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Consumer Opinions and RFID Implementation

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Abstract

Radio frequency identification (RFID) has been in use for a number of decades tracking various products and materials in a wide range of industries.

The objective of this study was to find simple factors and relationships explaining the usage of Internet shopping and online banking, and the attitudes toward RFID in hospitals. The question being addressed is whether the general population is accepting of the technology application in the tracking of patients and their medical histories in a hospital environment. A randomly selected survey of the population in the Midwest was taken to examine relationships between privacy attitudes and behaviors of consumers and support for RFID in hospitals.

Results from the survey showed that privacy is a significant concern among consumers today and provides an insight to opinions and behaviors that should be considered before implementing RFID tagging in the hospital environment.

Background of RFID Technology

Radio frequency identification (RFID) was developed in the 1940s and has been recently used to track various assets and products in a range of industries. RFID has been used to track where products have been made, shipped, and sold, making inventory management a lot easier. Radio frequency identification involves placing a special chip or tag in the desired product, which contains specific information identifying that product. The RFID chip can then be scanned to reveal the encoded information.

An RFID system consists of several components: a tag, an antenna, a reader, and a software network to interpret tag information. The tag is placed on an item with an antenna connected to the tag. A reader transmits the radio frequency waves, and the data is reflected back. The reader interprets the tag information. The reader is linked to a network database that holds all pertinent tag information for reference (Floyd 1993).

There are three different types of RFID tags: passive, active, and semi-active (Peter 2008). Passive tags are the most common type of RFID tag. They are the least expensive to manufacture and do not contain batteries. When the reader scans the tag, the electromagnetic waves from the reader turn on the power within the tag, which reflects information back to the reader.

Active tags contain an internal battery. The advantages of a battery are that the tag can broadcast continuously and can transmit signals further. Disadvantages include a shorter lifespan and a higher cost to manufacture. Semi-active tags also contain batteries. The batteries only power the circuit after it is energized by the reader. Electronic toll devices (which let people drive through toll booths without stopping) are a good example of semi-active RFID tags (Peter 2008).

Each type of RFID tag can have one of two types of tag memory. Class 0 tags contain read-only memory, whereas class 1 tags contain read/write memory. Smaller tags with smaller amounts of memory can be used on small products, and larger tags with larger memory capability can be used to label larger products or shipping containers (Peter 2008).

BACKGROUND OF RFID TECHNOLOGY

Many stores and manufacturers currently use a bar code system, the most common form of product tracking in the United States (Peter 2008). Products are labeled with bar codes that reveal pertinent information regarding that product when scanned. The current bar code system is very cost effective, but has some deficiencies when compared to the RFID technology. Bar codes must be individually read by a scanner, which requires the bar code to be 100% visible and may need them to be oriented a certain way. RFID technology would allow products to be scanned quickly all at the same time, whether or not the chip is visible (Peter 2008). Theoretically, under a RFID system a cashier at a grocery store could scan all items in a shopper's cart at the same time without removing any of the items. Another disadvantage of the bar code system is that they do not single out individual items. All items of the same type and size (a brand of shampoo, for example) would have the same bar code. An RFID chip allows all items to be marked and tracked individually, so the plant and production date could be identified (Peter 2008). This could be particularly useful if all products made at one plant on a single day are recalled by the manufacturer.

If RFID technology has all these advantages over the bar code system, why is it not more widely used? The main reason is the cost of RFID tags. In 1993, there were several different types of tags with costs ranging from $1 to $20 per tag (Floyd 1993), and tagging inexpensive consumer products was not cost effective. (Tags are cheaper today, but still too expensive). For example, it would be very inefficient to use $1 RFID tags to track individual candy bars, which typically sell for a price of less than $1. The cost of the tags has fallen to below 10 cents each for some applications (in large quantities). This cost, along with the other infrastructure, is still too expensive for some applications.

Another problem concerns liquid and metal products. Some RFID tags are difficult to scan on liquids or metal-encased products, such as a can of soda. This could pose problems for many items sold in a grocery store.

RFID Applications

RFID tags can be used in many different ways across many industries. Tags could be placed on meat and vegetables at the production site, making it possible to trace packaged products back to the farm from which they originated. If a product was defective, the problem could be tracked, and all foods coming from the same place could be safely identified and removed from stores (Peter 2008). Not only could RFID chips be placed on processed meat, but it could go as far back as tagging the originating animals themselves. When scanned, the chip could report pertinent information about the animal, such as its date of birth, any medical records, or where the animal came from. These RFID chips can be used on any food or nonfood items, tracing them back to the source (Peter 2008).

RFID tags are currently being used on automated toll collection systems throughout the United States. When passing through a toll, the car is scanned for a "speed pass" and the reader identifies what car just drove through and who to bill for the toll (Brewin 2002).

RFID can be used practically anywhere and on anything. It can be used to track airline baggage, allowing for easier traveling. RFID tags in keys that are read by the automobile ignition switch make it more difficult to steal cars. Cars could be identified and matched with their correct owners, or a driver can have a refueled car automatically billed to their credit card just by scanning an RFID tag in their car that contains their personal billing information (Brewin 2002). Tags can be used to track people, too. For instance, tags on identity passes or inserted under the skin can be used to track the movements of people in buildings or granting access to authorized rooms.

The benefits and issues surrounding RFID are illustrated in the following section describing the application of the technology in the medical industry.

RFID in Hospitals

One promising application of RFID technology is within the medical field, where RFID tags could be used in hospitals and other medical facilities. Recently, tags have been employed in emergency departments and surgical centers, where medical equipment is tagged in order to be located quickly (Fisher and Monahan 2008). Drugs can also be tagged in pharmacies in order to reduce errors in prescription distribution and reduce drug counterfeiting.

The tagging of each individual patient is a major promising application for RFID in hospitals and other medical facilities. An RFID tag could be placed on the patients' wristband, containing specific information pertaining to that individual. Because wristbands could drop off or be removed, an RFID chip can be inserted under the skin of a patient's arm or hand without leaving any visible marks (Swartz 2005). Each tag would contain a specific number identifying that patient, and could also include important information, such as blood type, allergies, and prior treatments. When scanned, the patient's number would appear, and the physician could then look up the medical records matching the patient's RFID tag number.

Placing RFID chips on or in patients reduces the chance of procedure errors within a medical facility; however, many patients may feel uneasy about implementing a microchip into their skin, even if only certain medical professionals would have access to the readers.

Nonpermanent chips could also be placed on the skin surface of certain patients. Along with tagging a patient's wristband, an RFID chip could be adhesively placed on any part of the patient's body (Gawel 2004). This could be useful for patients prior to surgery. For example, if a patient were to come in for knee surgery, a member of the medical staff would gather all of the patient's information (name, date of birth, date of surgery, type of surgery, surgeon's name, etc.) and place it on the RFID chip. The information would be confirmed by the patient, and the chip would be adhesively placed where the surgery would be taking place, in this case on the patient's knee. The surgeons would scan the chip with a reader to cross check the surgical information with the patient's charts and medical records. Unlike handwriting, which could be illegible, the reader would produce typed script that would be easy to read and interpret (Gawel 2004).

Medical facilities could benefit from RFID technology in several major ways. RFID systems can help facilities collect data in real-time and track the location of patients as well as staff, improving "workflow management" (Katz and Rice 2009). Additionally, RFID tags attached to patients could allow staff monitoring of patients' vitals, such as blood pressure and heart rate, in real-time therefore reducing the need for employees to physically record the data (Katz and Rice 2009). All of this can significantly reduce hospital operating costs.

Using this radio frequency identification technology in hospitals or other medical facilities is a very new concept and is not very well known. In November of 2007, a survey was sent out and collected from 382 hospitals in California, including 350 identifiable hospital CEOs, to see whether or not these hospitals were using, planning to use, or not planning to use current RFID technology in any way (Mogre 2009). Only 6.1% had RFID technology fully implemented into their hospitals, meaning the hospitals have adopted the use of this technology is some way, and about 15% were in the process of implementing the technology. About 45% of the respondents were taking the technology into consideration, and 18.2% acknowledged that they knew nothing about RFID technology (Mogre 2009). These numbers are quite low, illustrating that in order for RFID technology to become more utilized the technology and its benefits should be better communicated to medical institutions and user concerns addressed.

There are several perceived barriers to implementing RFID in the medical industry. Implementation of RFID can add complexity to the training and monitoring of the staff responsible for a safe and helpful environment. Also, the hospital needs to decide and monitor who would have access to the RFID databases.

One of the most significant barriers is the amount of work, expense and time to fully employ this new technology. A good example is the recent transformation of paper medical records to electronic medical records (EMRs) which allow for the staff to access medical records using computers rather than paper records (Miller and Tucker 2009). In 2005, a little less than half of the hospitals in the United States had adopted the new EMR system, which had actually been developed

as far back as the 1970s (Miller and Tucker 2009). If hospitals and other medical facilities were to execute this new RFID technology, it would take years to implement.

A recent national public opinion survey of 1,404 Americans showed that there are several concerns involving RFID, but these concerns are not a barrier to all applications of the new technology (Katz and Rice 2009). Inserting the chip into the body may raise concern, but evidence from this survey suggests that the nonpermanent, adhesive attachment of RFID devices to the body are not viewed as objectionable by much of the public. It would be wise to consider public opinion when making important decisions regarding this new radio frequency identification technology.

In order for RFID technology to become popular within the medical field, implementation would have to start out in small steps. Using RFID to track hospital equipment and inventory is starting to become standard in several facilities. By introducing this system into more facilities, RFID familiarity will rise and other applications may be seen. After the medical staff becomes familiar with the technology, hospitals can implement RFID in more places, which could cause more privacy concerns. It would be a slow process, but could lower costs and improve service quality in the long run.

Privacy Concerns

One main concern involving RFID is privacy, particularly in the United States. Technology has moved the physical presence to electronic storage and transmission. Paper statements have been replaced with online statements, along with the transition to online bill payments, online purchases, and online banking. Those concerned with their privacy might feel uneasy about having more of their personal information online, not knowing exactly who can access it. RFID is a similar technology that raises concerns with the public about whether information should be collected and who can access what type of personal information.

Those concerned with privacy are less likely to be open to the idea of implementing RFID technology throughout various industries. There can be many influences on how the privacy issue is viewed. Age and demographics, such as number of children in a household may influence how a person feels about privacy. Those who are older and have not grown up with the Internet may be more cautious of putting and viewing their personal information online. In order for RFID to be employed into our culture, privacy has to be taken into consideration and RFID reader and database access probably needs to be strictly monitored to ensure privacy with all of those involved.

RFID would take privacy to the next level. Who would be allowed to access the information read on the tag? As data collected from RFID tags accumulates, who would have access to those databases? Would the consumer or only authorized officials be allowed this access? All of these factors would have to be looked at separately depending on what type of product or person is involved with the implemented RFID system.

Online privacy has become a major concern in the United States because of the many technological advancements with computers and consumers. Several transitions from brick and mortar and paper to the Internet are examined in detail below in the areas of online shopping and banking.

Online Shopping

Many companies have transitioned to using websites and online billing as a means of easier communication with consumers. With this changing technology, some consumers find it easier to use the Internet in order to shop and make purchases online, straight from their own home.

Online privacy is an issue that can be difficult to resolve. It can be fairly unsettling to release personal information online, not knowing exactly who is going to read it. Online websites are now able to track browsing history and companies can compile behavioral patterns in order to tell what types of products (at what prices) each person is interested in. One survey showed that about 80% of the people surveyed thought it should be illegal for online marketers to trade or sell information belonging to the website's visitors without their permission (Alreck and Settle 2007). Marketers also utilize browsing and purchasing history to see how much consumers are willing to pay for certain items online. The same survey showed that about 79% of the people said they would be upset if they found out other online shoppers were getting better deals from the same website in the same time period than they were (Alreck and Settle 2007).

Many studies have shown that the solution to online privacy is not as simple as just enhancing privacy policies on websites to increase online purchasing behaviors (Miyazaki and Fernandez 2001). These policies are helpful, but many people are still wary of releasing personal information via the Internet. Internet technology has advanced, and so has the ability to hack into software and steal personal information.

Privacy concerns stemming from online shopping rose in 2007, according to a recent study by the University of Southern California's Center for the Digital Future, as the loss or theft of credit card and other personal data grew to record levels (Jesdanun 2008). The Identity Theft Resource Center reported that more than 125 million records were compromised in the United States in that same year. In that study, 61% percent of adults in the U.S. said they were very or extremely concerned about the privacy of personal information when buying online, an increase from 47 percent in 2006 (Jesdanun 2008). Prior to 2007, that number had been dropping every year.

Many people may be skeptical of giving out personal information online, but how many of these people actually refuse to use the Internet for every purchase? Han and McLaurin surveyed 350 people nationwide to see their attitudes towards Internet privacy (2002). Only about 34% of these people stated that perceptions of their privacy and lack of control on the Web prevented them from purchasing online. However, four fifths of the 34% reported previous online purchases (Han and McLaurin 2002). Therefore, skepticism about online privacy, in most of the cases, does not appear to completely eliminate online purchasing and browsing.

Several surveys have shown that Internet experience may lead to lower risk perceptions regarding online shopping and fewer concerns regarding system security (e.g., Kim, Ferrin, and Rao 2007). The more someone has used the Internet, the more likely they are to release certain information in order to conduct business online. There are also those who are aware of privacy policies, and because they are experienced users, are able to decide for themselves which websites to trust based on their privacy policies.

In recent years, shopping online and using online banking services have become the norm among younger generations who have grown up with this fairly new technology. About 93% of college students regularly use the Internet (Drennan, Mort, and Previte 2006). Universities have increased the use of the Internet in classrooms. Online classes are frequently available, as well as online teaching aides for professors, and quizzes or tests can be taken online instead of in a classroom which allows for more in-class learning time for the students. The students who use the Internet on a regular basis, therefore, are more likely to feel more comfortable using the Internet for other activities, such as browsing and shopping online.

In 2006, a sample of 76 young adults, aged 18-25, was surveyed on how they used the Internet (Drennan, Mort, and Previte 2006). About 54% of this sample had purchased goods or services over the Internet, whereas the population average was only 10%. This shows that younger generations are more likely to use the Internet for shopping or other online services. In addition, 80% of this sample had, at some point, subscribed to commercial or government websites by exchanging personal information for free services (Drennan, Mort, and Previte 2006).

Online Banking Services

Technology in this world is rapidly increasing, and more and more uses for the Internet are becoming available. Online banking is one example, and it is becoming more and more popular each year. Consumers find it convenient to handle their finances from their own home, and being able to pay for all of their bills at one time without having to write a check for each invoice and send it in the mail. All transactions are shown online, with no need to balance a checkbook. One survey states that 71% of their survey respondents reported that they were "very satisfied" with their online banking services (Longobardi and Raab 2004).

Online banking has been the fastest growing e-banking technology within the past decade (Bell, Hogarth & Robbins 2009). In 1995, only less than 5% of consumers were banking online, compared with 53% in 2007. Not only has there been an increase in the number of consumers using online banking, but there has also been an increase in the number of consumers paying their bills online. In 2003, only 32% of households reported banking online, and 55% of those were paying bills online. By 2006, 51% reported banking online, and 76% of those were paying bills online (Bell, Hogarth & Robbins 2009).

Many people have switched to online banking, but many are still concerned about their personal information. A checking account number, credit card number, and other personal information can all be found on one website with only a name and password as protection. Although online banking services strive to ensure customer privacy, the consumer has no idea who can view this information.

Privacy attitudes and trust in companies plays a major role when making decisions. Consumers must feel that they are able to trust a company with his or her personal information before doing business with them. Implementing RFID technology within a company could add a risk, threatening a consumer's privacy (Tsarenko and Tojib 2009). Consumers may feel uneasy about potentially having their purchased histories tracked. Consumer privacy behaviors and attitudes are not something to overlook when considering RFID technology. Most consumers need to be able to trust and rely on the company when giving up personal information.

Hypotheses

The objective of this study was to find simple factors and relationships explaining the usage of Internet shopping and online banking, and the attitudes toward RFID in hospitals.

Regarding RFID technology, it was hypothesized that those who are familiar with recent technologies will most likely also be accepting of RFID technology in connection with capturing personal information. It was also hypothesized that since RFID can have an impact on consumer privacy, those most concerned with how their personal information is handled may not agree with the implementation of RFID in hospitals.

Regarding Internet applications, it was hypothesized that those who routinely work with other recent technologies are more likely to make purchases online and use online banking services. It was also hypothesized that those who are most concerned with revealing too much personal information will most likely resist shopping online and using online banking services.

These hypotheses will be studied from a survey sent out to a random selection of United States consumers. Specific demographics will also be examined to see if relationships exist regarding opinions on RFID usage in hospitals, online privacy, and online banking services.

Methodology

A consumer survey was mailed out to a random sample of a total of 4,900 people living in Michigan, Illinois, and Indiana. The purpose of the survey was to see if there were any relationships among consumers concerning attitudes toward RFID usage in hospitals, online banking services, and shopping and purchasing items online. About 6.44% were returned with incorrect addresses. Dollar bills were placed in 450 of the envelopes to see if the money would give an incentive to return the completed survey. About 22% of these surveys were completed and returned. A small, hand written sticky note placed in another 450 envelopes (thanking the consumer for filling out the survey) was used as another incentive. Only 6.6% of these surveys were completed and returned. No incentive was sent out in the remaining 4,000 surveys. These surveys had a 5.8% return rate. This suggests that the "sticky" note did not significantly impact on completing surveys. All together, 339 total responses were mailed, and out of these responses about 277 were useable. A copy of the survey can be found in Appendix A.

The survey consisted of questions regarding distribution of consumer personal information, online and consumer privacy, and opinions of hospital RFID usage. Survey responses were entered into an Excel spreadsheet and uploaded into SPSS. These attitude and behavior responses were reduced to three factors each using a Factor Analysis program with Varimax rotation. Probit analysis or linear regression was used to test hypotheses about how attitudes and behaviors are linked.

Survey respondents were asked to rate their support for possible use of RFID tags on medical wristbands or employee badges in hospitals on a scale of 1-7, with 7 being very supportive and 1 being not supportive. Respondents were also asked various questions regarding privacy behavior and attitudes. Questions regarding privacy attitudes were rated on a scale of 1-7, with 7 being "strongly agree" and 1 being "strongly disagree". Questions regarding privacy behaviors were rated on a 1/0 scale, with 1 being yes and 0 being no. These privacy attitude questions were taken from previous studies by Smith, Milberg, and Burke (1996) and Parasuraman and Igbaria (1990). The questions can be found in Table 1.

Abbreviations	Questions
	Privacy Attitudes
P3_1_Ask	When companies ask me for personal information, I sometimes think twice before providing it.
P3_2_Com	Computer databases that contain personal information should be protected from unauthorized access - no matter how much it costs.
P3_3_Anxi	I am anxious and concerned about the pace of automation in the world.
P3_4_Afr	Sometimes I am afraid the data processing department will lose my data.
P3_5_Sel	Companies should never sell the personal information in their computer databases to other companies.
P3_6_Thr	Computers are a real threat to privacy in this country.
P3_7_Err	Companies should have better procedures to correct errors in personal information.
P3_8_Bot	It bothers me to give personal information to so many companies.
P3_9_Ste	Companies should take more steps to make sure that the personal information in their files is accurate.
P3_10_Sha	Companies should never share personal information with other companies unless it has been authorized by the individuals who provided the information.
P3_11_Fru	I am easily frustrated by computerized bills.
P3_13_Aut	I am sometimes frustrated by increasing automation in my home.
P3_14_Ref	People should refuse to give information to a business if they think it is too personal.
	Privacy Behaviors
CellPhone	Do you regularly use a cellular telephone?
BuyPhone	Do you regularly shop and buy items by phone?
Sweeps	Do you regularly enter promotional sweepstakes sponsored by companies?
Card	Do you regularly use a credit or debit card for making purchases?
Remove	Have you asked a firm to remove you from their mailing list in the last year?
DoNotCall	Have you joined a "Do Not Call" phone list to reduce unwanted calls?
NotBuy	Have you decided to not purchase an item from a firm or not use their services because of their privacy policy (i.e. the way they use personal information)?
Shredder	Do you regularly destroy personal documents using a paper shredder?
Banking	Do you regularly use on-line banking services?
Internet	Do you regularly shop and buy items on the internet?

Table 1

Results of Survey

RFID in Hospitals Survey Results

Three factors were formed based on opinions of people who responded to the questions on RFID usage in hospitals. Each factor contained several consumer behaviors concerning these opinions, which were all addressed in the same fashion. Those who had a negative opinion on one behavior were most likely to have a negative opinion on the remaining behaviors in the same factor. The factors, after Varimax rotation, can be found in Table 2. To determine which behavior belongs in each factor, the highest coefficient is chosen (shown in bold). The first factor contained the consumer behavior concerns about the pace of automation in the world, loss of data by the data processing department, computers being a threat to privacy in this society, and increased frustration with automation and computerized bills in the home. The second factor was concerned with the permission of unauthorized users given access to computer databases containing personal information, the selling of personal information between companies, better procedures in error correction and accuracy regarding personal information, and companies receiving permission by the individual to share their personal information. The third factor was concerned with thinking twice before giving out personal information, giving personal information to many companies, and refusing to give out too much personal information.

Table 2 – Factors after Varimax Rotation

	Component		
	1	2	3
P3_1_Ask	.061	.152	**.685**
P3_2_Com	.085	**.729**	-.091
P3_3_Anxi	**.764**	.168	.095
P3_4_Afr	**.601**	.212	.219
P3_5_Sel	.088	**.580**	.071
P3_6_Thr	**.612**	.302	.245
P3_7_Err	.274	**.622**	.224
P3_8_Bot	.384	.275	**.629**
P3_9_Ste	.221	**.680**	.199
P3_10_Sha	-.094	**.563**	.258
P3_11_Fru	**.802**	-.014	.070
P3_13_Aut	**.870**	-.002	-.018
P3_14_Ref	.090	.046	**.742**

The ten behavior questions regarding the opinions of the privacy of consumer personal information was put through a second factor analysis. Three factors were found. Varimax rotation results are shown in Table 3 below. The largest coefficients determined the grouping of the factors, which are shown in bold.

Table 3 – Varimax Rotation Results

	Component		
	1	2	3
CellPhone	**.554**	-.047	.005
BuyPhone	.208	.113	**.634**
Sweeps	-.139	-.060	**.778**
Card	**.700**	.036	.083
Remove	.036	**.749**	.124
DoNotCall	.183	**.621**	-.046
NotBuy	-.171	**.702**	.172
Shredder	.126	**.444**	-.117
Banking	**.696**	.277	-.145
Internet	**.739**	.082	.070

The first factor contained the consumer behavior opinions about regularly using a cellular phone, using a debit/credit card for making purchases, purchasing items using the Internet, and the usage of online banking. The second factor contained the behavior opinions about being removed from mailing lists, joining a "Do Not Call" phone list, not purchasing items from a company based on their privacy policy, and the regular use of a shredder to destroy personal documents. The third factor contained opinions regarding purchasing items over the phone and regularly entering promotional sweepstakes.

These factors and other demographics were used as variables in a linear regression with the dependent variable of support for RFID in hospitals. Table 4 shows the coefficients and standard errors for the factors and demographics. The significant coefficients at up to 10 percent level are shown in bold.

Interpretation

Those with post college education or an advanced degree tended to disagree with the usage of RFID on wristbands and employee badges in hospitals. On the other hand, people who rent where they live seem to have a more positive opinion, agreeing with the usage of RFID in hospitals. Other demographics were not significant. Table 4 also has significant negative coefficients for "REGR factor score 1 for analysis 1" and "REGR factor score 1 for analysis 2," although there was also a high correlation of 0.36 between these two factors. These behaviors can be found in Table 2: component 1, and Table 3: component 1, respectively. By looking at Table 2: component 1, it can be determined that those concerned about the pace of automation in the world, loss of data by the data processing department, computers being a threat to privacy in this society, and increased frustration with automation and computerized bills in the home most likely disagreed with RFID usage in hospitals. By looking at Table 3: component 1, it can be determined that those who regularly used a cellular phone, used a debit/credit card for making purchases, purchased items using the internet, and used online banking also disagree with the usage of RFID in hospitals.

Those with some type of post college education may have more knowledge on RFID technology or the practices of personal information collection, and therefore may feel uncomfortable

with the idea of being tracked. More research would have to be done on this demographic to find out what type of post college educated people disagree with the use of RFID in hospitals.

It is not surprising that those in Table 2: component 1 disagree with the use of RFID in hospitals. They are already concerned with privacy and an increase in automation. An increase in the use of RFID in hospitals would most likely add on to their concerns. It is surprising, however, that those in Table 3: component 1 disagreed with RFID in hospitals. This group is comfortable using cell phones, credit cards, Internet and other sources of technology. It is surprising that these people would disagree with the use of RFID technology in hospitals because of their familiarity with other forms of technology.

Table 4 – Coefficients & Standard Errors for Factors and Demographics

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	6.379	.681		9.368	.000
Female	-.148	.243	-.039	-.610	.543
Age35_44	-.087	.325	-.022	-.269	.789
Age45+	-.433	.322	-.114	-1.345	.180
SingleSepDiv	-.285	.325	-.072	-.877	.382
Adult2+	.086	.350	.019	.245	.807
NoKids	-.012	.258	-.003	-.046	.963
ThreeKids+	-.311	.370	-.055	-.842	.401
YesRelig	-.219	.236	-.058	-.929	.354
SomColDeg	-.426	.364	-.110	-1.173	.242
PostColl	-.713	.430	-.164	-1.659	**.098**
Renter	.542	.325	.119	1.669	**.096**
Nonwhite	-.142	.363	-.025	-.390	.697
Incom2	-.266	.385	-.062	-.691	.490
Incom3	-.011	.433	-.003	-.026	.979
Incom4	-.233	.439	-.057	-.531	.596
REGR factor score 1 for analysis 1	-.391	.124	-.207	-3.150	**.002**
REGR factor score 2 for analysis 1	.145	.117	.077	1.245	.214
REGR factor score 3 for analysis 1	-.139	.121	-.074	-1.150	.251
REGR factor score 1 for analysis 2	-.334	.132	-.177	-2.534	**.012**
REGR factor score 2 for analysis 2	-.068	.126	-.036	-.538	.591
REGR factor score 3 for analysis 2	-.068	.116	-.036	-.583	.560

Online Shopping Privacy Survey Results

Once again, factor analysis and Varimax rotation were used to form three factors based on opinion privacy attitudes and on privacy behaviors. Because some people did not answer the RFID in Hospitals question, they were excluded from the prior analysis and included in this analysis. As shown in Table 5 below, it can be determined that the first factor contained the consumer behavior concerns about the pace of automation in the world, loss of data by the data processing department, computers being a threat to privacy in this society, and increased frustration with automation and computerized bills in the home. The second factor was concerned with the permission of unauthorized users given access to computer databases containing personal information, the selling of personal information between companies, better procedures in error correction and accuracy regarding personal information, and companies receiving permission by the individual to share their personal information. The third factor was concerned with thinking twice before giving out personal information, giving personal information to many companies, and refusing to give out too personal information.

Table 5 – Factors after Varimax Rotation

	Component		
	1	2	3
P3_1_Ask	.062	.152	**.696**
P3_2_Com	.092	**.707**	-.065
P3_3_Anxi	**.764**	.176	.079
P3_4_Afr	**.611**	.239	.171
P3_5_Sel	.064	**.604**	.042
P3_6_Thr	**.622**	.308	.222
P3_7_Err	.270	**.625**	.181
P3_8_Bot	.416	.282	**.597**
P3_9_Ste	.223	**.689**	.160
P3_10_Sha	-.094	**.546**	.278
P3_11_Fru	**.799**	-.025	.076
P3_13_Aut	**.867**	-.030	-.003
P3_14_Ref	.092	.012	**.735**

The remaining behavior questions regarding the opinions of the privacy of consumer personal information was put through a second factor analysis, this time excluding the question of online shopping. Varimax rotation results are shown in Table 6 below. The largest coefficients suggest which questions are most important in each factor, and are shown in bold.

Table 6 – Varimax Rotation Results

	Component		
	1	2	3
CellPhone	-.078	**.659**	.051
BuyPhone	.131	.230	**.646**
Sweeps	-.063	-.163	**.761**
Card	.055	**.729**	.080
Remove	**.749**	.019	.120
DoNotCall	**.597**	.216	-.008
NotBuy	**.699**	-.191	.160
Shred	**.462**	.117	-.160
Banking	.258	**.678**	-.140

The first factor contained the consumer behavior opinions about being removed from mailing lists, joining a "Do Not Call" phone list, not purchasing items from a company based on their privacy policy, and the regular use of a shredder to destroy personal documents. The second factor contained the behavior opinions about regularly using a cellular phone, using a debit/credit card for making purchases, and using online banking services. The third factor contained opinions regarding purchasing items over the phone and regularly entering promotional sweepstakes.

The question regarding online shopping asked the consumers whether or not they regularly shop and buy items using the Internet. Results from the survey indicated that about 55% of consumers that mailed back the survey currently do use the Internet to shop and purchase items online.

Probit analysis was used to estimate which variable may be related to the probability that someone shopped online.

Table 7 shows the probit analysis results with the factors and specific demographics. Those who regularly attend religious services at least once a month were less likely to shop and purchase items online. Those who have had some college education or advanced degree were less likely to use the Internet for shopping and purchases. Consumers who make more than $90,000 a year were more likely to use the Internet to shop and make purchases. Table 7 also has significant coefficients for FAC1_1, FAC2_1, FAC1_3, and FAC2_3, although there was also a high correlation between some of these two factors. These behaviors can be found in Table 5: component 1, Table 5: component 2, Table 6: component 1, and Table 6: component 2, respectively.

Table 5: component 1 was significant, so those concerned about the pace of automation in the world, loss of data by the data processing department, computers being a threat to privacy in this society, and increased frustration with automation and computerized bills in the home were less likely to shop online. This group of people was also less likely to support RFID in hospitals. Table 5: component 2 shows that people concerned with the permission of unauthorized users given access to computer databases containing personal information, the selling of personal information between companies, better procedures in error correction and accuracy regarding personal information, and companies receiving permission by the individual to share their personal information tended to not use online shopping and purchasing.

Table 6: component 1 was significant, so those concerned about being removed from mailing lists, joining a "Do Not Call" phone list, not purchasing items from a company based on their privacy policy, and the regular use of a shredder to destroy personal documents were users of online shopping and purchasing. By looking at Table 6: component 2, it can be determined that those that regularly use a cellular phone, use a debit/credit card for making purchases, and use online banking services are more likely to also use the internet to shop and purchase items.

Interpretation

The results showed that those who attend religious services at least once a month are less likely to shop online. Some religions do not agree with the use of technology because they believe it takes focus away from their higher deity. Those with an income of over $90,000 per year are more likely to shop online because time may be worth more than money to this demographic. It was not surprising that those in Table 5: component 1 and Table 5: component 2 were less likely to shop online. Those who are frustrated with computerized bills and increased automation in their home are less likely to advance to another new technology and purchase items using the Internet. Likewise, those who are concerned about who can access their personal information are also less likely to purchase items online, afraid of revealing too much personal information.

The findings that those who regularly use credit cards and cellular phones also are more likely to purchase items online was expected. These people already use some of the latest technology and would not be afraid to increase their use of technology by shopping online. It is a little surprising, however, to find that those who did not purchase items from a company based on their privacy policy and who regularly used a shredder to destroy personal documents are more likely to shop online. These people are concerned with revealing their personal information to those who are unauthorized to view it, and it would be expected that they would feel uncomfortable revealing this information to online stores, but results indicate that they in fact, are more likely to shop online. Further work is needed to learn if the correlation between the factors is contributing to this result.

Table 7 – Probit Analysis with Factors & Demographics

	B	S.E.	Wald	df	Sig.	Exp(B)
FAC1_1	-.604	.176	11.78	1	**.001**	.546
FAC2_1	-.335	.164	4.198	1	**.040**	.715
FAC3_1	.071	.168	.176	1	.675	1.073
FAC1_3	.322	.174	3.415	1	**.065**	1.380
FAC2_3	1.339	.253	27.930	1	**.000**	3.815
FAC3_3	.168	.163	1.073	1	.300	1.183
Female	-.368	.340	1.172	1	.279	.692
Age35_44	.124	.444	.078	1	.780	1.132
Age45	-.008	.430	.000	1	.986	.992
SingleSepDiv	-.041	.455	.008	1	.928	.960
Adult2	-.553	.480	1.324	1	.250	.576
NoKids	.345	.357	.932	1	.334	1.411
ThreeKids	.206	.491	.175	1	.675	1.228
YesRelig	-.612	.332	3.412	1	**.065**	.542
SomeColDeg	-.966	.543	3.170	1	**.075**	.380
PostColl	-.375	.626	.358	1	.550	.687
Renter	.286	.464	.380	1	.537	1.331
Nonwhite	.910	.557	2.664	1	.103	2.484
Incom2	.469	.570	.676	1	.411	1.598
Incom3	.943	.625	2.274	1	.132	2.567
Incom4	1.126	.632	3.175	1	**.075**	3.084
Constant	.622	1.006	.382	1	.536	1.863

Online Banking Survey Results

The factor analysis and Varimax rotation was once again used to determine three more factors correlating with consumer behaviors on privacy, this time excluding the question of online banking. Results are shown in Table 8, and factor groups are shown in bold.

Table 8 – Varimax Rotation Results

	Component		
	1	2	3
CellPhone	-.016	**.634**	-.077
Internet	.091	**.724**	.086
BuyPhone	.149	.261	**.583**
Sweeps	-.098	-.164	**.824**
Card	.077	**.718**	.057
Remove	**.762**	.037	.098
DoNotCall	**.604**	.163	-.006
NotBuy	**.694**	-.205	.165
Shred	**.459**	.109	-.131

The first factor contained the consumer behaviors involving being removed from mailing lists, joining a "Do Not Call" phone list, not purchasing items from a company based on their privacy policy, and the regular use of a shredder to destroy personal documents. The second factor contained the behaviors involving regularly using a cellular phone, using a debit/credit card for making purchases, and purchasing items using the Internet. The third factor involved purchasing items over the phone and regularly entering promotional sweepstakes.

The question regarding online banking asked the consumers whether or not they currently use online banking services. Results from the survey indicated that about 64% of consumers that mailed back the survey currently do use online banking services.

Table 9 shows the results of a probit analysis with demographics and factors as independent variables. Those with two or more adults living in the household seemed to be more likely to use online banking. On the other hand, people who rent the space in which they live were less likely to use online banking.

Table 9 also has significant coefficients for FAC1_1, FAC1_2, and FAC2_2, although there was also a high correlation between some of these two factors. These behaviors can be found in Table 5: component 1, Table 8: component 1, and Table 8: component 2, respectively. By looking at Table 5: component 1 it can be determined that those concerned about the pace of automation in the world, loss of data by the data processing department, computers being a threat to privacy in this society, and increased frustration with automation and computerized bills in the home were less likely to use online banking services. By looking at Table 8: component 1, it can be determined that those who tend to request being removed from mailing lists, who joined a "Do Not Call" phone list, who do not purchase items from a company based on their privacy policy, and who regularly use a shredder to destroy personal documents seemed to use online banking services. By looking at Table 8: component 2, it can be determined that those that regularly use a cellular phone, use a debit/credit card for making purchases, and purchase items using the internet were very likely to use online banking.

Interpretation

The results showed that households containing two or more adults were more likely to use online banking services. A married couple might find it easier to handle their collective finances together at home rather than separately traveling to the bank. On the other hand, the results showed that renters were less likely to use online banking services. One possible explanation would be that renters may not have access to the Internet or are not able to receive an Internet connection in their rented space. This would require the inconvenience of using computers elsewhere.

As before, it is not surprising to find that those who are concerned with the pace of automation in the world and who find computers as a threat to privacy are also not likely to use online banking services. It is also not surprising to find that those who do use technology, such as cellular phones and credit cards are more likely to use online banking. As expected, those who use online shopping are also more likely to use online banking services.

As with online privacy, it is also surprising to find that those who are concerned with revealing their personal information to those who are unauthorized to view it and who regularly

shred personal documents are more likely to use online banking services. It would be expected that they would not feel comfortable revealing this information to online banking services, but results indicate that they in fact, are more likely to use online banking.

Table 7 – Probit Analysis with Factors & Demographics

	B	S.E.	Wald	df	Sig.	Exp(B)
Female	.137	.338	0.164	1	.685	1.147
Age35_44	.574	.450	1.632	1	.201	1.776
Age45	-.404	.428	.890	1	.345	.668
SingleSepDiv	.372	.443	.704	1	.401	1.451
Adult2	.874	.474	3.394	1	**.065**	2.396
NoKids	.159	.354	.201	1	.654	1.172
ThreeKids	.126	.547	.053	1	.818	1.134
YesRelig	-.193	.330	.343	1	.558	.824
SomeColDeg	-.441	.506	.760	1	.383	.644
PostColl	.350	.620	.319	1	.572	1.419
Renter	-.892	.452	3.903	1	**.048**	.410
Nonwhite	-.025	.530	.002	1	.962	.975
Incom2	-.322	.519	.386	1	.535	.725
Incom3	-.404	.586	.476	1	.490	.668
Incom4	.107	.594	.033	1	.857	1.113
FAC1_1	-.379	.174	4.725	1	**.030**	.685
FAC2_1	-.045	.161	.079	1	.779	.956
FAC3_1	.031	.170	.033	1	.856	1.031
FAC1_2	.567	.181	9.833	1	**.002**	1.762
FAC2_2	1.108	.200	30.834	1	**.000**	3.029
FAC3_2	-.095	.167	.320	1	.571	.910
Constant	.368	.954	.149	1	.699	1.445

Conclusion

The objective of this study was to find simple factors and relationships explaining the usage of Internet shopping and online banking, and the attitudes towards RFID in hospitals.

It was expected that those who are most concerned with how their personal information is handled might not agree with the implementation of RFID in hospitals. The survey results agree with this statement. It was found that those who are concerned about the pace of automation in the world, loss of data by the data processing department, computers being a threat to privacy in this society, and increased frustration with automation and computerized bills in the home most likely disagreed with the use of RFID in hospitals. These people are concerned about the current advancement of technology in society and where their personal information is being sent and viewed; therefore, they are more likely to resist implementing yet another new technology into society that could potentially increase their privacy concerns.

It was also expected that those who routinely work with other recent technologies are more likely to make purchases online and use online banking services. The survey results also agree with this statement. In regard to online shopping, it was found that those who regularly use a cellular phone, a debit/credit card for making purchases, and used online banking were also more likely to shop online. In regard to online banking, it was found that those who regularly use a cellular phone, a debit/credit card for making purchases, and purchased items using the Internet were also more likely to use online banking services. These people are current on the many uses of technology in today's society, including using the Internet in some form. By being more familiar with the technology around them, they are more likely to use the Internet for shopping and banking.

It was expected that those who are most concerned with revealing too much personal information will most likely resist shopping online and using online banking services. The results mostly agreed with this statement, with the exception of one surprising finding. As expected, it was found that those concerned about the pace of automation in the world, loss of data by the processing department, computers being a threat to privacy, and increased frustration with automation and computerized bills in the

home were less likely to shop online and use online banking services. These people are wary of where their personal information will end up. This group of people is also frustrated with computerized billing. Using online banking services would just further increase their frustration.

It was also found that those concerned with the permission of unauthorized users given access to computer databases containing personal information, the selling of personal information between companies, better procedures in error correction and accuracy regarding personal information, and companies receiving permission by the individual to share their personal information were not likely to shop and purchase items online. As before, these people are most concerned about where to reveal personal information. Shopping online and using online banking services would increase this privacy concern.

It was surprising, however, to find that those concerned about being removed from mailing lists, joining a "Do Not Call" phone list, not purchasing items from a company based on their privacy policy, and the regular use of a shredder to destroy personal documents were more likely to use online shopping and online banking services. It would be expected that this group of people would not be likely to shop online or use online banking services because of their concerns of releasing personal information. Additional work is needed to make sure that correlations between factors are not influencing these findings.

Lastly, it was expected that those who are familiar with recent technologies will most likely also be accepting of RFID technology in connection with capturing personal information and here we found a different result. Surprisingly, those who regularly used a cellular phone, a debit/credit card for making purchases, purchased items using the Internet, and used online banking services disagreed with the use of RFID on wristbands and employee badges in hospitals. It would be expected that these people would mostly agree with the use of RFID in hospitals. Again, additional work is needed to make sure that correlations between factors are not influencing these findings.

Demographics were also surveyed to see if any other relationships existed. Regarding the use of RFID in hospitals, it was found that those with post college education or an advanced degree tended to disagree with the use of RFID in hospitals. These people may have more knowledge on

RFID technology. They may feel uncomfortable with the idea of carrying tags on their employee badges and being able to be tracked. It was also found that people who rent the space where they live tended to agree more with the use of RFID in hospitals. More research is needed to further explain this demographic relationship.

Regarding online shopping, it was found that those who regularly attend religious services at least once a month were less likely to shop online. Various research has found religiousness as a useful psychographic variable for predicting behaviors. Those with post college education or an advanced degree were also less likely to shop and purchase items online. More research would need to be done to further explain this demographic. Consumers who make more than $90,000 a year were more likely to use online shopping. Time may be worth more than money to this demographic; therefore, they would find it easier to make their purchases online.

Regarding online banking, it was found that those with two or more adults living in one household were more likely to use online banking. A married couple might find it easier to handle their collective finances together at home rather than separately traveling to the bank. On the other hand, renters were less likely to use online banking. One explanation would be that renters might not have access or receive an Internet connection in their rented space. This would require the inconvenience of using computers elsewhere.

These survey results show many of the relationships we expected, and a few that we did not. Privacy concerns in relation to the RFID opinion are important Patients might postpone medical treatments or choose other hospitals that don't use RFID technology if their privacy concerns are not met. Public opinion as it relates to RFID personal tagging acceptance should continue to be studied so that the timing and extent of the RFID system implementation can be properly planned to maximize its chances of success.

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Appendix A – Survey

Radio frequency identification (RFID) is a new technology that assigns unique numbers to things. The numbers are put on chips or tags that are smaller than a grain of rice and that can be read by scanners. By checking a database of these numbers, information about a scanned item can be found. RFID technology is used in key fobs that people wave in front of gas pumps to buy gas, to let some cars pass through highway toll booths without stopping, in car keys so cars check the numbers in the keys before starting, and in credit cards so people wave cards by readers to complete transactions. Some RFID chips contain small batteries and broadcast their numbers over short distances. Others require scanners to be very close and the identifying numbers are reflected back from the chips to the scanners like radar signals. This survey asks for your opinions about potential RFID applications and about other technologies. In the first section, please read about possible RFID applications and rate your interest in or reaction to them.

1. Hospitals are exploring the use of RFID tags in medical wrist bands and employee badges in order to identify where any patient, doctor, or nurse is located whenever that information is needed.

	Very Supportive			Somewhat Supportive			Not Supportive
Please rate your support for this possible use of RFID tags in hospitals	7	6	5	4	3	2	1

2. Trucking companies are considering the use of RFID chips in truck tires so that a scanner can identify the age of each tire and tires that have reached their normal safe lifespan can be replaced.

	Very Supportive			Somewhat Supportive			Not Supportive
Please rate your support for this possible use of RFID tags in truck tires	7	6	5	4	3	2	1

3. Prescription drug manufacturers are considering adding RFID tags to their medication containers to help identify counterfeit drugs and to reduce the likelihood that patients receive the wrong drug.

	Very Supportive			Somewhat Supportive			Not Supportive
Please rate your support for this possible use of RFID tags on drug bottles	7	6	5	4	3	2	1

4. If RFID tags with batteries were added to automobile license plates or car tires, scanners could quickly track stolen cars on the highway and tickets for speeding or for failing to stop at traffic signals could automatically be sent to car owners.

	Very Supportive			Somewhat Supportive			Not Supportive
Please rate your support for this possible use of RFID tags in car license plates and tires	7	6	5	4	3	2	1

5. If RFID tags were added to postage stamps, delivery confirmation would be easier. If a package could not be delivered and the return address was missing, it could be returned to where the postage was purchased and, if the stamps were bought with a credit card, it could be returned to the sender.

	Very Supportive			Somewhat Supportive			Not Supportive
Please rate your support for this possible use of RFID tags in postage stamps	7	6	5	4	3	2	1

	Very Informed			Somewhat Informed			Not Informed
6. Before you started this survey, how would you rate your knowledge about RFID technology	7	6	5	4	3	2	1

7. Retailers are testing the use of RFID tags on individual items in stores. This may help them identify when shelves are close to empty of certain items and may help reduce shoplifting (if they place scanners at exits). If every package had these tags, the store checkout process could be much faster because scanners could quickly identify all the items in carts.

	Very Supportive			Somewhat Supportive			Not Supportive
Please rate your support for this possible use of RFID tags on product packages	7	6	5	4	3	2	1

8. Fruit and vegetable growers could attach RFID tags to their harvest containers to make it simpler to follow their products through the supply chain to supermarkets and restaurants and make it easier to grocers and restauranteurs to highlight the farm source of the produce.

	Very Supportive			Somewhat Supportive			Not Supportive
Please rate your support for this possible use of RFID tags on produce cartons and cases	7	6	5	4	3	2	1

9. If RFID tags are included in packages, it would be possible to design refrigerators that could track products inside and check their expiration dates. Microwave ovens could scan items and automatically use the optimum cooking levels and times. If these tags are in clothing, a washer or dryer could scan the items and wash and dry them in the best way possible.

	Very Supportive			Somewhat Supportive			Not Supportive
Please rate your support for this possible use of RFID readers in appliances	7	6	5	4	3	2	1

10. Livestock farmers are placing RFID tags in animal ear tags which makes it possible to link an animal's number with the RFID code on each meat package. If a problem was discovered with a meat package, it could be traced back to the meat packer and ultimately to the farm where the animal was raised.

	Very Willing			Somewhat Willing			Not Willing
Please rate your willingness to pay a price premium (less than 20-cents per package) for meat that can be traced back to its origin	7	6	5	4	3	2	1

11. If RFID tags were in products, it may be possible for stores to know each shopper's purchase history when they enter a store (if tags were in clothing, shoes, or loyal shopper card) and for someone to scan a shopper's purchases in the parking lot or from outside of their home. Trash could be scanned to learn what a household recently consumed. Consumers could disable RFID tags if an option like a pull tab was added inside of packages. Disabling tags would make returning products to stores more difficult.

	Very Supportive			Somewhat Supportive			Not Supportive
Please rate your support for adding this option to disable RFID tags in products	7	6	5	4	3	2	1

	Very Likely			Somewhat Likely			Not Likely
Please rate how likely you would be use this option to disable most RFID tags in products	7	6	5	4	3	2	1

Here are some statements about *personal information*. From the standpoint of personal privacy, please indicate the extent to which you, *as an individual*, **agree** or **disagree** with each statement by circling the appropriate number.

	Strongly Agree >>>>>>>>>>			**Neutral** >>>>>>>>>>			**Strongly Disagree**
1. When companies ask me for personal information, I sometimes think twice before providing it.	7	6	5	4	3	2	1
2. Computer databases that contain personal information should be protected from unauthorized access – no matter how much it costs.	7	6	5	4	3	2	1
3. I am anxious and concerned about the pace of automation in the world.	7	6	5	4	3	2	1
4. Sometimes I am afraid the data processing department will lose my data.	7	6	5	4	3	2	1
5. Companies should never sell the personal information in their computer databases to other companies.	7	6	5	4	3	2	1
6. Computers are a real threat to privacy in this country.	7	6	5	4	3	2	1
7. Companies should have better procedures to correct errors in personal information.	7	6	5	4	3	2	1
8. It bothers me to give personal information to so many companies.	7	6	5	4	3	2	1
9. Companies should take more steps to make sure that the personal information in their files is accurate.	7	6	5	4	3	2	1
10. Companies should never share personal information with other companies unless it has been authorized by the individuals who provided the information.	7	6	5	4	3	2	1
11. I am easily frustrated by computerized bills.	7	6	5	4	3	2	1
12. Companies should take more steps to make sure that unauthorized people cannot access personal information in their computers.	7	6	5	4	3	2	1
13. I am sometimes frustrated by increasing automation in my home.	7	6	5	4	3	2	1
14. People should refuse to give information to a business if they think it is too personal.	7	6	5	4	3	2	1

Below are some questions to help us better understand who responded to this survey. Please check only one response for each question.

1. What is your gender? ____ Female ____ Male

2. What is your age?

___18-24 yrs. ___25-29 yrs. ___30-34 yrs. ___35-39 yrs. ___40-44 yrs. ___45-49 yrs. ___≥50 yrs.

3. What is your marital status?

___ Single ____ Married ____ Engaged/Committed ____ Separated/Divorced/Widowed

4. How many adults (including yourself) currently live in your household? ___ 1 ___ 2 ___ 3 ___ ≥4

5. How many children currently live in your household? ___ 0 ___ 1 ___ 2 ___ 3 ___ 4 ___ ≥5

6. How many frequent flyer/frequent buyer/customer loyalty programs does your household participate in?

____ None ____ 1-3 ____ 4-6 ____ 7-9 ____ 10-12 ____ 13-15 ____ More than 15

7. Do you regularly use a cellular telephone? ____ Yes ____ No

8. Do you regularly shop and buy items on the internet? ____ Yes ____ No

9. Do you regularly shop and buy items by phone? ____ Yes ____ No

10. Do you regularly use on-line banking services? ____ Yes ____ No

11. Do you regularly enter promotional sweepstakes sponsored by companies? ____ Yes ____ No

12. Do you regularly use a credit or debit card for making purchases? ____ Yes ____ No

13. Have you asked a firm to remove you from their mailing list in the last year? ____ Yes ____ No

14. Have you joined a "Do Not Call" phone list to reduce unwanted calls? ____ Yes ____ No

15. Have you decided to not purchase an item from a firm or not use their services because of their privacy policy (i.e., the way they use personal information)? ____ Yes ____ No

16. Do you regularly destroy personal documents using a paper shredder? ____ Yes ____ No

17. How frequently did you attend organized religious services during the last year?

____ Less than once per month ____ At least once per month

18. What is the last grade of school you completed?

____ Some high school or less ____ Completed high school but no college

____ Some college/post high school ____ College graduate ____ Post college graduate courses/degree

19. Do you own or rent your current living space? ____ Own ____ Rent

20. What is your race/ethnicity? ____ White ____ Non-White

21. Which of the following categories best describes your household income before taxes?

____ Under $30,000 ____ $30,000 to $59,000 ____ $60,000 to $89,000 ____ ≥$90,000

Thank you!

Appendix B – Presentation Power Point Slides

Consumer Opinions and RFID Implementation

Anna Brown
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June 25, 2010

Overview

- **Objective**
- Background of RFID
- Application of RFID
- Online Privacy Issues
- Hypothesis
- Methodology of Survey
- Results of Survey
- Conclusion

Objective

- Objective: To find simple factors and relationships explaining the usage of Internet shopping and online banking, and the attitudes toward Radio Frequency Identification (RFID) in hospitals.

Is the general population accepting of the RFID technology application in the tracking of patients and their medical histories in a hospital environment?

Overview

- Objective
- **Background of RFID**
- Application of RFID
- Online Privacy Issues
- Hypothesis
- Methodology of Survey
- Results of Survey
- Conclusion

Radio Frequency Identification (RFID)

- Developed in the 1940s
- Used to track various assets and products
  - Product is tagged with RFID chip, contains specific information identifying product
  - Can track where products have been made, shipped, and sold

Bar Code System vs. RFID

- Bar code system most common form of product tracking within the U.S.
- RFID has advantages
  - Data can be read much faster and at greater distances, no special orientation of product or visibility of tag
    - e.g. Items in a grocery cart can be scanned at once for quick checkout
    - e.g. Tolls captured through automobile "speed pass"
  - Products can be tagged and identified individually

Bar Code System vs. RFID

- RFID Disadvantages
  - Expensive
  - Some tags difficult to scan on liquids or metal-encased products
    - e.g. can of soda
- RFID is unique for application on people
  - Track movements of employees
  - Grant access to authorized rooms

Concerns for RFID

- Invasion of privacy
  - Ability to track where people are going and what they are doing
  - Who would have access to personal information collected?
- Rapid increase of technology
  - Some may resist introduction of new technologies

Overview

- Objective
- Background of RFID
- **Application of RFID**
- Online Privacy Issues
- Hypothesis
- Methodology of Survey
- Results of Survey
- Conclusion

RFID Potential in Hospitals

- Promising application of RFID
  - Tag medical equipment for quick location
  - Tag drugs to reduce errors in prescription distribution
  - Tag patient hospital wrist bands
    - Contain patient information: name, D.O.B, allergies, blood type, etc.

RFID Potential in Hospitals

- Tags inserted under the skin without leaving any visible marks

- Tags adhesively placed onto patient's skin
  - e.g. place tag on area of surgery

RFID Potential in Hospitals

- November 2007 – survey of 382 hospitals in California
  - 6.1% RFID fully implemented
  - 15.2% process of implementing
  - 45.5% taking into consideration
  - 18.2% no knowledge of RFID

Benefits of RFID in Hospitals

- Able to collect data in real-time
  - Monitor patients' vitals - blood pressure, heart rate, body temp.
- Track location of patients and employees
  - Improve "workflow management"
- Keep track of medical equipment
- Reduce patient and procedure mix-ups

Concerns of RFID in Hospitals

- Frustration to those who are still learning to use electronic medical records (EMRs)
- Burden of training of entire medical staff (e.g. slow implementation of EMRs)
- Security concerns of who has access to RFID database

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Online Privacy

- Technology has moved the physical to electronic
- Consumers wary about releasing personal information over the Internet
  - Name, address, credit card number, etc.
- Two specific areas of transition examined: *Online shopping* and *Online banking*

Online Shopping & Banking

- Companies have transitioned to using websites as a means of easier communication with consumers
- Personal information must be released for some services
- Consumers remain wary of sharing personal information.
- Identity theft a major issue

Online Shopping & Banking

- Online banking has been the fastest growing e-banking technology in the past decade
- 1995 – fewer than 5% banking online
- 2007 – 53% banking online
- In 2003, 32% banking online, 55% of those paying bills online
- By 2006, 51% banking online, 76% of those paying bills online

Online Shopping & Banking

Do the opinions and behaviors of consumers regarding online shopping and online banking suggest support for the wider implementation of RFID?

Overview

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Hypothesis

Hypothesis #1

Since RFID can have an impact on consumer privacy, those most concerned about sharing personal information will resist the implementation of RFID in hospitals.

Hypothesis

Hypothesis #2

Those who routinely work with other recent technologies are more likely to make purchases online and use online banking services.

Hypothesis

Hypothesis #3

Those who are most uncomfortable with sharing personal information will be less likely to shop and bank online.

Hypothesis

Hypothesis #4

Those who are the most familiar with recent technologies will most likely be accepting of RFID technology in connection with capturing personal information

Overview

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Methodology

- Sent to 4,900 people in Midwest
- 6.44% incorrect address
- 5.8% return rate
- 450 dollar bills
  - 22% returned
- 450 hand written notes
  - 6.6% returned
- 339 total responses, 277 useable

Methodology

- Questions regarding:
  - Opinions of RFID in hospitals (1-7 scale)
  - Privacy attitudes (1-7 scale)
    - e.g. Increased pace of automation, computers threatening privacy
  - Privacy behaviors (1/0 scale)
    - e.g. regular use of cell phone, credit card, and online services
  - Demographics
    - e.g. Gender, age, income, etc.

Methodology

- Survey responses coded, entered into Excel sheet, uploaded into SPSS
- Reduced to three factors using a Factor Analysis program with Varimax rotation
- Probit analysis or linear regression was used to test hypotheses

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RFID in Hospitals Survey Results

Factors after Varimax Rotation

	Component		
	1	2	3
P3_1_Ask	.061	.152	**.685**
P3_2_Com	.085	**.729**	-.091
P3_3_Anxi	**.764**	.168	.095
P3_4_Afr	**.601**	.212	.219
P3_5_Sel	.088	**.580**	.071
P3_6_Thr	**.612**	.302	.245
P3_7_Err	.274	**.622**	.224
P3_8_Bot	.384	.275	**.629**
P3_9_Ste	.221	**.680**	.199
P3_10_Sha	-.094	**.563**	.258
P3_11_Fru	**.802**	-.014	.070
P3_13_Aut	**.870**	-.002	-.018
P3_14_Ref	.090	.046	**.742**

RFID in Hospitals Survey Results

- Factor one:
  - Pace of automation in the world
  - Loss of data by the data processing department
  - Computers are a threat to privacy
  - Increased frustration with automation and computerized billing in the home

RFID in Hospitals Survey Results

Factors after Varimax Rotation

	Component		
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P3_1_Ask	.061	.152	**.685**
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P3_13_Aut	**.870**	-.002	-.018
P3_14_Ref	.090	.046	**.742**

RFID in Hospitals Survey Results

- Factor two:
  - Permission of unauthorized users given access to computer databases containing personal information
  - Selling of personal information between companies
  - Better procedures in error correction and accuracy regarding personal information
  - Companies receiving permission by the individual to share their personal information

RFID in Hospitals Survey Results

Factors after Varimax Rotation

	Component		
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P3_13_Aut	**.870**	-.002	-.018
P3_14_Ref	.090	.046	**.742**

RFID in Hospitals Survey Results

- Factor three:
  - Thinking twice before giving out personal information
  - Giving personal information to many companies
  - Refusing to give out too much personal information

RFID in Hospitals Survey Results

Factors after Varimax Rotation

	Component		
	1	2	3
CellPhone	**.554**	-.047	.005
BuyPhone	.208	.113	**.634**
SWeeps	-.139	-.060	**.778**
Card	**.700**	.036	.083
Remove	.036	**.749**	.124
DoNotCall	.183	**.621**	-.046
NotBuy	-.171	**.702**	.172
Shredder	.126	**.444**	-.117
Banking	**.696**	.277	-.145
Internet	**.739**	.082	.070

RFID in Hospitals Survey Results

- Factor one:
  - Regular use of cellular phone
  - Use of debit/credit card for making purchases
  - Use of Internet to purchase items
  - Use of online banking

RFID in Hospitals Survey Results

Factors after Varimax Rotation

	Component		
	1	2	3
CellPhone	**.554**	-.047	.005
BuyPhone	.208	.113	**.634**
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Shredder	.126	**.444**	-.117
Banking	**.696**	.277	-.145
Internet	**.739**	.082	.070

RFID in Hospitals Survey Results

- Factor two:
  - Removed from mailing lists
  - Joining a "Do Not Call" phone list
  - Not purchasing items from a company based on their privacy policy
  - Regular use of a shredder to destroy personal documents

RFID in Hospitals Survey Results

Factors after Varimax Rotation

	Component		
	1	2	3
CellPhone	**.554**	-.047	.005
BuyPhone	.208	.113	**.634**
Sweeps	-.139	-.060	**.778**
Card	**.700**	.036	.083
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Shredder	.126	**.444**	-.117
Banking	**.696**	.277	-.145
Internet	**.739**	.082	.070

RFID in Hospitals Survey Results

- Factor three:
  - Purchasing items over the phone
  - Regularly entering promotional sweepstakes

Hypothesis Testing

Hypothesis #1

Since RFID can have an impact on consumer privacy, those most concerned about sharing personal information will resist the implementation of RFID in hospitals.

RFID in Hospitals Survey Results

Coefficients & Standard Errors for Factors and Demographics

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
PostColl	-.713	.430	-.164	-1.659	**.098**
Renter	.542	.325	.119	1.669	**.096**
REGR factor score 1 for analysis 1	-.391	.124	-.207	-3.150	**.002**
REGR factor score 1 for analysis 2	-.334	.132	-.177	-2.534	**.012**

RFID in Hospitals Survey Results

- Expected
  - Factor 1 analysis 1 most likely disagree with implementation of RFID in hospitals
    - Pace of automation in the world
    - Loss of data by the data processing department
    - Computers are a threat to privacy
    - Increased frustration with automation and computerized billing in the home

Results

Hypothesis #1

Since RFID can have an impact on consumer privacy, those most concerned about sharing personal information will resist the implementation of RFID in hospitals.

The survey results agreed with this statement.

Hypothesis Testing

Hypothesis #2

Those who routinely work with other recent technologies are more likely to make purchases online and use online banking services.

Online Shopping Survey Results

Coefficients & Standard Errors for Factors and Demographics

	B	S.E.	Wald	df	Sig.	Exp(B)
Yes Religion	-.612	.332	3.412	1	**.065**	.542
SomeColDeg	-.966	.543	3.170	1	**.075**	.380
Incom4	1.126	.632	3.175	1	**.075**	3.084
FAC1_1	-.604	.176	11.78	1	**.001**	.546
FAC2_1	-.335	.164	4.198	1	**.040**	.715
FAC1_3	.322	.174	3.415	1	**.065**	1.380
FAC2_3	1.339	.253	27.930	1	.000	3.815

Online Shopping Survey Results

- Expected
  - Factor 2 analysis 3 more likely to shop online
    - Regular use of cellular phone
    - Use of debit/credit card for making purchases
    - Use of online banking

Online Banking Survey Results

Coefficients & Standard Errors for Factors and Demographics

	B	S.E.	Wald	df	Sig.	Exp(B)
Adult2	.874	.474	3.394	1	**.065**	2.396
Renter	-.892	.452	3.903	1	**.048**	.410
FAC1_1	-.379	.174	4.725	1	**.030**	.685
FAC1_2	.567	.181	9.833	1	**.002**	1.762
FAC2_2	1.108	.200	30.834	1	**.000**	3.029

Online Banking Survey Results

- Expected
  - Factor 2 analysis 2 more likely to use online banking services
    - Regular use of cellular phone
    - Use of debit/credit card for making purchases
    - Use of Internet to purchase items

Results

Hypothesis #2

Those who routinely work with other recent technologies are more likely to make purchases online and use online banking services.

The survey results agreed with this statement.

Hypothesis Testing

Hypothesis #3

Those who are most uncomfortable with sharing personal information will be less likely to shop and bank online.

Online Shopping Survey Results

Coefficients & Standard Errors for Factors and Demographics

	B	S.E.	Wald	df	Sig.	Exp(B)
Yes Religion	-.612	.332	3.412	1	**.065**	.542
SomeColDeg	-.966	.543	3.170	1	**.075**	.380
Incom4	1.126	.632	3.175	1	**.075**	3.084
FAC1_1	-.604	.176	11.78	1	**.001**	.546
FAC2_1	-.335	.164	4.198	1	**.040**	.715
FAC1_3	.322	.174	3.415	1	**.065**	1.380
FAC2_3	1.339	.253	27.930	1	**.000**	3.815

Online Shopping Survey Results

- Expected
  - Factor 1 analysis 1 less likely to shop online
    - Pace of automation in the world
    - Loss of data by the data processing department
    - Computers are a threat to privacy
    - Increased frustration with automation and computerized billing in the home

Online Shopping Survey Results

- Expected
  - Factor 2 analysis 1 less likely to shop online
    - Permission of unauthorized users given access to computer databases containing personal information
    - Selling of personal information between companies
    - Better procedures in error correction and accuracy regarding personal information
    - Companies receiving permission by the individual to share their personal information

Online Shopping Survey Results

- Not Expected
  - Factor 1 analysis 3 more likely to shop online
    - Removed from mailing lists
    - Joining a "Do Not Call" phone list
    - Not purchasing items from a company based on their privacy policy
    - Regular use of a shredder to destroy personal documents

Online Banking Survey Results

Coefficients & Standard Errors for Factors and Demographics

	B	S.E.	Wald	df	Sig.	Exp(B)
Adult2	.874	.474	3.394	1	**.065**	2.396
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FAC1_2	.567	.181	9.833	1	**.002**	1.762
FAC2_2	1.108	.200	30.834	1	**.000**	3.029

Online Banking Survey Results

- Expected
  - Factor 1 analysis 1 less likely to use online banking services
    - Pace of automation in the world
    - Loss of data by the data processing department
    - Computers are a threat to privacy
    - Increased frustration with automation and computerized billing in the home

Online Banking Survey Results

- Not Expected
  - Factor 1 analysis 2 more likely to use online banking services
    - Removed from mailing lists
    - Joining a "Do Not Call" phone list
    - Not purchasing items from a company based on their privacy policy
    - Regular use of a shredder to destroy personal documents

Results

Hypothesis #3

Those who are most uncomfortable with sharing personal information will be less likely to shop and bank online.

The results mostly agreed with this statement.

Hypothesis Testing

Hypothesis #4

Those who are the most familiar with recent technologies will most likely be accepting of RFID technology in connection with capturing personal information.

RFID in Hospitals Survey Results

Coefficients & Standard Errors for Factors and Demographics

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
PostColl	-.713	.430	-.164	-1.659	.098
Renter	.542	.325	.119	1.669	.096
REGR factor score 1 for analysis 1	-.391	.124	-.207	-3.150	.002
REGR factor score 1 for analysis 2	-.334	.132	-.177	-2.534	.012

RFID in Hospitals Survey Results

- Not expected
  - Factor 1 analysis 2 most likely disagree with implementation of RFID in hospitals
    - Regular use of cellular phone
    - Use of debit/credit card for making purchases
    - Use of Internet to purchase items
    - Use of online banking

Results

Hypothesis #4

Those who are the most familiar with recent technologies will most likely be accepting of RFID technology in connection with capturing personal information.

The results did not agree with this statement.

Demographic Results – RFID in Hospitals

Coefficients & Standard Errors for Factors and Demographics

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
PostColl	-.713	.430	-.164	-1.659	.098
Renter	.542	.325	.119	1.669	.096
REGR factor score 1 for analysis 1	-.391	.124	-.207	-3.150	.002
REGR factor score 1 for analysis 2	-.334	.132	-.177	-2.534	.012

Demographic Results – RFID in Hospitals

- Post college education most likely agree with implementation of RFID in hospitals
- Renters most likely disagree with implementation of RFID in hospitals

Demographic Results – Online Shopping

Coefficients & Standard Errors for Factors and Demographics

	B	S.E.	Wald	df	Sig.	Exp(B)
YesRelig	-.612	.332	3.412	1	.065	.542
SomeColDeg	-.966	.543	3.170	1	.075	.380
Incom4	1.126	.632	3.175	1	.075	3.084
FAC1_1	-.604	.176	11.78	1	.001	.546
FAC2_1	-.335	.164	4.198	1	.040	.715
FAC1_3	.322	.174	3.415	1	.065	1.380
FAC2_3	1.339	.253	27.930	1	.000	3.815

Demographic Results – Online Shopping

- Those who practice religion at least once a month are less likely to shop online
- Those with some college education are less likely to shop online
- Those with an income >$90,000 are more likely to shop online

Demographic Results – Online Banking

Coefficients & Standard Errors for Factors and Demographics

	B	S.E.	Wald	df	Sig.	Exp(B)
Adult2	.874	.474	3.394	1	.065	2.396
Renter	-.892	.452	3.903	1	.048	.410
FAC1_1	-.379	.174	4.725	1	.030	.685
FAC1_2	.567	.181	9.833	1	.002	1.762
FAC2_2	1.108	.200	30.834	1	.000	3.029

Demographic Results – Online Banking

- Two or more adults living in one household are more likely to use online banking services
- Renters are less likely to use online banking services

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- Results of Survey
- **Conclusion**

Conclusion

- Privacy concerns in relation to the RFID opinion are important
- Public opinion as it relates to RFID personal tagging acceptance should continue to be studied so that the timing and extent of the RFID system implementation can be properly planned to maximize its chances of success.
- Further research is needed to confirm these findings