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AMCIS 2007 Panel Summary: The Promise of RFID Technologies

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AMCIS 2007 PANEL SUMMARY: THE PROMISE OF RFID TECHNOLOGIES

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ABSTRACT

Radio Frequency Identification (RFID) has started to revolutionize the way today's organizations do business. Since its highly publicized adoption by Wal-Mart, several companies have started using RFID in their supply chains with varying results. On the academic level, many new research streams have been launched concerning the applications of RFID in business. However, whether or not the academic community is ready to adopt this technology itself remains a question. To consider the future of this technology in research and industry alike, the authors organized two panels on the topic of the promise of RFID technologies at the 2007 Americas Conference on Information Systems (AMCIS) held in Keystone, Colorado. They also demonstrated the capability of the technology using a proof-of-concept pilot system as a means for providing added services to conference attendees. This article reports on the two panels, as well as on the results from the pilot experiment.

Keywords: RFID, conference management, technology adoption

I. INTRODUCTION

RFID (Radio Frequency Identification) is an enabling technology that has the promise of revolutionizing businesses and business operations. To evaluate the future of this technology in research and industry alike, the authors organized two panels on the topic of "the promise of RFID technologies" at the 2007 Americas Conference on Information Systems (AMCIS) held in Keystone, Colorado. In this paper, we provide a brief background of the technology and a summary of the findings of the panels, as well as a demonstration of the technology during the conference. In the rest of this paper, we will refer to the first panel as Panel 1, and the second panel as Panel 2.

RFID technology is centered around the concept of an RFID "tag" – a small chip connected to an antenna (usually embedded in a substrate that can be placed in a card, label, or other form of converter) capable of receiving radio signals and transmitting a code placed in the chip back to the source of the radio signal. Several major corporations have already committed to the use of RFID in their business operations, and it is expected that RFID tags will be accepted as a universal tagging/labeling technology at crate/box levels (and potentially down to the item level) in the not too distant future.

RFID offers several advantages over other tagging methodologies such as barcoding. First, the tags do not have to be in a direct line of sight of the readers, allowing items to be read inside boxes or behind barriers. Second, items can be read from a considerable distance (average read distances are reported to be around 9-10 feet, although some items can be read up to 30 feet or more away). Third, multiple items can be read at the same time, without the need for reading items individually. Finally, by optimizing the placement of readers and antennas, objects can be read automatically without a human attendant. These advantages immediately impact the flow of items in business supply chains— box- and crate-level tags can be sensed with a level of efficiency and automation that has not been possible before. Panel 1 aimed at identifying how well the technology is living up to its promise and what types of steps industrial and academic communities involved with the technology need to take in order to realize this promise. Panel 2 aimed at evaluating how the technology can be used to increase efficiency and improve customer service in conference management applications.

As with any new technology, there are mixed levels of acceptance across businesses as well among the general public. While businesses such as Wal-Mart have already realized the potential of this technology and incorporated it into their supply chain processes in distribution centers and warehouses [Hardgrave, Waller and Miller, 2005], others see this technology as an added burden and an extra cost in their business processes. There have been an enormous number of objections to the widespread use of RFID in industry, primarily because of potential issues related to consumer privacy and security [Albrecht and McIntyre 2005, 2006; Hardgrave, Waller, and Miller 2005]. These problems and adverse reactions to this technology make it all the more interesting as a topic for further research, as well as for teaching and training to ensure its proper utilization and reduce the type of misuse related to security and privacy issues. Panel 1 members felt that the sheer volume of data streams generated by RFID-enabled applications will lead to research on new methods of data storage, mining and warehousing; new methods for modeling and development of software; as well as new methods of optimizing business processes such as supply chains and inventory control.

The biggest promise of this technology, however, is its limitless applicability. Tagging crates and boxes in a business supply chain is just one of the areas where this technology is being used. Other applications include, but are not limited to: access control systems, resource and asset tracking methods, time and attendance management, package handling and routing, and location-based computing. While the possibilities are many, there are potential issues and dangers that need to be explored before RFID comes into widespread use. Panel 1 summarized some of the most important issues that need to be considered before a positive return on investment from RFID deployment can be obtained.

While the concept of identifying objects by embedded radio-frequency devices is not new, only recently has RFID adoption become more widespread because of the significant improvement in performance and cost brought about by the introduction of second generation (Gen2) tags. However, applications that take advantage of these devices are still rare, and those that are available are typically written for specific platforms. Although several businesses have reported improvements in efficiency, reduction in inventory and out-of-stocks through the use of RFID, such improvements in business processes do not happen by magic [Want 2004]. Middleware and “Edgeware” systems have to be developed for use with RFID and other sensors and output devices for proper integration into current business processes. Developing these applications is often tricky and time-consuming. While some standards do exist for specific types and generations of tags, a wide segment of the market is driven by proprietary communication methods designed by device manufacturers, thus increasing the difficulty of interoperability. Panel 1 discussed several issues concerning this problem as well.

The use of RFID is already prevalent in supply-chain management (SCM) applications, where pallets, cases, and individual items can be tagged with RFID labels, enabling them to be tracked through the different parts of the supply chain [see e.g., Bose and Pal 2005; Chappell et al. 2002]. RFID provides dual benefits to logistics service providers by improving operational efficiency for standard logistics processes, such as transportation control and asset management,

and by supporting the coordination of the physical flow of goods and related value-added information services [Fleisch et al. 2005]. A growing number of businesses are trying to innovate their supply-chains using RFID [Hardgrave, Waller, and Miller 2005; Holmqvist and Stefansson 2006]. Studies show that products are out of stock in the grocery and mass-merchandise sector 7 percent of the time on average. By implementing RFID in its supply chain, Wal-Mart has already reduced out-of-stocks by 16 percent on RFID tagged items, replenished them three times faster, and reduced manual orders by 10 percent [Roberti 2005]. In addition, Procter & Gamble Company has commissioned research that reveals that out-of-stocks on some fast-moving items can be as high as 17 percent [Windley 2003].

In summary, RFID is an emerging technology that is bringing about a large number of innovative changes in business processes, which has resulted in a new stream of research on the application of RFID in future industry applications. Although new, the technology has already been implemented in major corporations [Grossman 2004]. RFID-enabled business applications are changing the modus operandi of 21st-century businesses. RFID can introduce efficiency and cost reductions to business processes. These benefits trickle down in the form of lower prices, improved service and greater convenience for consumers [Eckfeldt 2005]. RFID systems have been designed for different purposes—a taxonomy of various RFID systems currently available, with their strengths and weaknesses, can be obtained from Hassan and Chatterjee [2006]. By itself, RFID does not provide solutions, but needs to be appropriately integrated into existing infrastructure [Sarma 2004]. This process of integration is not straightforward—in fact, there is a significant potential for errors and security breaches [Engels and Sarma 2005; Inoue, Yasuura, and Hagiwara 2006]. Panel 1 members and attendees concurred that the technology is mature enough for organizations to integrate it into their operations.

The rest of this paper is organized as follows: In Section II, we provide a summary of the specific topics discussed in Panel 1. In Section III, we provide a summary of the results of the RFID demonstration system, which was the topic for Panel 2. Finally, in Section IV, we provide our conclusions based on the lessons learned from both the panels and the demonstration.

II. PANEL 1. THE PROMISE OF RFID TECHNOLOGIES, PART I

The presenters in the first panel included members from both academia and business. In addition to panel moderators Dr. Vikram Sethi, and Dr. Arijit Sengupta, representing Wright State University, four executives were invited from various organizations involved in RFID deployment. The invited executives included Mr. Damon Bramble, General Manager of Alien Technologies RFID Solutions Center; Mr. Ed Roberto, Chief Operating Officer of Trenstar, Inc.; Mr. Paul Nuzum, President of Supply Chain Insights; and Mr. Brian Mcgraine, RFID Business Development Manager, Sun Microsystems. While Mr. Bramble could not attend due to flight cancellations, the other three industry representatives were present.

Dr. Sethi started the panel by introducing the panel members, providing the motivation for the topic of “Why RFID?” and he discussed what lies in the future for RFID technologies. The panel was structured to provide short presentations from each panel member, followed by a prepared question-answer session, and an audience question-answer session.

The first topic undertaken by the panel was the use of RFID in the tracking of high-value assets. The deployment of RFID for this purpose makes a fairly common business case for adopting this technology. Trenstar, Inc., one of the organizations represented in this panel, is using tags to track a half-million beer kegs, over 75,000 synthetic rubber containers (e.g., for the automotive tire industry), as well as luggage containers for several leading airlines[Trenstar 2007a]. Sample tags used for these applications were passed around among the audience, including UHF tag inlays, smart labels, and specialized low-frequency “blue-button” tags used for tagging beer kegs. To increase container utilization, a common method used is pooling (using the same containers to carry different types of products). The objective is to minimize accidental as well as deliberate misplacement of containers. As an example, 1000 lost beer kegs, each costing $50, could result

in $50,000 in lost assets for a beer company. While it is easy to think that a $5 tag placed on the kegs and associated readers in strategic locations would reduce the revenue lost from misplaced kegs, the process of tagging (typically welding) current kegs, assigning every keg a tag, and the associated logistics of tracking, quickly becomes a fairly heavy investment, which may not be quickly recovered, even within a five-year period. The investment could possibly be made more productively by identifying the regions where most misplaced kegs occur, and then making the initial investments in those regions. The same type of initial investment issues arise in other areas of business, especially related to the item-level tagging of low-value items. However, often the investment, if not implemented properly, can feel like a financial liability. For example, initial assessments by the Campbell's Soup Company indicated that the use of RFID solely to comply with mandates would only result in added costs; however, recent reports show that Campbell's Soup may realize the same benefits that Gillette (now owned by Procter and Gamble) is getting from tracking promotions [Roberti 2007]. Thus, implementation needs careful planning, taking into account the company's operations and supply chain environment, in order to get the most out of the RFID investment [Trenstar 2007b]. The panel summarized a set of recommendations for organizations to consider when deploying RFID, which will be discussed later in this paper.

On the topic of return on investment with RFID, the discussion was centered around a report from Aberdeen [September 2006], which shows that the average time for recovering RFID-based investments is currently about 30 months, with times ranging from 18 to 48 months. The panel posited that as the prices of tags drop and adoption rates rise, payback schedules will decrease to between 18 to 24 months.

Figure 1 shows a chart from the previous report, indicating the highest and lowest time periods for recovering investment on RFID, categorized by different areas from which such returns may come.

The next topic considered by the panel was the issue of pre-implementation testing and simulation. The topic started with a discussion of the services provided by the test lab of Sun Microsystems in Longmont, Colorado [Story 2005]. This facility is capable of simulating extreme environmental conditions such as vibrations, temperature and humidity. For example, the Longmont test lab can simulate vibrations, from moderate vibrations caused by vehicles up to extreme vibrations caused by earthquakes. In addition, the lab is equipped to simulate extreme temperature changes, humidity changes, and combinations of all these conditions. The panel discussed why organizations involved with RFID need to consider such tests. The general agreement was that many RFID deployments fail because of unexpected weather and environmental conditions. Thus a thorough simulation and testing of the environments in which the systems will function is a highly desirable milestone of any RFID deployment project. An interesting observation by the panel on this topic was that the testing phase of new technology deployment should be considered one of the most important inputs to the process. The phrase "garbage in, garbage out" is absolutely relevant here—if systems are not properly tested before being deployed, the outcomes most likely will not be up to expectations. While RFID is one of Sun's interest areas, efforts to develop Java-based middleware never acquired the momentum needed for success, so developing highly customized test cases for RFID deployment has become an important function in the Longmont testing lab. The services provided at this testing center include specialized tests on different types of tags and readers, including testing on high-speed conveyors, portal testing with reader and antenna arrays, temperature sensors for cold chain tests, and tests with metals and liquids.

An example of an extensive test specification discussed was the Boeing Spec 2000 specification [ATA 2007]. Specifically, Chapter 9 of the Spec 2000 specification includes "Automated Identification and Data Capture (AIDC) specifications such as barcoding, 2d data matrix and RFID, which are used to mark and identify products and/or store information which can be read in an automated manner." Within the airline industry, this allows tracking of parts and shipments. Spec 2000 conformance is a major effort that requires thorough testing for readability and traceability in varying environmental conditions, including severe temperature changes, speeds and vibrations. For such applications, an extensive test plan and facility is a major necessity.

Other areas of specialized testing include cold chain applications. Cold chain testing evaluates tags designed to continuously monitor temperature data; these tags can store up to 700 data points that can be interrogated by an RFID reader. A major issue in RFID adoption is selecting the best readers and tags for a particular application.

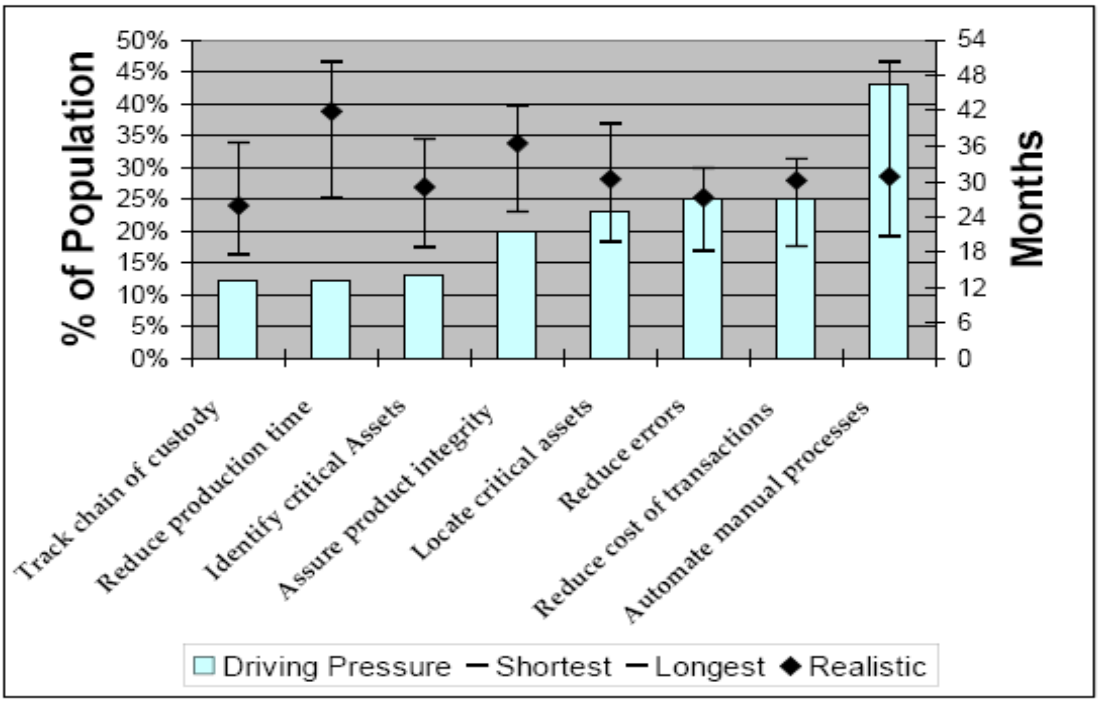

Figure 1. Return of Investment Time Periods for Different Areas of Operations (Source: AberdeenGroup, September 2006)

The next major topic to be discussed by the panel was adoption risks and challenges with respect to RFID. Supply Chain Insights has conducted extensive research with 31 supply chain executives to understand how these companies use RFID. Complete statistics and results from this survey were published in a series of articles in the Prologis Supply Chain Review [Johnson and Nuzum, 2005a, 2005b, 2005c, 2005d, 2005e, 2005f, 2006]. One of the most popular among these reports is "RFID: Lessons Learned," from which some information is quoted as follows [Johnson and Nuzum 2005e]:

Among the 31 companies interviewed:

19% were complying with a retailer mandate

6% were impacted by the Department of Defense mandate.

Of the 31 interviewed:

74% were conducting initial research into RFID technology

55% were building a business case for implementing RFID

48% were conducting a pilot

19% were implementing an RFID operation

10% were doing none of the above

The most important recommendations from these supply-chain initiatives were:

1. Learn about RFID Technology (even if you do not use it).
2. Establish a test lab pilot.
3. Always tag upstream.
4. Watch out for repackaging.
5. When barcodes fail, try RFID.
6. Focus first on your highest-value items.
7. Think long term, avoid slap and ship strategies.
8. Think inside the box.

The most important aspect of deploying RFID in a business involves analyzing the internal business processes of the company and how RFID can be incorporated into them (think inside the box).

The last major issue discussed at the panel was academic research initiatives with RFID. The WRITER (Wright Research Initiative for Technology Evolution with RFID) is a new research initiative started at Wright State University for the purpose of conducting innovative sponsored research on the development of cutting edge research topics and systems for assisting early adopters of RFID. One such application is for services provided at academic conferences; a pilot, demonstrated at AMCIS 2007, was discussed during the panel (more details on this pilot will be discussed later in this paper). The importance of the necessity for test labs for any kind of RFID-related research was also reiterated. The panel concluded that research on RFID can be improved by adding actual experimental data and real deployment information to theoretical information. Several current projects at WRITER follow this trend, including FlexRFID, a modeling methodology developed at WRITER which allows visual development of RFID-based control applications, necessary for deployment of RFID-related technology in most adopting organizations. This modeling method reduces the development overhead and speeds up deployment time for most small-to-medium-level applications, and it uses real business scenarios to create working solutions [Sengupta 2006]. Evidence of this was quite apparent in the AMCIS 2007 sessions in the “RFID Business Impact” mini-track, where several papers were presented that involved real and simulated experiments on RFID data [Riemenschneider 2007; Thiesse 2007].

In addition to the prepared discussion topics, discussion on several intriguing topics was generated by audience questions.

On the issue of security and privacy with the use of RFID tag, a question was raised as to what kind of security is possible with tags—could someone with a reader come and alter a tag to change its price information to mark an item as worth less than it is? The panel concluded that the technology to read and write to these tags is still fairly bulky, not something that can be hidden in a pocket. Second, the tags have very limited memory capacity and typically do not contain any pricing or other information but only an ID that links to the information in the corporate database, so changing something in the tag will merely make the tag unusable. In addition, security mechanisms like locking and access passwords on tags which can make the tag unreadable and unchangeable to adversaries, are currently available. Many of the privacy and security concerns are a result of misinformation, and the physics behind the technology makes it virtually impossible for an adversary to be able to read items inside a household or a store from 50 to 100 feet away.

On the question of integrating data from new RFID implementations into existing systems, this is a current research issue that several organizations are trying to solve. Most software products that work with RFID are geared toward specific applications. Current adopters are developing software products that are one-off custom developed products, because standard ERP-type

implementations are not presently available. Most current applications use a services-oriented architecture to handle this, but software development is still specific to one particular problem. Trenstar's success is due to its investment in middleware for a rules-and-workflow-based integration platform that is applicable to many industries. However, Trenstar's middleware takes a very abstract view of supply chain optimization for asset tracking and hence has succeeded in adapting to changing application areas and requirements.

As to the question of prices and compatibility of tags from different sources, the panel responded that the prices are dependent on the types and capabilities of tags and the volume of the purchase. Tag prices range from a nickel for volume-purchased passive squiggle tags to $100 or more for specialized active tags and tags with embedded sensors. Since different types of tags can operate at different frequencies, there is no one reader that can read all of them. However, at specific application levels, there are standards (such as the EPC Gen1 and Gen2 standards) ensuring that compliant tags can be read by compatible readers, regardless of manufacturer. A common observation is that the higher the value of the asset, the greater the probability that its tags will be compatible across reader manufacturers, but for the low price/high volume market, tags may not be globally compatible.

With respect to incompatibilities among reports about positive ROI and failed RFID projects, the Aberdeen September 2006 report points out three impediments to achieving ROI: (1) instability of technology; (2) underestimating required investment; and (3) selecting an inappropriate application. One of the panelists commented about a client (unfortunately specific details could not be revealed) who wanted to save money by tracking reusable assets with RFID. This company reported substantial annual loss from theft of these assets and wanted to track them using RFID and felt that recovering these items would result in a positive return on their RFID investment. Unfortunately, this project failed because this company did not properly estimate additional expenses arising from additional time and process changes for attaching the tags to the items, and overheads related to recovery of these items if the items are not properly returned. The lesson from such failed projects should, however, provide enough hindsight for targeting specific vendors and specific subapplications for a more consistent ROI.

With respect to the approximate amount of funding needed to begin developing RFID-based applications in a lab, the actual amount of necessary funds is typically driven by the purchase volume. However, if the researcher can determine one or two application areas that are interesting, it may be possible to get seed funding from a funding agency, and, after a successful first project, follow-up funding should be available. One thing that has worked in Wright State's favor is that several RFID corporations have moved into the Dayton area recently. A seed grant of approximately $30,000 was enough to initiate the WRITER Center, and, with support from the college, to enable growth.

With respect to the areas suitable for research, although most current research is in the supply chain applications of RFID, WRITER focuses on the areas of data modeling, mining and warehousing because of the interesting problems, challenges and research questions in the areas of data management. A course initiated by Dr. Sengupta at the College of Business has led to implementing projects provided by industry partners. On the topic of courses on RFID, a curriculum exists in the form of certification programs like the CompTIA RFID+, which could be used as a model for teaching such courses, leading to the additional objective of students to taking and passing the RFID+ certification test. These courses typically can be taught to undergraduate students of Information Systems with little or no prerequisite requirements.

III. THE PROMISE OF RFID TECHNOLOGY, PART II

During AMCIS 2007, Wright State University's Raj Soin College of Business, partially sponsored by Alien Technology, demonstrated the capabilities of RFID using a prototype application capable of tracking attendees at academic conferences. This application was developed at the WRITER research center. The results of this demonstration were presented in Panel 2, which was chaired

by Professors Barbara Denison and Arijit Sengupta. Attendees were given the details of the operations of the systems and data obtained from the RFID readers, and informal conversations with participants were presented.

The RFID prototype system mentioned above demonstrated a potential application of RFID in conference attendee management. The system developed for AMCIS 2007 allowed attendees to be registered with only their names and affiliations. Once registered, the attendance of participants in specific meetings can be tracked via RFID tags placed in their name badges. The specific system deployed at AMCIS 2007 did not actually track attendees individually across all meetings but only demonstrated how such an application could be used in future conferences using only two tracking stations.

One hundred RFID tags were distributed to interested attendees on a volunteer basis. The tags used were Alien Technologies passive Gen-2 Squiggle tags (ALR-9440) with the new Higgs™ silicon chip. These tags have a small form-factor, with the inlay being only 1 cm x 10 cm, and they can be comfortably attached to the back of a standard name badge. The Higgs™ chip in these tags is a new proprietary chip developed by Alien Technologies capable of higher efficiency in readability, throughput and range than the previous Gen2 products. At AMCIS 2007, two stations were set up to read tags; both of these stations were equipped with a laptop, an Alien Technologies ALR-9800 UHF smart reader, two circular antennas, and an Eiki Firefly electronic projector. The first of the read stations were set up at the entrance to the AMCIS 2007 cyber-café, which was also used for registering new attendees. This station also acted as the main server, hosting the database of attendees. A personal wireless router served as the link between the server and the "mobile" stations. The original plan, to have one central station and two mobile stations, did not materialize since one of the three readers shipped to the conference failed. As a result, only one mobile station was set up at the entrance to the Longs Peak ballroom in addition to the central tracking station at the Cyber-café. Figure 2 shows the schematic of the central and mobile stations.

Figure 2. (a) Central Station and (b) Mobile Station Configurations

During the normal hours of the conference (between 8:30 A.M. and 6:00 P.M.), the readers were set up to read tags autonomously. Whenever attendees with RFID tags on their badges came within 15 feet of the antennas, they were detected, and their pictures along with their titles and affiliations showed up on the projector screen. The system was set up around 3 P.M. on Thursday, August 9, 2007, the first day of the conference. Tags were distributed to attendees during the afternoon of August 9 and all day on Friday, August 10. A few leftover tags were distributed on the morning of August 11 as well. The system was dismantled at the end of the day on Saturday, August 11.

No personal information was collected from this experiment. Participation was purely on a volunteer basis. Tags were distributed until they ran out. Some of the basic demographic information of the participants is shown in Table 1.

Table 1. Demographic Information on Participants in RFID Demonstration

Total tags distributed:	102
Gender distribution:	23 female, 79 male
Position distribution:	28 students, 63 faculty, 9 other
Distribution by day:	Friday: 29, Saturday: 63, Sunday: 10

The reading stations were programmed in the following manner. The readers were programmed to continuously read tags in the "inventory" mode (in which the readers read and store tag information read from any antenna). The software running at each station periodically polled the reader to retrieve the current set of tags and send the information to the central server, while also updating the currently displayed information. Any attendee passing through the interrogation zone of the reader would get read, causing his/her name and image to be displayed on the screen. Since the data was refreshed every few seconds, it was possible for attendees staying in the read zone longer than five seconds to result in multiple reads. The monitoring system allowed adjustments for the read interval and duration of display of attendee images. The total number of reads over the two-and-a-half days of operation was 6,656, with 1,014 reads on Thursday, 2,889 on Friday, and 2,753 on Saturday. A chart showing the total number of reads on the three days during hours of operation is shown in Figure 3.

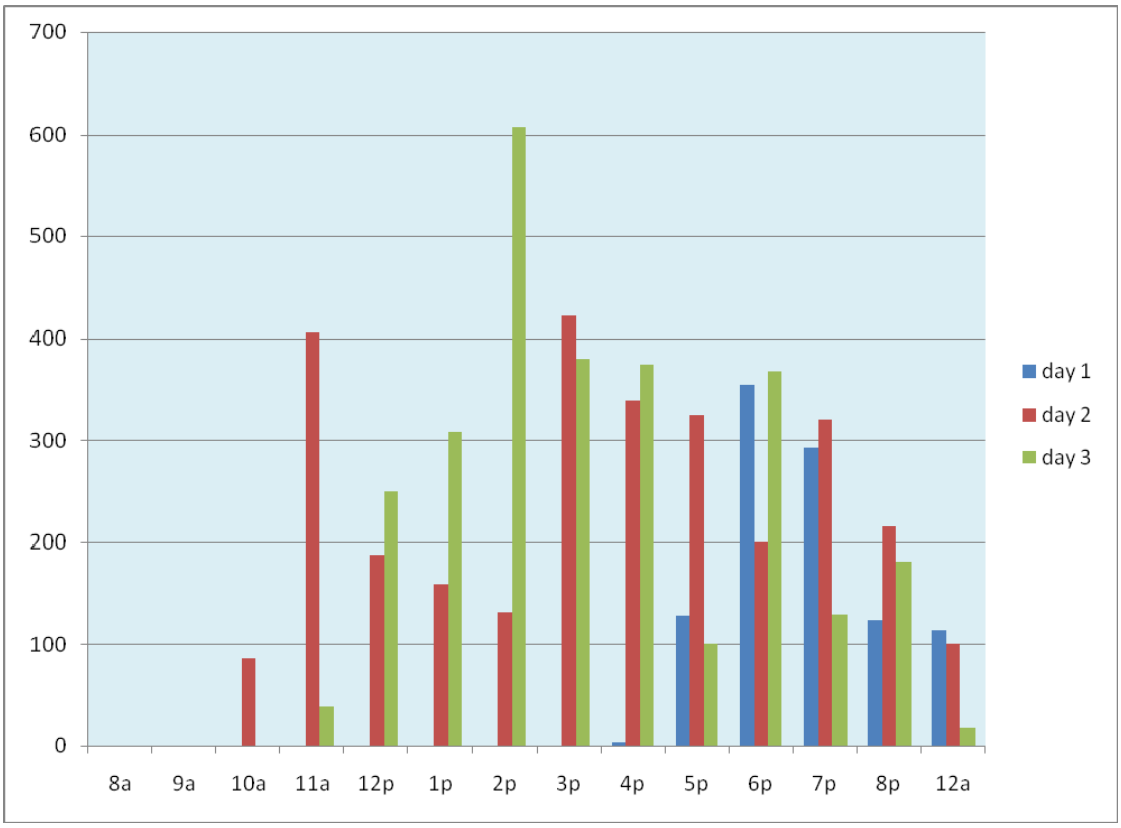

Figure 3. Read Distribution across Days and Hours

The distribution of the reads by station is shown in Table 2. The quandrypeak2 station in the table refers to the failed station, which was dismantled after one hour of operation.

Table 2. Number of Reads during Each Day for Each Read Station

Date	Location	reads
8/9	Registration	893
8/9	quandrypeak2	19
8/9	Longspeak	102
8/10	Registration	1784
8/10	Longspeak	1105
8/11	Registration	1418
8/11	Longspeak	1335

The maximum number of reads for a single tag was 585 (likely for users from the booth right across the hall from the reader antennae), the minimum was 1, mean was 64.621, median and mode were both 34, and the standard deviation was 97.74.

However, the most important aspect of the experiment turned out to be the interaction with conference attendees. While there was quite a bit of enthusiasm for receiving a tag and seeing the capabilities of the technology, there were several individuals who were concerned about the privacy aspects of the application. Some of the actual comments heard at the conference were:

> "Are you promoting the 'big brother' concept?"
>
> "The first time I heard of this, it made me think of the branding of people during the holocaust."
>
> "I have my right to privacy."
>
> "Why should any human being agree to be tagged?"

While we were almost able to reach our target of 100 attendees with tags by the end of the first full day of the conference, we were surprised by the reaction of the attendees and the resistance from many to receiving a tag, leading us to believe that a full-scale deployment of conference badges with RFID tags, although providing many added benefits to the attendees, would probably not be very well accepted. However, given that the purpose of this experiment was to understand the feasibility of using RFID in conference badges, the system established that the technology has the capability of providing additional services.

The panel members and the audience discussed several new potential services that can result from the adoption of RFID in conferences. Some of the services that can be provided by "RFID-enabled" conferences include:

- Automated session attendance counts
- Identifying current session attendees at each session entrance
- Automated lunch/dinner head counts, including automated computation of number of vegetarian or special meals required
- Ensuring only authorized persons can access special conference areas such as Internet Café and placement areas.
- Checking for proper access at cyber-café and other restricted locations

- History of session attendance (persons needing conference attendance credit can especially benefit from this facility)
- Automated exchange of contact information for attendee visits to exhibits
- E-mail of session presentations to attendees
- Text message of room directions and other useful information to attendees
- Approximate locating of attendees; i.e., where was Dr. Smith seen last?
- Finally, as suggested by one of the attendees during Panel 2, the RFID session counts can be shown in real-time at the registration area to show the attendee counts at current sessions, displaying sessions that are attracting large crowds for future use by conference organizers to generate further interest in attendance.

If nothing else, as was experienced at AMCIS 2007, RFID tags can be a great conversation starter!

IV. CONCLUSION

The two panels provided several insights into the future of RFID technology in supply chain, retail and services industries. However, the panels demonstrated that there are several areas of problems and concerns that need to be resolved before the promise of the technology can be fulfilled. The most challenging issue in the business viability of RFID is the determining which businesses can achieve a positive return on investment from its use. Security and privacy issues are proving to be difficult stumbling blocks for widespread adoption of the technology. In applications such as conference attendance management, such issues are becoming more pertinent.

In the AMCIS experiment, it was clear that a significant fraction of attendees were worried about the privacy aspects of the technology, in spite of the very scaled-down nature of the experiment. The question naturally arises as to why highly educated academic individuals, most of whom have a terminal degree, would be hesitant about having a tag. Obviously, if we as researchers cannot resolve the privacy concerns and appreciate the benefits of RFID technology, we cannot expect that general consumers will be able to accept the technology any more easily. Already, everyday technology such as mobile phones can be used by providers and others as tracking devices. Most mobile phones built after 2001 have a built-in GPS chip that enables emergency personnel to locate the physical origin of a call. Yet this hasn't stopped us from using mobile phones. Every day we visit banks, grocery stores and other buildings with closed-circuit TV cameras and other monitoring devices. Most department stores and other businesses can use customers' credit cards and loyalty cards to monitor buying habits, but such monitoring has been accepted as a normal part of life. Will consumers accept the benefits from RFID tagging of consumer goods, packages, and even consumers themselves? This question must be addressed for RFID technology to succeed, and it will play a significant role in fulfilling RFID's promise.

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LIST OF ACRONYMS

RFID	Radio Frequency Identification
ERP	Enterprise Resource Planning
WWW	World Wide Web

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