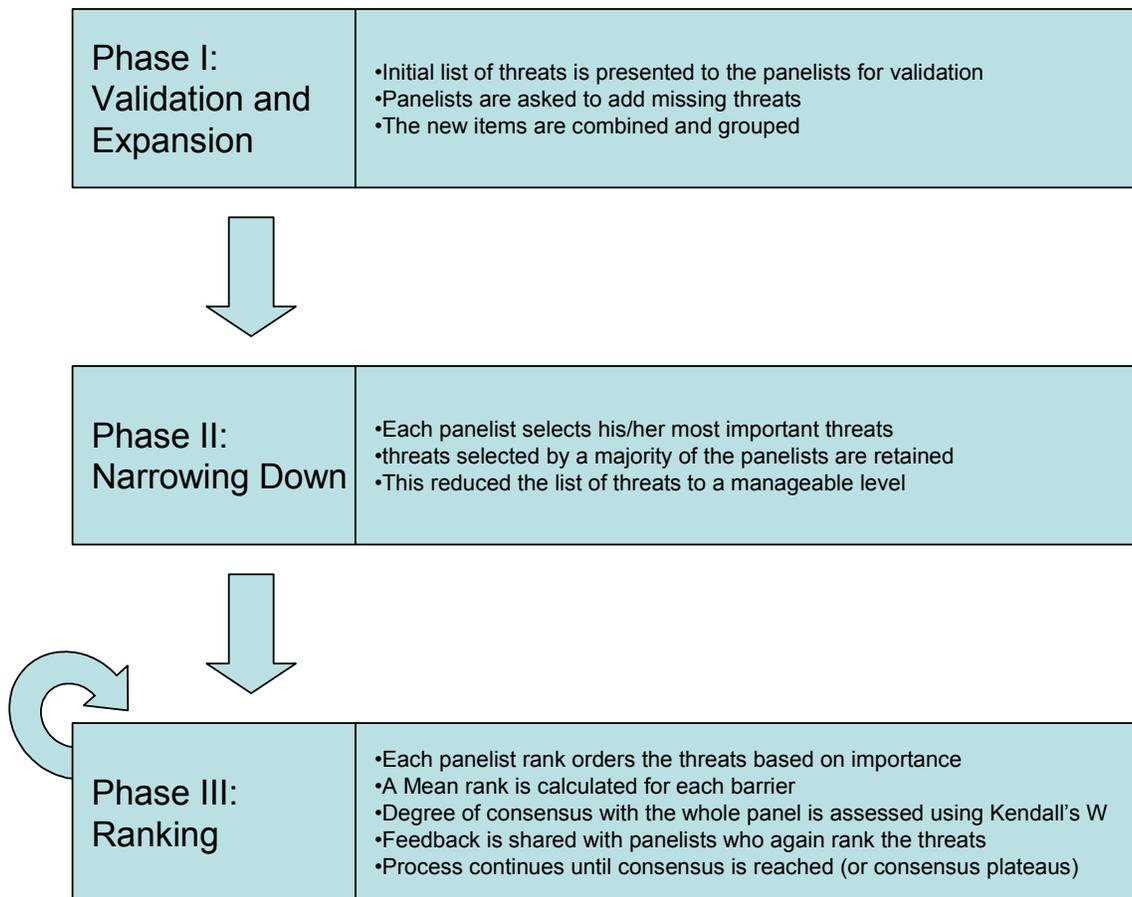
4) **Lack of standards**
Another threat to RFID adoption is the lack of standards (Kuchinskas, 2004; Sliwa, 2004). RFID has been hyped as the "Internet of Things" (Schoenberger, 2004). The key to realizing that dream is the standardization of protocols used in running the system. An analogy is found in the evolution of the internet. Before the World Wide Web became standard with the use of the TCP/IP protocol, the world consisted of various different networks that were unable to talk to each other. Until that time, people really could not develop applications that exploited the benefits of electronic communications. The development of common standards changed the scenario for ever. The same is the case with RFID, albeit with a higher cost. If firms go for proprietary protocols, the true value of RFID may never be realized. A situation may exist where suppliers, retailers, and vendors all follow different protocols and interoperability becomes the major problem.

5) **Cost of implementation**
Last, but not the least, is the threat of escalating costs. Various studies (Brockner, 1992; M. Keil, Mann, & Rai, 2000; Mark Keil, Rai, Mann, & Zhang, 2003) have shown that projects suffer from time or cost escalation. In implementing an RFID-based strategy, costs accrue from three sources. Cost of implementing new systems (including training), cost of hardware to read RFID tags at various locations, and the cost of the tag itself. Most studies talk only about the cost of the tag, per se, as the primary cost, and much time and energy is being devoted on bringing the cost of the hardware down (Smith & Konsynski, 2003). The thinking being that as soon as per unit cost of the chip goes down, implementation of a RFID based system would be easy. However firms that ignore costs associated with implementing such an information-intensive system might be walking into a budgeting disaster.

The above mentioned points are just some of the most prominent hurdles that seem to prevent the wholehearted acceptance of RFID. However, as of today, there is no consensus as to what are the real significant hurdles that must be addressed before a critical inflexion point is crossed. The only consensus seems to be that problems exist and must be solved. This paper tries to address this very problem so that academia and industry can work together to address the significant problems to bring this technology to fruition.

Figure 2. Delphi Study Methodology

Phase I: Validation and Expansion	•Initial list of threats is presented to the panelists for validation •Panelists are asked to add missing threats •The new items are combined and grouped

Phase II: Narrowing Down	•Each panelist selects his/her most important threats •threats selected by a majority of the panelists are retained •This reduced the list of threats to a manageable level

Phase III: Ranking	•Each panelist rank orders the threats based on importance •A Mean rank is calculated for each barrier •Degree of consensus with the whole panel is assessed using Kendall's W •Feedback is shared with panelists who again rank the threats •Process continues until consensus is reached (or consensus plateaus)

Research Approach

The aim of this study is to identify and develop a list of significant threats to RFID adoption and rank order them in list of significance. The novelty of this technology and lack of theory poses constraints in identifying and rank ordering threats. Thus the best sources of such information are experts who are familiar and/or have used this technology. A rank ordered Delphi approach as posited by Schmidt (1997) can be used to obtain a rank ordered list of significant threats to RFID adoption. This Delphi study helps in producing a rank ordered list of threats by eliciting opinions of a panel of experts through iterative controlled feedback and group consensus.

Our panel of experts is chosen as a mix of academics and practitioners who are knowledgeable about the technology and/or are using it. This mix of panelists would have divergent opinions, distinct experiences and different backgrounds.

Data collection and analysis will be based on Schmidt's method as shown in Figure 2. In Phase I, the starting list of threats will be presented to the panel to validate the list and add missing threats as they perceive them. Phase II would be used to shortlist the comprehensive list of barriers to a manageable few to further enable rank ordering. After this phase II, only the threats that are perceived by majority of the panel will be retained. Phase III involves the ranking and rating the selected list from phase II. The ranking phase involves careful reviewing of the list of threats and rank ordering according to priority: the threat which would present the most serious impediment to RFID adoption and so on. Controlled feedback for all ranking rounds would be provided in form of mean ranks. The ranking round would be stopped according to the procedure outlined by Schmidt (1997). The ranking stops when either a strong consensus is reached or when the consensus plateaus.

The result of this study would be a rank ordered list of threats for RFID adoption in the order of importance. This would enable both researchers and practitioners to focus on these issues and try to mitigate these threats so that we could realize and benefit from the opportunities RFID promises.

Expected Contributions

It is well known from problem-solving literature that problem recognition forms the foremost step in the solution design process.   This paper lays the first step in identifying the problems as significant threats confronted by researches and practitioners. There has been very little focus in the academic press on RFID. Thus this work further promotes RFID to the research community. This work also provides significant threats to RFID and thus enables potential opportunities for researchers to address those threats and mitigate the risks. This work contributes to practice by listing the various threats associated with the technology, so that companies subscribe to a cautious strategy while adopting this technology.

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