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Consumers' Attitudes Towards Traceability of Food and Meat Products

Kulmani Rana
Western Michigan University

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Lee Honors College

Western Michigan University

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Kulmani Rana

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Executive Summary:
The purpose of this research is to survey consumers on their support for Radio Frequency Identification tags on fruit and vegetable containers and their willingness to pay for traceability of meat products. Ironically, there is no single universally accepted definition of traceability. There is evidence that the US has fallen behind its major trading partners in terms of implementing a nationwide food traceability system. Researchers in the past have concluded that consumers' WTP for traceability increases significantly when bundled with additional assurances. There is real concern among consumers about implementation of traceability systems in food as well as meat products. Based on the statistical analysis, the major relevant factors are consumers' religiousness and their willingness to share personal information. Manufacturers and retailers have long ignored consumers' behavior and attitudes towards the traceability systems and it is crucial that these factors are taken in to consideration for successful implementation of RFID enabled traceability systems in near future.

Introduction:
Food crises in recent years have had an enormous effect on food industry. Subsequently, food manufacturers and retailers have invested heavily in quality improvement and traceability systems. There is widespread consensus among researchers and industry stakeholders that traceability will become a standard prerequisite in coming years. RFID have come out as a feasible traceability solution for food as well as meat products.

Subsequently, a number of researchers have tried to explore the costs and benefits of the implementation of RFID based traceability systems. But, researchers have ignored the consumers' behavior towards the implementation of such systems. There is a wide variety of opinions among consumers about the use of RFID in food and meat traceability. The primary purpose of this research is to explore consumers' attitudes and behavior towards the implementation of traceability systems in food and meat products.

Literature Review:

A generic definition for traceability is given by ISO 9000:2000 as the "ability to trace the history, application or location of that which is under consideration (ISO, 2000)[1]. The EU commission (EU, 2002) further narrows down the definition to food industry by defining traceability as the ability to trace and follow a food, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution (EU, 2002). Liddell and Bailey have defined traceability in a similar manner as the ability to track the inputs used to make food products backward to their source at different levels of the marketing chain (Liddell & Bailey, 2001). Traceability of a food also consists of development of "an information trail that follows the food product's physical trail" (Smith et al., 2005). Hobbs et al. (2005) assess the different traceability initiatives emerging in the private sector and through regulatory intervention in various countries and conclude that there are different notions of what is meant by traceability.

[1] ISO is a worldwide federation of national standards bodies which promotes the development of standardization and international standards for a wide range of products. ISO 9000 guidelines are quality management system standards.

However, recent research suggests that U.S. red-meat system is falling behind many of its major competitors and trading partners in terms of traceability, transparency, and other quality assurances (TTA) (Liddell & Bailey, 2001).

The broad definitions of traceability offered by various researchers do not address some key operational issues. No single approach is adequate for every objective (Golan E. , Krissoff, Kulcher, Calvin, Nelson, & Price, 2004). A major report published by USDA in 2004 accentuates that "*complete traceability is impossible*". Even a futuristic system for tracking beef, in which consumers scan their packet at the check-out counter and receive information on the date and location of the animal's birth, lineage, immunization, records, acreage of pasturage, and use of mammalian protein supplements, is incomplete. There are numerous processes involved in the production of beef. Therefore, to conceive a system which can provide information about every single process with precision adequate to attain every single objective is impossible.

The USDA report further affirms that the characteristics of good traceability systems vary and cannot be defined without reference to the system's objectives. USDA attributes three major characteristics to a traceability system: *breadth*, *depth*, and *precision*. *Breadth* describes the amount of information the traceability systems store. There is a lot of information about the food we eat, and a recordkeeping system storing all the attributes of would be colossal, redundant, and costly. The *depth* of a traceability system is how far back or forward a system tracks. In a number of cases, the depth of a system is determined by its breadth: once the firm or regulator has decided which attributes are worth tracking, the depth is determined (Golan et al.).

Precision reflects the degree of assurances with which the tracing system can pinpoint a particular food product's movements or characteristics (USDA). Precision is basically determined by the unit of analysis used in the system and acceptable error rate. Systems with large tracking units, such as the entire feedlot, will have poor precision in identifying safety or quality problems (Golan et al.). Systems with smaller units, such as individual cattle will have greater precision. The breadth, depth, and precision of a system should be determined by the specific objectives of the system.

With the expansion of global trade, computerization, and communications, plain language descriptions of products and services need to be replaced by identification and product tracing systems that are usable in all trade and industry sectors worldwide (Yourdanov & Angelova, 2006). Yourdanov & Angelova also claim that traceability is increasingly becoming a standard across the agri-food industry, largely driven by recent food crises and the consequent demands for transparency within the food chain. They list the benefits and solutions provided by identification and tracing as follows:

- Procedures for identifying and tracing the product during all stages of production, delivery and installation.
- Requires knowing what parts comprise the product, their specification, their status etc.
- Requires knowing the exact content of products that have been delivered to each customer so that the right customer service can be provided.
- However, helps to satisfy "Process Control"

General overview of traceability systems in meat industry:

Several authors believe that US is lagging behind many countries in developing traceability systems for food. A major study concluded that traceability, for livestock, poultry and meat, in its broadest context, can, could, or will eventually be used:

> "(1) to ascertain origin and ownership, and to deter theft and misrepresentation, of animals and meat; (2) for surveillance, control and eradication of foreign animal diseases; (3) for biosecurity protection of the national livestock population; (4) for compliance with requirement of international customers; (5) for compliance with country-of-origin labeling requirement; (6) for improvement of supply-side management, distribution/delivery systems and inventory controls; (7) to facilitate value-based marketing; (8) to facilitate value-added marketing; (9) to isolate the source and extent of quality – control and food safety problems; and (10) to minimize the product recalls and make crisis management protocols more effective" (Smith et al., 2005).

In the same study, the authors also affirm that domestically and internationally, it has now become necessary that producers, packers, processors, wholesalers, exporters and retailers assure that the meat source, the production practices and/or the process of generating final products, can be verified (Smith et al., 2005).

Firms build traceability systems to improve supply side management and construct lower cost distribution systems, but simply knowing where a product is in the supply chain does not improve supply management unless the traceability system is paired with a real – time delivery system or some inventory – control system (Golan et al., 2004). Throughout the food industry, companies are adopting new electronic traceability systems ("information trails") to track production, purchases, inventory and sales to provide a basis for good supply management, allowing them to more efficiently managed resources (Smith et al., 2005).

Traceability systems help firms isolate the source and extent of safety or quality – control problems. Firms have an incentive to invest in traceability systems because they help minimize the production and distribution of unsafe or poor quality products, which in turn minimizes the potential for bad publicity, liability and recalls (Golan et al., 2004). Gledhill proposes that meat processors can minimize risk by proactively adopting more stringent standards relative to "life-cycle traceability" of their products; such traceback offers a strategic advantage that can greatly reduce costs in the event of a product recall and reinforce the confidence of customers and consumers in the strength and integrity of a company's products and brands. Domestic and export customers, to protect their investment in "own brands", are demanding that their suppliers trace back food product to source-of-origin (Smith et al., 2005).

RFID: The Basics

Radio frequency tags present a robust and potentially cost effective solution for tracking meat and produce. They are unaffected by contamination and, with an appropriate enclousure, withstand both the temperatures and chemicals used in cleaning and disinfection (Yourdanov & Angelova, 2006). Yourdanov et al. describe the basic RF tag apparatus consisting of following parts:

- A tamper - proof device permanently attached or implanted, termed the identifier
- An activating/reading device (both the electronic identifier and reader must have an antenna)
- Software (electronic recordings and transfer of data is far more accurate than in formation written by hand)

At its most basic level, an RFID tag contains a tiny transponder and antenna that have a unique number or alphanumeric sequence; the tag responds to signals received from an interrogator's antenna and transmits its number back to the interrogator (Mennecke & Townsend, 2005). Mennecke et al. also state that while the tags themselves are relatively simple, they allow the development of tracking software that can maintain much better inventory information than bar-code systems or systems rely on human entry of identification information. RF tags have an advantage over bar coding in that the tags can be implanted in a container or item/product without damaging any data, and RF tags also provide a non-contact, non-line-of-sight ability to gather real-time data and can penetrate most non - metallic materials, including bio-matter.

Mennecke et al. also talk about various classifications of RF tags. The authors classify RFID tags in to two systems: Active vs Passive tags and Read-Only vs Read/Write Tags. The characteristics of each category are defined as follows:

Active Tags:

- Catch the attention of the RFID reader by broadcasting a signal
- Function with battery power (a battery is either connected to or built into the tag)
- Work over a greater distance and are more expensive (because of the cost of the battery)
- Are generally readable only by proprietary technology of the tag's manufacturer

Passive Tags:

- Only react to an interrogator's contact signal

- Communicate without battery power (giving them essentially unlimited life)
- Derive power from the interrogator antenna's electromagnetic field
- Soon will be able to be read by a variety of equipment

RFID tags can also classified by its energy source as semi-active. Semi-active tags remain dominant until they receive signals and have longer battery life. A passive tag has no battery of its own and makes use of the incoming radio waves broadcast by a reader to power its response. An active tag uses its own battery power to perform all operations. A semi-active tag uses its own battery power for some functions but, like the passive tag, uses the radio waves of the reader as an energy source for its own transmission (Ho et. al, 2005).

Read-Only Vs Read/Write Tags:

Read-only tags are preset to a specific number and retain that information throughout their life, whereas read/write tags can actually be written to by an appropriate read/write device (Mennecke & Townsend, 2005). A potential problem with these tags is that they can be reprogrammed by hackers and it may be possible to load malware into their memories. Mennecke et al. further conclude that writeable tags are particularly useful when information about an item needs to be easily associated with an item, particularly if there might be a problem with access to the database that would associate a read-only number with an item's information. A RFID-tagged animal, for instance, would benefit from a tag that contained many lot of bits on information about the animal's health and feed data and its recent transportation history, so that processors would not have to access any outside database to extract the animal's relevant information. Writeable tags are also useful in creating information redundancy within an inventory system, maintaining information about an asset that is physically separate from the main database (Mennecke et al.).

Comparing meat traceability in US and Other Countries:

Liddell and Bailey report the U.S. pork system ranks last when compared to systems in UK, Denmark, Canada, Japan, Australia and New Zealand for *traceability, transparency and assurance* (TTA). They also concluded that "the U.S. pork industry may diminish its competitive advantage in world pork markets if it fails to enhance its TTA programs (Liddell & Bailey, 2001)".

A number of researchers have tried to compare traceability system in US with traceability systems in other countries in EU and elsewhere. The US consumer's willingness to pay (WTP) has also been the subject of study by many scholars. One study compared consumers' WTP in US and Canada. They concluded that many, but not all, Canadian and American consumers would be willing to pay for TTA characteristics in red-meat products (Dickinson et al.).

Hobbs et al. (2005) also write about consumers' WTP for traceability in Canada. Their focus was on the WTP for traceability and quality assurances in meat, and the relative value of quality assurances, and quality assurances bundled with traceability, compared to traceability alone (Hobbs et al., 2005). They concluded that consumers were willing to pay nontrivial amounts for a traceability assurance, although these results are stronger for beef than pork. They also noted that quality assurances with respect to food safety and on-farm production methods for beef were more valuable to consumers than a simple traceability assurance. Bundling traceability with these additional assurances is likely to be of more value to Canadian consumers. This finding is consistent with the results obtained in a comparable study of US consumers

(Dickinson & Bailey, 2002). The authors also conclude that the economic value of the traceability and quality assurances appear to be higher for beef than pork. One could assure that the value of the traceability and quality assurances appear to be higher for beef than pork could differences in the media attention and increased consumer awareness to beef safety issues, such as problems with *BSE* and *E.Coli*.

Hobbs et al. point out that there has been little economic research done to evaluate the validity of this assumption and analyze the extent to which sample traceability delivers benefits to consumers. They also argue that, although simple traceback may have a role to play in limiting the extent of food safety outbreaks and in maintaining the consumer confidence in an industry, traceability alone does little to reduce consumers' information symmetry with respect to quality attributes (Hobbs at al., 2005).

The experimental auction model used by Hobbs et al. shows that Canadian consumers are likely to place a higher value on quality verification system, which facilitates the provision of additional quality assurances, than on the traceability alone. Quality assurances combined with traceability capabilities seem to create more economic value for canadian consumers. This suggests that future economic research should concentrate on differentiation between traceability systems providing "simple traceback" vs systems providing "traceback along with quality assurance". As the latter is perceived to have more economic value by the consumers.

Another study done by Dickinson and Bailey in 2005 explores consumers' WTP for red meat traceability in the US, Canada, the UK, and Japan. The results of this research turn out to be consistent with the views of other scholars who suggest that consumers are willing to pay a nontrivial premium for traceability, but the same consumers show even higher WTP for traceability-provided features such as additional meat safety and humane animal treatment assurance (Dickinson & DeeVon, 2005).

Dickinson and Deevon (2005) investigate WTP for traceability in food because traceable systems are being developed in the European Union and other parts on the world and will almost certainly be employed in the near future for more food industries in the United States and Canada. They also explain this through an example: Canada has a target of eventually making 80% of its domestic food traceable (Agri-Food, 2002), and a small number of American meat packers already have traceable systems in place.

Traceability is a tool that separates the world's largest food systems (Bailey, Jones and Dickinson; Liddell and Bailey). Dickinson & DeeVon also suggest that although, traceability is standard in EU food systems, the US meat industry has a different approach, which favors private, rent-seeking activities related to traceability rather than a regulatory solution. Hence, WTP for traceability has been a crucial issue in recent times. There is evidence that not only American, but also Canadian, British, and Japanese consumers, on average, are willing to pay nontrivial sum of money for red meat traceability (Dickinson & DeeVon, 2005).

These authors agree with the findings of Hobbs et al. (2005) and conclude that profitable traceability is probably best bundled along with additional product characteristics that only traceability can verify. Dickinson and Deevon (2005) also suggest that consumers may value traceability and traceability-verified features in other product markets, not just in food markets. However, there is sufficient evidence to reflect that a substantial proportion of consumers in all four countries who would not pay for traceability or features that can be verified through a traceability system.

Until the end of 2004, food and feed business operators in Europe had to conform to the traceability directives demanded by their customers along the entire chain. But as 1 January 2005, the new EU regulations mandate that all food and feed business operators be legally bound to have traceability systems, even when their customers do not require it.

The General Food Law, i.e., Regulation (EC) 176(2002) of the European Parliament and the Council published on 28 January 2002

I. outlines the general principles and requirements of food law,
II. establishes the European Food Safety Authority and
III. provides procedures in matter of food safety i.e., among other things the implementation of traceability systems in the food and feed supply chains in Europe.

A study done by Angulo et al. in 2005 focuses on food safety and consumers' willingness to pay for labeled beef in Spain. The authors conclude that although consumers are increasingly concerned about food safety issues, they are not willing to pay more for labeled beef with traceability certificate. Three-out-of-four survey respondents declared that they are not willing to pay anything extra. Results from this research also indicate that consumers have perceived beef price increases, and these increases have been generated by more rigorous controls implied by traceability, as a quality strategy and not as a safety strategy (Angulo et al., 2005). The authors conclude that Spanish consumers perceive food safety as a minimum responsibility producers have, and believe that producers should guarantee safety without consumers being obliged to pay a premium for it.

Tonsor & Schroeder use a case study approach to overview an extensive traceability system currently being used in Australia. Based on the Australian experience, authors present recommendations for pending U.S. animal identification systems. The authors recommend that the U.S. animal identification system needs to be eventually mandated, free of significant regional differences. The system should be flexible to help with meat traceability or other advancements as needs and opportunities arise (Tonsor & Schroeder, 2006). The authors argue that a voluntary identification program will lead to two distinctive markets (those with identification and those without). Such identification program will increase the industry costs and at the same time it will also reduce the consumer confidence in the identification system (Tonsor & Schroeder, 2006).

Tonsor & Schroeder also emphasize that if the U.S. beef industry desires to remain competitive in the international meat market, it will likely be forced to adjust to the changing food market and implement systems such as national animal traceability programs. Furthermore, if U.S. meat industries want to be active in maintaining and building upon current domestic support of their products, programs should provide consumers with assurances regarding possible concerns over animal health, potential bio-terrorism, and food safety issues (Tonsor & Schroeder, 2006). The U.S. beef industry is in its very early developmental phase of a uniform animal identification system and a lot can be learned from the systems in place in other countries as the U.S. system evolves.

Another major study done by Rijswijk et al. in 2008 focuses on "consumer perceptions regarding traceability investigated by means-end-chain laddering[2]". Consumers in four European countries (Germany, France, Italy, Spain) were questioned about the benefits they associate with traceability related attributes (Rijswijk et al., 2008). The authors observe while the benefits of traceability were similarly important in the countries investigated, although some cross-national differences were also observed. For example, German consumers were interested in whether or not a product was produced using organic production methods. The authors highlight that this is in line with their shopping behavior, as German consumers expressed a greater preference for organic stores. Additionally, the authenticity of the product is considered an important feature by German consumers. When a product was perceived to be "authentic", people believed that it was what it claims to be, and information about the product was honest (Rijswijk et al., 2008).

For, French consumers, foremost links that emerged were between quality label, quality and taste as well as safety label and the concept of healthy/heath (Rijswijk et al., 2008). Furthermore, the authors also note that there is a strong preference for products from a particular origin (country or region), in part because people deserve to support a region economically. French consumers are also looking for value for money when they consider product prices.

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[2] Laddering refers to an interviewing technique that can be used to elicit means-end connections and attribute-consequence-value networks people use when making decisions about what brand to buy, what store to shop at, what issue to support, or even who to vote for. The laddering interview reveals the linkages between attributes, consequences, and values used by respondents to justify their beliefs and/or behavior(Reynolds & Whitlark, 1995).

The authors also noticed a strong link between product, origin, control and security in HVM (Hierarachical value map) for Italian consumers. Security emerged as an important value in the Italian data. Italian consumers derive pleasure from buying products that are perceived as better (Rijswijk et al., 2008). Authors further state that for Spanish consumers, quality is important concept. Knowing whether a product is of good quality is derived from its origin, price, and reputation and whether it has a European Origin label. Safety and trust in turn provide consumers with a feeling of calm (Rijswijk et al., 2008). Therefore, for US to export to these countries, to be competitive, US exporters must provide the information consumers want.

Overview of traceability in the food supply:

A study done by USDA (2004) affirms that U.S. food producers have developed an enormous capacity to track the flow of food along the supply chain, though individual systems still vary. The report also notes that some systems are very precise, tracking food products to the last minute of production or the exact area of field where they were grown. Others are less precise, tracking product to farms in a large geographical area, such as the area served by a single grain elevator.

Product traceability has been a contentious issue in the food and beverage industry, often pitting manufacturers, packagers, and distributors against retailers, customers (Miller, 2009). Miller also points out that recent food safety crises have all sides of the issue working towards better traceability systems. Additionally, new technological developments and methods have transformed food traceability from a being expensive to an acceptable cost, in some cases, even benefiting businesses.

There has been a major shift in the way traceability is understood by various market participants. While there is no dearth of government statues regarding traceability in U.S., the enforcement staff is almost non-existent. The laws governing traceability of food products were relatively weak before Sept. 11, 2001 terrorist attacks. A new array of security related laws were introduced after 9/11. Miller also emphasizes that limiting enforcement agents to "post-event" inspections (specifically in U.S.) have changed these laws from being preemptive safeguards to being "after the fact" responses.

While some governments have been ineffective, the enlightened self-interest of the brand owners can become a driving force for traceability....and with good reason (Miller, 2009). Miller further notices that trade organizations such as GMA (Grocery Manufacturers Assn.) are pushing for expand FDA's funding and extending authority to proactively verify that sites are adhering to FDA traceability and recordkeeping rules[3]. Furthermore, GMA is recommending the use of technology to aid traceability down to the farm themselves. Major food retailers such as Wal-Mart have joined "commercial" regulatory movement such as GFSi (Global Food Safety Initiative) and are compelling their food suppliers to meet new sets of standards on food safety management and traceability (Maestri & Chang, 2004).

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[3] The Food and Drug Administration (FDA) issued a final regulation that requires the establishment and maintenance of records by persons who manufacture, process, pack, transport, distribute, receive, hold, or import food in the United States. Such records are to allow for the identification of the immediate previous sources and immediate subsequent recipients of food. The text to the statue can be accessed at: http://www.fda.gov/Food/FoodDefense/Bioterrorism/Recordkeeping/ucm061631.htm#IIId1

Miller notes a lot of companies that were covered in the research assumed that since they had some form of traceability, they have all the traceability they need. However, it is no longer required either from a legal perspective or from a commercial perspective. Because of the implications, actual formal surveys of food manufacturers practicing true product traceability are very hard to come by (Miller, 2009). This is ironical that despite the low-priced technology which is available to even small producers, FDA Assistant Commissioner for Food Protection David Acheson (2008) reported to Congress[4], that the 2008 *Salmonella* outbreak caused so much damage and took so long to trace back to source because so many of chain members were still dependent on paper-based record systems.

A more recent article published in March 2010 in *Progressive Grocer* clearly states that traceability has been a major issue for produce trading partners for the past four years. But a series of high-profile recalls has turned traceability into one of the most significant issues since the birth of scanning in 1974 (Major, 2010). The article further outlines that the food industry needs a uniform, all-encompassing system that can be easily activated in the events of a product recall, built on a platform that elevates transparency, improves operational efficiencies, enhances communication and increases trust in brands throughout a particular store.

The unveiling of the USDA's mandatory *country-of-origin labeling* (COOL) in 2004, food retailers started evaluating RFID technology as a potential answer to the demand for increased accountability in the supply chain (Gilbert, 2003). Gilbert further explains that RFID technolgy has the potential to help synchcronize and streamline the flow of inventory across the supply

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[4] The Transcript to the media briefing on Salmonella outbreak can be found at: www.fda.gov/downloads/NewsEvents/.../MediaTranscripts/ucm121521.pdf#

chain to achieve quantifiable gains such as shipment visibility, inventory accuracy, and labor productivity. Althought RFID implementation obstacles exist, technological advances, declining prices for RFID chips and readers, and emerging electronic product code (ePC) standards are quickening the pace of adoption (Gilbert, 2003).

Gilbert further notes another crucial benefit of RFID for the food industry is its ability to provide essential information on customer demand in real time, without the delay associated with human intervention. This real-time responsiveness is critically important in an industry where perishable goods and dated products require monitoring of temperature and expiration dates to avoid spoilage and lost sales (Gilbert, 2003). This is further explained through an example: if temperature of stored goods reaches a dangerous level or a product recall occurs, RFID will allow companies to track products, pull them from shelves, and resolve issues immediately, helping to reduce negative impacts on business. The increased accuracy, visibility, and real-time decision-making that RFID enables translates into responsiveness, better forecasting, and better planning, all of which can positively impact the top and bottom lines(Gilbert, 2003).

A research done by Chrysochou et al. in 2009 examines consumers' perceptions of the various technological solutions for traceability in food supply chain. The authors conclude that one of the main benefits of traceability carriers is their ability to provide consumers with *additional product-related information*. In case of RFID, consumers showed concern about the impact of radio waves on their health. However, there is no clear evidence of the impact of electromagnetic radiation of RFID on health (Thiesse, 2006). These irrational fears among consumers have been used by media and pressure groups to rally support against their implementation, such as boycotting against the use of RFID (Thiesse, 2006).

Another relevant finding by Chrysochou et al. was that consumers considered traceability important to preserve the environment. The authors also notice the consumers' concerns regarding *ethical and privacy liberties* particularly in case of RFID. In the US, there is an evolving debate between privacy groups, retailers and government agencies on the use of RFID for tracking consumer purchases (Chrysochou et al., 2009). Therefore, the issues of ethical and privacy liberties pose a major challenge to acceptability and implementation of RFID traceability systems.

Methodology:

A total of 4900 surveys were sent out to consumers in the states of Michigan, Indiana, Illinois, and Ohio. 6.44% of the surveys were returned because of incorrect addresses. To test incentives, 450 survey envelopes were mailed with one dollar bills. The envelope with one dollar bills had a return rate of 22%. To test personalization, 450 survey envelopes had hand written notes, thanking consumers for filling out the survey questionnaire; these had a return rate of 6.6%. The rest of the surveys were sent out without any incentive, these had a return rate of 5.8%. In total, 277 usable responses were received.

The survey[5] had 46 questions in total and was divided in to three parts. The first section had 11 questions and in this section consumers were asked to rate their interest in the possible RFID applications. The consumers were asked to rate their interest on a scale of 1 to 7; 7 being very

[5] A copy of the original survey can be found in Appendix I.

supportive and 1 being not supportive at all. The second part consisted of 14 statements about the consumers' personal information. Consumers were asked the extent to which they agree or disagree with a particular statement from the standpoint of personal privacy on a scale of 1 to 7; 7 meaning a strong agreement and 1 meaning a strong disagreement. The last part of the survey included questions about consumers' personal information. The questions included gender, age, marital status and income levels etc. The consumers were asked to check the appropriate choice.

After receiving the survey responses, the responses were entered to an excel worksheet. The summary statistics of the responses was generated using the factor analysis in the SPSS system, and the relationship among factors was analyzed using SAS.

Results:

Rotated Component Matrix[a]

	Component		
	1	2	3
P3_1_Ask	.065	.148	.699
P3_2_Com	.088	.703	-.054
P3_3_Anxi	.763	.174	.085
P3_4_Afr	.611	.238	.173
P3_5_Sel	.060	.592	.062
P3_6_Thr	.621	.310	.222
P3_7_Err	.268	.639	.164
P3_8_Bot	.418	.279	.596
P3_9_Ste	.219	.711	.142
P3_10_Sha	-.099	.523	.314
P3_11_Fru	.800	-.022	.071
P3_13_Aut	.867	-.022	-.008
P3_14_Ref	.097	.012	.728

Rotated Component Matrix[a]

	Component		
	1	2	3
CellPhone10	.547	-.058	.000
Internet10	.745	.073	.075
BuyPhone10	.211	.131	.624
Banking10	.711	.237	-.116
Sweeps10	-.137	-.077	.786
Card10	.688	.046	.077
Remove10	.018	.756	.121
DoNotCall10	.205	.601	-.027
NotBuy10	-.179	.701	.163
Shred10	.123	.456	-.138

Description of factors used:

Two sets of three factors were used for the factor analysis. The first set of factors measured privacy attitudes and the second set measured privacy behavior.

Three factors for privacy attitudes and their components can be listed as follows:

I. Factor 1 – "Automation concerns"

- Anxious and concerned about pace of automation
- Afraid that data processing department will lose my data
- Computers are a threat to privacy
- Frustrated by computerized bills
- Frustrated with increased automation in my house

II. Factor 2 – "Personal information"

- Hesitant to give personal information to companies
- Companies should never sell stored personal information to other companies
- Companies should have better systems to correct errors in personal information
- Companies should make sure that the personal information in their file is accurate
- Companies should never share personal information unless it has been authorized

III. Factor 3 – "Sharing information"

- Companies should make sure that unauthorized people cannot access personal information in their computers
- Thinking twice before giving out personal information
- People should refuse to give information to a business if they think it is too personal

Three factors for privacy behavior and their components can be listed as follows:

I. Factor 1 – “Technology usage”

- Regularly use a cellular telephone
- Regularly buy and shop items on the internet
- Regularly use online banking services
- Regularly use a credit or debit card for making purchases

II. Factor 2 – “Privacy actions”

- You asked a firm to remove you from their mailing list in the last year
- You joined a “Do Not Call” phone list to reduce unwanted calls
- Avoid purchasing from a certain firm because of their privacy policy
- Regularly destroy personal documents using a paper shredder

III. Factor 3 – “Sharing information”

- Likelihood of buying by phone and entering sweepstakes.
- In both cases, people are voluntarily giving up information.

Hypothesis 1: Education is related to support for each of the RFID applications

T-values for education are not significant. Hence, the hypothesis does not hold true.

Hypothesis2: Income is related to support for each of the RFID applications

T-values for income are not significant. Hence, the hypothesis does not hold true.

Hypothesis3: Religiousness is related to support for each of the RFID applications

T-values for religiousness are significant for in case of produce. Hence, religiousness is related to support for RFID applications for produce. However, religiousness is not related to support for RFID applications for meat.

Hypothesis 4: Privacy attitudes are related to support

T-values for privacy attitudes are significant for produce as well as meat. Hence, privacy attitudes are related to RFID applications for both produce and meat.

Hypothesis 5: Privacy behaviors are related to support

T-values for privacy behaviors are significant for produce. Hence, privacy behaviors are related to RFID applications for produce.

TOBIT analysis results for produce:

Parameter Estimates

Parameter	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	6.181414	0.523975	11.80	<.0001
YesRelig	1	-0.733992	0.285148	-2.57	0.0101
SomColDeg	1	-0.416870	0.445951	-0.93	0.3499
PostColl	1	-0.456640	0.531811	-0.86	0.3905
Incom2	1	-0.398092	0.454040	-0.88	0.3806
Incom3	1	0.261724	0.482124	0.54	0.5872
Incom4	1	0.523603	0.481588	1.09	0.2769
FAC1_1	1	-0.462425	0.154816	-2.99	0.0028
FAC2_1	1	0.101210	0.143420	0.71	0.4804
FAC3_1	1	-0.122685	0.149078	-0.82	0.4105
FAC1_2	1	0.301996	0.164929	1.83	0.0671
FAC2_2	1	-0.069357	0.152998	-0.45	0.6503
FAC3_2	1	0.185837	0.144312	1.29	0.1978
_Sigma	1	2.210401	0.126982	17.41	<.0001

TOBIT analysis results for meat:

Parameter Estimates

Parameter	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	5.324989	0.657241	8.10	<.0001
YesRelig	1	-0.415152	0.364028	-1.14	0.2541
SomColDeg	1	-0.262078	0.572330	-0.46	0.6470
PostColl	1	-0.058158	0.681102	-0.09	0.9320
Incom2	1	-0.036445	0.579077	-0.06	0.9498
Incom3	1	0.117746	0.612364	0.19	0.8475
Incom4	1	0.954418	0.610965	1.56	0.1183
FAC1_1	1	-0.496464	0.197368	-2.52	0.0119
FAC2_1	1	0.370572	0.181377	2.04	0.0410
FAC3_1	1	-0.257052	0.191440	-1.34	0.1794
FAC1_2	1	0.250355	0.211175	1.19	0.2358
FAC2_2	1	-0.224753	0.196252	-1.15	0.2521
FAC3_2	1	0.133940	0.182889	0.73	0.4640
_Sigma	1	2.810533	0.168885	16.64	<.0001

Conclusions:

We found a wide variety of opinions among consumers regarding the traceability of food and meat products. There was also a considerable difference in consumers' opinions about the traceability of food items in comparison to traceability of meat items. For produce traceability, there was a significant correlation between consumers' religiousness and their attitudes towards traceability. This correlation turned out to be negative using the TOBIT analysis. Meaning, regular Church goers are not in favor of implementation of traceability systems in produce items. Another relevant factor for food items was automation concern among consumers'. Consumers' with concern towards automation were against the implementation of RFID enabled traceability system. Regular technology users were generally in favor of traceability systems. This was not a surprise as these consumers' were already comfortable with technology in other realms of their lives. The last significant factor produce traceability was consumers' concern for sharing information. The results for meat traceability were noticeably different from the results for produce. The two significant factors in this case were automation concern and consumers' willingness to share personal information. There was a negative correlation between consumers' concern about automation and their support for traceability implementation. Consumers willing to share personal information had a favorable attitude towards traceability.

In conclusion, there is real anxiety and concern among consumers about RFID enabled traceability systems. Religion as turns out plays an important role in their attitudes towards traceability. Another significant concern among consumers is sharing personal information.

Stakeholders in food industry need to take into consideration these consumers' attitudes and behavior apart from looking at economic feasibility of traceability systems.

Appendix I:

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 >>>>>>>>>>> Neutral >>>>>>>>>>> Strongly
Agree **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

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!

Summary of statistical results:

The SAS System 09:08 Sunday, December 19, 2010 1

The QLIM Procedure

Summary Statistics of Continuous Responses

Variable	Mean	Standard Error	Type	Lower Bound	Upper Bound	N Obs Lower Bound	N Obs Upper Bound
q8_fruit	5.242754	1.676290	Censored	1	7	15	79

Model Fit Summary

Number of Endogenous Variables	1
Endogenous Variable	q8_fruit
Number of Observations	276
Log Likelihood	-492.06845
Maximum Absolute Gradient	5.55438E-6
Number of Iterations	21
Optimization Method	Newton-Raphson
AIC	1012
Schwarz Criterion	1063

Algorithm converged.

Parameter Estimates

Parameter	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	6.181414	0.523975	11.80	<.0001
YesRelig	1	-0.733992	0.285148	-2.57	0.0101
SomColDeg	1	-0.416870	0.445951	-0.93	0.3499
PostColl	1	-0.456640	0.531811	-0.86	0.3905
Incom2	1	-0.398092	0.454040	-0.88	0.3806
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FAC1_1	1	-0.462425	0.154816	-2.99	0.0028
FAC2_1	1	0.101210	0.143420	0.71	0.4804
FAC3_1	1	-0.122685	0.149078	-0.82	0.4105
FAC1_2	1	0.301996	0.164929	1.83	0.0671
FAC2_2	1	-0.069357	0.152998	-0.45	0.6503
FAC3_2	1	0.185837	0.144312	1.29	0.1978
_Sigma	1	2.210401	0.126982	17.41	<.0001

The QLIM Procedure

Summary Statistics of Continuous Responses

Variable	Mean	Standard Error	Type	Lower Bound	Upper Bound	N Obs Lower Bound	N Obs Upper Bound
q10_live	4.873188	1.987746	Censored	1	7	25	80

Model Fit Summary

Number of Endogenous Variables	1
Endogenous Variable	q10_live
Number of Observations	276
Log Likelihood	-519.62923
Maximum Absolute Gradient	6.43167E-7
Number of Iterations	24
Optimization Method	Newton-Raphson
AIC	1067
Schwarz Criterion	1118

Algorithm converged.

Parameter Estimates

Parameter	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	5.324989	0.657241	8.10	<.0001
YesRelig	1	-0.415152	0.364028	-1.14	0.2541
SomColDeg	1	-0.262078	0.572330	-0.46	0.6470
PostColl	1	-0.058158	0.681102	-0.09	0.9320
Incom2	1	-0.036445	0.579077	-0.06	0.9498
Incom3	1	0.117746	0.612364	0.19	0.8475
Incom4	1	0.954418	0.610965	1.56	0.1183
FAC1_1	1	-0.496464	0.197368	-2.52	0.0119
FAC2_1	1	0.370572	0.181377	2.04	0.0410
FAC3_1	1	-0.257052	0.191440	-1.34	0.1794
FAC1_2	1	0.250355	0.211175	1.19	0.2358
FAC2_2	1	-0.224753	0.196252	-1.15	0.2521
FAC3_2	1	0.133940	0.182889	0.73	0.4640
_Sigma	1	2.810533	0.168885	16.64	<.0001

Presentation

Consumers' attitudes towards traceability of food products

Kulmani Rana
Lee Honors College
Western Michigan University

Traceability: Overview

There is no single universally accepted definition of traceability

- A generic definition for traceability is given by ISO 9000:2000 as the "ability to trace the history, application or location of that which is under consideration (ISO, 2000)
- Broad definitions of traceability offered by various researchers do not address key operational issues

Traceability: Overview

USDA attributes three major characteristics to a traceability system

- Breadth: amount of information the traceability systems store
- Depth: how far back or forward a system tracks
- Precision: the degree of assurances with which the system can pinpoint a food's movements/characteristics

RFID: The Basics

Radio frequency tags present a robust and potentially cost effective solution for tracking meat and produce

- Unaffected by contamination
- With an appropriate enclosure, can withstand both the temperatures and chemicals used in cleaning and disinfection

RFID: The Basics

The basic RF tag apparatus consisting of:

- A tamper - proof device permanently attached or implanted, termed the *identifier*
- An *activating/reading device* (both the electronic identifier and reader must have an antenna)
- *Software* (electronic recordings and transfer of data is far more accurate than in formation written by hand)

Classifications of RF tags

Active Tags:

- Catch the attention of the RFID reader by broadcasting a signal
- Function with battery power
- Work over a greater distance and are more
- Are generally readable only by proprietary technology of the tag's manufacturer

Classifications of RF tags

Passive Tags:

- Only react to an interrogator's contact signal
- Communicate without battery power
- Derive power from the interrogator antenna's electromagnetic field
- Soon will be able to be read by a variety of equipment

Semi-Active Tags

Classifications of RF tags

Read-Only Vs Read/Write Tags:

- Read-Only tags are preset to a specific number and retain that information throughout their life
- Read/Write tags can be written to by an appropriate read/write device
- Read/Write tags could be reprogrammed by hackers (malware could be loaded into their memories)

Meat traceability in US and Other Countries

- U.S. pork system ranks last compared to systems in UK, Denmark, Canada, Japan, Australia and New Zealand for traceability, transparency, and assurance (TTA)
- U.S. pork industry may diminish its competitive advantage in world pork markets if it fails to enhance TTA

Meat traceability in US and Other Countries

Study on consumers' WTP for red meat traceability in the US, Canada, the UK, and Japan

- Results were consistent with the studies: consumers are willing to pay a nontrivial premium for traceability
- Same consumers show even higher WTP for traceability-provided features such as additional meat safety and humane animal treatment assurance

Meat traceability in US and Other Countries

- Traceability is standard in EU food systems
- US meat industry has a different approach
  - Favors private, rent-seeking activities related to traceability rather than a regulatory solution
  - Needs to be eventually mandated, free of significant regional differences
  - A voluntary identification program will lead to two distinctive markets (those with identification and those without)

Consumer perceptions in different countries

- German consumers: interested in whether a product was produced using organic production methods
- French consumers: link quality label, quality and taste as well as safety label and the concept of healthy/heath
- Italian consumers: derive pleasure from buying products that are perceived as better.
- Spanish consumers: quality perception derived from origin, price, reputation, and European Origin label

Food Traceability in US

- Recent high-profile recalls has turned traceability into one of the most significant issues since the birth of scanning in 1974.
- USDA's mandatory country-of-origin labeling (COOL) in 2004 lead food retailers to start evaluating RFID technology as a potential answer to the demand for increased accountability

Concerns about RFID

- Consumers' concerns regarding *ethical and privacy liberties* particularly in case of RFID
  - In the US, there is an evolving debate between privacy groups, retailers and government agencies on the use of RFID for tracking consumer purchases
- In case of RFID, consumers showed concern about the impact of radio waves on their health

Methodology

- A total of 4900 surveys were sent out to consumers in the states of Michigan, Indiana, Illinois, and Ohio
  - 6.44% of the surveys were returned because of incorrect addresses
- To test incentives, 450 survey envelopes included one dollar bills
  - These had a return rate of 22%
- To test personalization, 450 survey envelopes had hand-written notes, thanking consumers for filling out the survey
  - These had a return rate of 6.6%

Methodology

- The rest of the surveys were sent out without any incentive
  - These had a return rate of 5.8%
- A total of 340 survey responses were returned
  - 276 were usable for this research
- Responses were entered in to an excel worksheet.
- Summary statistics and factor analyses were generated with SPSS and hypotheses were tested using SAS

Factor Analysis

- Responses to 13 privacy attitude statements (used in other studies) were included in a factor analysis
  - 3 factors emerged
- Responses to 10 privacy behavior questions were included in a factor analysis
  - 3 additional factors emerged

Attitude Factor Analysis

Rotated Component Matrix[a]

	Component		
	1	2	3
PS_1_[illegible]	.065	[illegible]	[illegible]
PS_2_Com	.065	.763	-.051
PS_3_[illegible]	[illegible]	[illegible]	[illegible]
PS_4_Att	.611	.235	[illegible]
PS_5_Sel	[illegible]	.592	[illegible]
PS_6_[illegible]	[illegible]	[illegible]	[illegible]
PS_7_En	.205	[illegible]	[illegible]
PS_8_Bu	.415	.273	.590
PS_9_[illegible]	.212	.711	[illegible]
PS_10_Sha	-.094	.523	.314
PS_11_[illegible]	[illegible]	-.022	.071
PS_13_Aut	[illegible]	-.022	[illegible]
PS_14_Ref	.097	.012	[illegible]

Privacy Attitude Factors

Factor 1 – "Automation concerns"

- Anxious and concerned about pace of automation
- Afraid that data processing department will lose my data
- Computers are a threat to privacy
- Frustrated by computerized bills
- Frustrated with increased automation in my house

Privacy Attitude Factors

Factor 2 – "Personal information"

- Hesitant to give personal information to companies
- Companies should never sell stored personal information to other companies
- Companies should have better systems to correct errors in personal information
- Companies should make sure that the personal information in their file is accurate
- Companies should never share personal information unless it has been authorized

Privacy Attitude Factors

Factor 3 – "Sharing information"

- Companies should make sure that unauthorized people cannot access personal information in their computers
- Thinking twice before giving out personal information
- People should refuse to give information to a business if they think it is too personal

Behavior Factor Analysis

Rotated Component Matrix[a]

	Component		
	1	2	3
CellPhone10	547	-058	[illegible]
Internet10	743	073	075
BuyPhone10	211	131	024
Banking10	711	207	-116
Sweeps10	137	077	740
Car10	683	046	077
Remove10	013	756	121
DoNotCall10	[illegible]	601	-027
NotBuy10	-171	701	163
Shred10	123	450	-138

Privacy Behavior Factors

Factor 1 – "Technology usage"

- Regularly use a cellular telephone
- Regularly buy and shop items on the internet
- Regularly use online banking services
- Regularly use a credit or debit card for making purchases

Privacy Behavior Factors

Factor 2 – "Privacy actions"

- Asked a firm to remove you from their mailing list in the last year
- Joined a "Do Not Call" phone list to reduce unwanted calls
- Avoid purchasing from a certain firm because of their privacy policy
- Regularly destroy personal documents using a paper shredder

Privacy Behavior Factors

Factor 3 – "Volunteer Information"

- Regularly shop and buy items by phone
- Regularly enter promotional sweepstakes sponsored by companies

Hypotheses

- Education associated with RFID Tracing Support
  - Higher educated will be more supportive
- Income associated with RFID Tracing Support
  - Households with higher incomes will be more supportive
- Religiosity associated with RFID Tracing Support
  - More religious will be less supportive
- Those expressing stronger privacy attitudes will be less supportive
- Those expressing stronger privacy behaviors will be less supportive

Produce Dependent Variable

- 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.
  - Support for RFID tags on cases and cartons rated on a 7 to 1 scale

Meat Dependent Variable

- 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.
  - Support for system that would add less than 20-cents per meat package was rated on a 7 to 1 scale

TOBIT analysis results for produce

Parameter Estimates

Parameter	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	[illegible]	[illegible]	[illegible]	[illegible]
YesRelig	1	[illegible]	[illegible]	-2.57	0.0101
SomColDeg	1	[illegible]	[illegible]	[illegible]	[illegible]
PostColl	1	[illegible]	[illegible]	-0.86	0.3905
Incom2	1	[illegible]	[illegible]	[illegible]	[illegible]
Incom3	1	[illegible]	[illegible]	[illegible]	[illegible]
Incom4	1	[illegible]	[illegible]	[illegible]	[illegible]
FAC1_1	1	[illegible]	[illegible]	[illegible]	[illegible]
FAC2_1	1	[illegible]	[illegible]	[illegible]	0.4804
FAC3_1	1	[illegible]	[illegible]	[illegible]	[illegible]
FAC1_2	1	[illegible]	[illegible]	[illegible]	0.0671
FAC2_2	1	[illegible]	[illegible]	[illegible]	[illegible]
FAC3_2	1	[illegible]	[illegible]	[illegible]	[illegible]
_Sigma	1	[illegible]	[illegible]	[illegible]	[illegible]

TOBIT analysis results for meat

Parameter Estimates

Parameter	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	5.324900	[illegible]	[illegible]	<.0001
YesRelig	1	-0.415152	[illegible]	-1.14	0.2541
SomColDeg	1	-0.202078	0.572330	[illegible]	[illegible]
PostColl	1	[illegible]	[illegible]	[illegible]	[illegible]
Incom2	1	[illegible]	[illegible]	[illegible]	[illegible]
Incom3	1	[illegible]	0.612364	[illegible]	[illegible]
Incom4	1	[illegible]	[illegible]	[illegible]	[illegible]
FAC1_1	1	[illegible]	[illegible]	-2.52	0.0119
FAC2_1	1	0.379572	[illegible]	2.04	[illegible]
FAC3_1	1	-0.257052	[illegible]	-1.34	[illegible]
FAC1_2	1	[illegible]	[illegible]	1.19	[illegible]
FAC2_2	1	-0.224753	0.196252	-1.15	0.2521
FAC3_2	1	0.139940	0.192089	[illegible]	[illegible]
_Sigma	1	[illegible]	[illegible]	[illegible]	<.0001

Tobit Analysis Results

- Education and income were not linked with RFID support
- Religiosity was only linked with produce RFID support
- Privacy attitude and behavior links varied by RFID application

Conclusions

- Consumers' opinions about the traceability of produce differ from opinions about the traceability of meat
- For produce traceability, more religious people were less supportive of traceability

Conclusions

- A significant attitude factor for produce was automation concern
  - Those concerned with automation were against the implementation of RFID enabled traceability system
- A borderline significant behavior factor for produce was technology usage
  - Consumers with greater technology use were more supportive of produce traceability

Conclusions

- For meat traceability, two significant attitude factors were automation concern and consumers' willingness to share personal information
  - Those with concern about automation were less supportive of RFID traceability implementation
  - Consumers willing to share personal information had a favorable attitude towards traceability

Conclusions

- There is real anxiety and concern among consumers about RFID enabled traceability systems
- Stakeholders in food industry need to take into consideration these consumers' attitudes and behavior apart from looking at economic feasibility of traceability systems

Questions?

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