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Abstract

RFID is a powerful new technology which, in combination with other information technologies, offers great potential for supporting interorganizational collaboration. The case study reported herein suggests that organizations adopting RFID will need to change their technical and organizational processes and make accommodations in response to political and environmental constraints. The study focused on an initiative undertaken by the Wisconsin Livestock Identification Consortium (WLIC). Through it, a large number of disparate organizations are working together to utilize RFID to track livestock movements, thereby helping to mitigate the potentially harmful effects of contagious diseases. This study demonstrates how political and administrative challenges interacted with technical aspects of the interorganizational system design. Suggestions are offered for further research on assimilation of RFID and other emerging technologies in interorganizational contexts.

Introduction

Emerging technologies pose an ongoing challenge for public- and private- sector organizations, while giving rise to new opportunities to improve organizational and interorganizational processes. The case study described herein examines the assimilation of a new technology (RFID) in an interorganizational context which, due to public health ramifications, demands a very high participation rate by a variety of organizations. The Wisconsin Livestock Identification Consortium (hereafter, WLIC or "the Consortium"), in an attempt to address concerns about the potential spread of contagious diseases such as Hoof-and-Mouth disease and Mad Cow disease, sought to institute new procedures for animal identification and tracking, using national and/or state standards for data representation, RFID tags and reader, and related procedures. The study reveals that political and administrative challenges interacted with technical aspects of the interorganizational system design.

The paper begins with an abbreviated review of previous research, concluding with the questions that guided this study. We next describe the methodology employed, followed by a summary of the key actors, events, and decisions of the WLIC. After discussion of political, administrative and technical challenges they faced, we discuss the implications and limitations of the study, and offer suggestions for further research.

Previous Research

A long line of diffusion-of-innovations studies have examined *individual* adoption *(*e.g., see Tan and Teo, 2000), *organizational* adoption (e.g., Angeles and Nath, 2000; Gallivan, 2001) and, to a lesser extent, *interorganizational* adoption

of emerging technologies and systems (see Elliot and Loebbecke, 2000; Teo, et al, 2003). Elliot and Loebbecke (op cit.), in a cross-case comparison of smart-card initiatives, calledi for further research on interorganizational innovations.

Many previous studies of interorganizational systems in the public and private sectors emphasized technical challenges, including ensuring the quality of shared data (Gosain, et al., 2004-05), reaching agreements on interoperability standards (Kumar and Crook, 1999; Gogan, 2005), and accommodating participants' varied IT architectures and levels of technical sophistication (Angeles and Nath, 2000; Truman, 2000). Careful attention to these and other technical issues is a necessary, but not sufficient, condition for success (Gil-Garcia and Pardo, 2005; Markus, 2005). Each participant comes to the table with a different level of readiness (Chwelos, et al., 2001). Distrust can create powerful barriers to adoption and use (Hart and Saunders, 1998; Han, et al., 2004). Regulatory and commercial pressures (Teo, et al., 2003), aspects of the specific interorganizational context (Chatfield, et al., 2000), and intermediating institutions (Damsgaard and Lyytinen, 2001; Provan and Milward, 2001) can influence implementation choices. Clearly, careful attention to these administrative and political factors is needed to ensure the successful introduction of emerging technologies (Fedorowicz et al, 2006; Pardo et al. 2004). Thus, we focus on one of the "central research questions" posed by Fichman (2004) aimed at understanding the interplay among these factors: "Which holistic combinations of factors explain IT innovation outcomes on large-scale deployment efforts?" by examining a broad range of technical, administrative and political factors in our analysis.

Previous studies of RFID adoption recognize that it leads to changes in existing business processes within and across organizational boundaries (Knebel et al., 2006; Wamba et al., 2006). Most studies focus on gauging the impacts of RFID on intra- and interorganizational processes (e.g., Subirana et al., 2003) or they concentrate on the technical abilities and deficiencies of current generation tags and readers (Sarma, 2004; Wyld, 2005). Wyld's (2005), discussion of the main technology-based implementation issues involved in animal identification, keying on identification technology features, technology costs, and data privacy, concludes with a recommendation that adopters seek out secondary operational benefits. In so doing, these researchers also point to a range of technical, administrative and political factors as significant determinants of the success of RFID adoption.

Research Questions and Methodology

Our literature review (condensed above) reveals that technical, political, and administrative challenges affect the diffusion, adoption and use of emerging technologies. These challenges are best understood when examined in the interorganizational contexts in which they are situated and with a focus on their interaction; thus, a field-based case study is an appropriate research methodology (Klein and Myers, 1999; Walsham, 1995; Yin, 2002). We posed the following questions to guide this RFID case study:

> RQ1: What technical, political and administrative challenges face participants in an interorganizational collaboration?
>
> RQ2: How do political, administrative and technical challenges interact to affect the success of the interorganizational collaboration?
>
> RQ3: What impact does an emerging technology have on decision-making in an interorganizational context?

This case study relied on both primary and secondary sources. First, a search was conducted to locate news stories related to use of RFID chips in animal identification, and to identify key actors involved with the National Animal Identification System and the Wisconsin Livestock Identification Consortium (WLIC). Interviews of one to two hours each were conducted in September, 2005 with three key informants from the Wisconsin initiative: Chairman of the WLIC board of directors, Chief Operating Officer, and the individual who was most responsible for the formation of the WLIC. Interviewees were asked to describe their own and others' roles in promoting the animal identification regulations and systems, the relationship between their efforts in Wisconsin and the national animal identification agenda, and their views of the political, administrative and technical challenges that the Wisconsin Consortium faced.

Interviews were recorded and professionally transcribed. Following the interviews, a focused search of the WLIC and NAIS web sites, as well as additional review of news sources, was conducted to corroborate assertions made in the interviews with published sources.

The Wisconsin Livestock Identification Initiative

In the past, U.S. animals have been identified through official animal disease eradication programs such as vaccination against brucellosis in the 1930s, forties and fifties. When that disease was essentially eliminated in the sixties, states began to withdraw this requirement, and as a result, also lost the ability to trace herds.

In 1995, a heifer infected with tuberculosis crossed into Wisconsin from Michigan and commingled with other heifers that were part of a multiple ovulation embryo program. This unfortunate event resulted in the shutdown of one of only two bovine breeding programs in the world, at a cost of $1 million to the company, 21st Century Genetics. It took a long time to track the infected animal because intra-state movements of animals were not regulated; there was no system to identify where an animal came from, where it had been, and those that had come in contact with it. The former general manager of 21st Century Genetics initiated talks with a small number of influential people in Wisconsin agriculture to explore various options for rapid tracking of Wisconsin farm animals.

In February 2001, one million domestic animals were slaughtered in Britain as a result of an outbreak of foot-and-mouth disease. Fearing the disease would spread to North America, in 2002 a group of farmers established the Wisconsin Livestock Identification Consortium (WLIC) with start-up funds from the state. The 2002 European outbreak of Bovine Spongiform Encephalopathy (BSE, or "mad cow" disease) intensified concern and spurred the U.S. Department of Agriculture (USDA) to establish a National Animal Identification System, or NAIS (see http://animalid.aphis.usda.gov). As of February 2007 participation in this system is voluntary. USDA's ultimate goal is an effective, uniform national animal tracking system. When fully operational, it is designed to allow animal tracing within 48 hours of detection of disease in a participating animal, which will ensure rapid containment and protection of American animals. The Wisconsin consortium developed the system that was adopted by the USDA.

The Wisconsin Livestock Identification Consortium (see www.wiid.org) is a multi-species effort led by Wisconsin's livestock and industry organizations in cooperation with the Wisconsin Department of Agriculture, Trade and Consumer Protection, the USDA and the University of Wisconsin Extension. As of March 2005, 58 livestock industry groups had joined WLIC and were working to implement the National Animal Identification System in Wisconsin. They elected a board of directors whose 12 members actively participate in the Consortium through quarterly and annual meetings, various committees, and "hands-on" pilot projects. The board establishes objectives and governing policies.

Implementation of NAIS entails three major steps. The first will identify premises that produce, house, hold or manage animals, using a unique seven-character national identifier. The rules and regulations, data collection and storage attached to premises registration are under the authority of each state's Department of Agriculture. The second step (not yet implemented in Wisconsin at the time of our study) is animal identification, which will require either a 15 digit unique individual animal ID number (AIN), or a 13-character Group/Lot identification number (GIN). For individual identification, a distributor will provide RFID ear tags, and the distributor will forward those animal identification numbers (AIN's) which were allocated to the premises to the state and/or national animal identification database. The third step (also not yet implemented) will be animal tracking through a one number/one animal system. The ID number will be read by stationary electronic readers as animals move through livestock markets and slaughter facilities. Producers may elect to obtain equipment to read the ID tags of animals moving from farm to farm, and buyers of unrecorded animals will need to report these movements to the state or national database. USDA expects mandatory premises registration and animal identification in the NAIS by January 2008 and mandatory reporting of animal movements by January 2009 (USDA, 2007).

The Wisconsin Premises Registration Act (Wisconsin Act 229), effective November 2005, requires registration with the Department of Agriculture, Trade and Consumer Protection for any location where livestock congregate. Registration by anyone who keeps, houses, or co-mingles livestock became mandatory in Wisconsin as of January 1, 2006. WLIC administers premises identification in the state as an agent of the Wisconsin Department of Agriculture, Trade and Consumer Protection, which retains authority for compliance and prosecution of violators who face a $1,000 penalty per instance. The information is kept in a confidential database accessible to animal health officials.

As of February 2006 more than 45,000 premises of the predicted 60,000 to 70,000 livestock premises in the state had been registered. Wisconsin helped shape the NAIS standards and procedures and was an early adopter; its registrations represent nearly 25 percent of the 180,000 premises registered nationwide at the end of November 2005. In a May 5, 2005 press

release, Rod Nilsestuen, Wisconsin's Secretary of Agriculture, Trade and Consumer Protection stated: "Wisconsin set the example for the nation when it came to premises registration and now we're setting the pace, too." (WLIC, 2005).

Table 1. Wisconsin Livestock Identification Consortium Case Summary

Aim	track infected and potentially-infected livestock
Collaborators	state agencies + Private sector businesses + industry associations
Stakeholders	Farmers, hobbyists, public health, USDA
Governance	Consortium of business and government leaders
Project Stage	Phase I (premises identification)

Findings: Intersection of Political, Administrative, and Technical Challenges

In the next sections, we discuss defining moments and hurdles within the collaboration. In answer to RQ1, we undertake to categorize these as political, administrative or technical in nature. In so doing, it becomes apparent that many of the issues facing the collaborators posed challenges with implications for more than one of these categories, demonstrating that the complexities found in the real world do not readily lend themselves to discrete classification. This leads to examination of RQ2, which seeks to identify patterns of interaction among the three. RQ3 is addressed primarily in the section on technical challenges as it reflects on the nature of new technology introduction.

Political Challenges

There are two critical tasks associated with initiating a collaboration: recruiting participants and crafting shared goals. Livestock identification in Wisconsin found its first champion in a politically well-connected figure whose breeding business incurred a $1 million loss from a tuberculosis-infected heifer that co-mingled with their bulls. Although he succeeded in recruiting the founding members, it took some time to yield a critical mass of participants. Two subsequent events helped to convince others of the need for livestock identification: the 2001 outbreak of foot-and-mouth disease in Europe and the December 2003 report of the first U.S. case of mad cow disease.

WLIC leaders expressed surprise at how much time and resources were required for education and outreach activities. Recruitment challenges varied by species group. Wisconsin dairy farmers came on board early. These farmers had past experience with infectious disease outbreaks. Also, through breeding and herd management programs, many already tag animals at birth and record data about them. Premises identification (phase one) was not seen as a large step, but it is not yet clear how Wisconsin farmers will respond to phase two (animal identification). Our informants predicted that affixing RFID tags to dairy cows would not be a problem in Wisconsin. In nearby Michigan, large farmers support tagging, but many small dairy farmers oppose it. Individual hobby-owners of horses in Wisconsin viewed identification and tracking as an unnecessary burden despite a potential public health risk: horses have been shown to carry tuberculosis from one location to another, especially when they have been in areas where tuberculosis-positive deer live. Other farmers, such as pork producers, have also indicated a reluctance to participate.

Politically well-connected leadership has been helpful thus far. Current WLIC chair Deb Reinhart discussed this aspect:

> "…Because we piloted the premises identification plan for the USDA, and because we've been at the table on this issue, we've had a lot of influence with our legislators in Washington. Nationally we have influence. When we attend national meetings on the issues, attendees want to hear what we have to say. It amazes me to see the response we get and the amount of teaching that we are doing in the industry."

Interviewees explained that the Wisconsin Premises Registration Act of 2004 gave the tagging initiative momentum and won accolades for the state as a pace-setter in animal identification. The initiative also benefited from its positioning within the federal National Animal Identification System (NAIS), which set a target of mandatory premises registration by 2008 and mandatory animal movement reporting by 2009.

Administrative Challenges

A well-designed governance structure ensures that stakeholders have a voice and that administrative structures do not become bureaucratic roadblocks. The livestock identification initiative first came together in an ad hoc manner, and subsequently the governance structure was formalized with a vision, mission statement, a 12-member board of directors, and bylaws. WLIC leaders struggled with how to include relevant stakeholders. The dairy industry is very strong in Wisconsin, but it was also necessary to include others, such as swine and poultry farmers. As new participants joined the WLIC, they wanted a say in its direction and in specific aspects of the tagging initiative. According to its current head,

> "The new model is to find consensus on our board and encourage them to look at the middle ground. Often, as the chair of this consortium, I feel like a driver at the head of a team of horses, trying to get the team headed in the same direction and pulling in tandem. Each species group has agreed to work together. Our goal now is to get more inclusive representation by adding horse breeders, chicken or pig farms, etc. to the board. It has proven difficult in this dairy state to get other interests elected to the board so their needs can be understood and addressed. "

The WLIC governance model helped to ensure broad representation, but participants sometimes became bogged down in cumbersome deliberations. Leaders walked a fine line between inclusion of affected stakeholders and limiting the size of the governing organization to best propel it forward.

The WLIC director described another administrative challenge: identifying all livestock premises, especially the small hobby farmers with a few emus, ostriches, or horses.

> "This has never been done. We have nothing to reference it against, so now if there are 70,000 premises, and we get 40,000 premises registered, how do we get the other 30,000? The problem is we don't know if there are 70,000; we don't know if there's 90,000."

To capitalize on RFID technology, farmers and government agencies needed to make changes in their operations. Some implementation issues were minimized by virtue of the phased implementation approach: premises identification, followed by animal identification, and culminating in animal tracking. Phasing can help to minimize organizational disruption and control costs.

Financial viability was an ongoing challenge. The long lead time needed for governmental budget requests increases the challenge of obtaining ongoing support. For the WLIC, initial funding took a long time and hard work to procure. According to one of the founding members:

> "We struggled along for 3 years and then we had connections with the National Coop Business Association and we paid dues to them; we were on the board of that organization and I was chairman of it. We got their lobbyist to help us and were able to get some money earmarked for the program. That's how the initial funding came."

Today the Wisconsin initiative is supported by a mix of state and federal sources. An Agricultural Diversification Development grant from the Wisconsin Department of Agriculture, Trade and Consumer Protection provided initial funding. Congress appropriated $750,000 in year one and $1 million in years two and three to the USDA/APHIS/Veterinary Service to establish a cooperative agreement with WLIC.

However, their financial situation is tenuous because the State legislature took away the consortium's ability to charge a $20 per head producer fee; instead they must rely on state tax dollars and federal money. Apart from the $150/year membership fee, the Wisconsin Consortium has no way to raise revenue.

Technical Challenges

Technical challenges intersected with administrative and political challenges, especially around three key issues: *data sharing/privacy*, *cost of participation*, and *agreeing upon technology standards* (RQ2). Many of the technical questions and concerns raised by producers resulted directly from factors bearing on RQ3, namely that RFID technology:

- is relatively new,
- exists in many formats to accommodate different needs and constraints,

- has yet to achieve agreement on technical standards, and
- is, for the most part, untapped as a widespread and long term solution.

The WLIC has begun collecting data within the state, while awaiting a national repository which does not yet exist. Many separate national initiatives already capture some of the necessary animal identification data (such as one used by dairy improvement cooperatives around the country), but these do not gather all the data required for 48 hour animal trace-back. Private state associations collect beef cattle and hog data, but a centralized, national view is needed because animals often move across state lines.

The timeliness of data flows supporting collaboration across agencies represents another important challenge. The faster the data must flow from creation or source to use, the greater the data and process management challenges. Consistent with NAIS, Wisconsin aspires to reach a 48 hour trace back capability.

Europe and Canada have national-level repositories, but for some time, the U.S. Department of Agriculture's position was that private industry should collect the data. Recently USDA announced they will develop the necessary software to connect across the various databases so that queries can be run as if there was a central database. Cattle ranchers and other agricultural leaders are uncomfortable about revealing information regarding farm locations, number of animals owned, and other proprietary information. They fear that competitors, environmental groups or others could use this information in ways that would be detrimental to individual farmers or to the industry as a whole. So, implementation of a virtual national repository will require careful balancing of these concerns with food safety concerns.

Some producers are concerned about the costs they will incur for RFID tags and readers. One interviewee informed us that 30 million calves are born per year. If an RFID tag costs $2.00 to $5.00, farmers would spend $60 to $150 million on tags. Readers currently cost in the thousands of dollars. Large-scale farmers were quite concerned with the cumulative cost of RFID tags (multiplied across large herds), but less concerned about the cost of tag readers (one reader handles many animals). Small farmers' concerns were opposite: for them, the tag reader cost was significant. The USDA has taken a "technology-neutral" position on equipment standards. This uncertainty, plus the expectation that RFID costs will drop significantly in the next few years, has led many farmers to adopt a wait-and-see stance.

Competing technologies vie for de facto or de jure ratification, which creates uncertainty for collaborators in many industries, a challenge also facing WLIC. For example, The NAIS specifies data standards (the numbering scheme), but as of our case study, NAIS described these as "voluntary." Wisconsin adopted the suggested standards and made them mandatory for participants. This aspect did not engender any controversy; however, the lack of standards for tags and tag readers created a lot of uncertainty. USDA had not (and as of winter 2007, still has not) specified national standards for livestock management tags and tag readers. Different technologies, including multiple forms of RFID tags, have been heavily promoted by different vendors and adopted by different individual producers and industry and state organizations. Dairy farmers tend to prefer large, inexpensive ear-clip tags, which show-horse owners abhorred. So, even though many farmers do adhere to the voluntary data standards, or are prepared to do so, there is a great deal of confusion about how to record, collect and protect the data, and this is impeding adoption. Since NAIS data are collected at the state level, efforts to combine states' data into a national database also may be hindered by these choices.

Discussion and Suggestions for Further Research

The WLIC faced political, administrative and technical challenges from within participating organizations, from within the governing organization, and from sources external to the initiative. We observed in this case study that seemingly unrelated decisions can affect the selection, design or use of new IT applications in unexpected ways.

This case demonstrates that a compelling event like a disease outbreak will not necessarily lead to process changes or adoption of appropriate technologies for coping with such events. Instead, our findings suggest that one or more effective leaders are needed to interpret such a crisis or threats and to issue a compelling call to action. Legislative and regulatory requirements helped to reinforce this call to action, but did not in themselves provide the catalyst that propelled the initiative forward.

The case also suggests that long-term use of new technologies for interorganizational collaboration requires active long-term management, especially when current and potential participants fall into divergent stakeholder groups, in this case based on animal species. The governance structures need to reflect the interests of these varied stakeholder groups, yet be flexible

since these groups, their alliances, and their agendas may change over time. Leaders must recognize each participating organization's level of technical and organizational readiness. It is easy to underestimate the resources needed to recruit, retain, train, and support participants. A phased-in timetable can address some challenges, but external political constraints may impede progress nonetheless. Adoption and ongoing use depend on achieving operational value for all stakeholders in excess of their perceived costs and risks.

The tagging initiative was introduced as a mechanism to cope with outbreaks of mad cow or foot-and-mouth disease, which thus far have been quite rare. Some potential participants apparently do not feel there is a great threat. To achieve full compliance, leaders may need to articulate other benefits from the use of identification technologies. Or, they may need to find ways to share the costs of RFID adoption so that participants feel it is less of a burden in comparison with the uncertain benefits.

In the WLIC initiative, technical challenges rarely played a prominent role in isolation, yet they sometimes had a strong indirect impact through their interaction with political and administrative issues. For example, some constituents expressed great concern with the basic goals of the initiative, and balked at taking the first step. Other constituents questioned particular design choices. The question of which RFID standards to adopt for the animal tags and tag-reading equipment became most pressing when seen through the eyes of different stakeholders (i.e., animal species owners).

Designing and then getting users to adopt new technologies for interorganizational collaboration is easiest when eventual participants already adhere to common standards and adopt common hardware and software sourcing rules. Where standards and sourcing guidelines are missing or varied in present use, the options are more risky: either get the participants to agree to pay for and locally implement a common standard and sourcing agreement to replace the existing Babel; impose standards and sourcing mandates externally and risk user resistance; ignore standards and leave connectivity and translation up to each participant; or centrally build many costly and cumbersome translating bridges among member systems.

Compared with a multiple-case or large-sample study, a single-case study can offer a richer picture of the interaction among variables. This study demonstrated a high degree of interaction among political, administrative and technical aspects. A limitation is that we interviewed just three key informants and relied heavily on information from published sources to round out the details. A richer picture can be painted, and further insights obtained, if a larger number of stakeholders are interviewed – especially if interviews are conducted at several points in time, to capture unfolding events and decisions. Further insights could be attained by conducting follow-up interviews as the WLIC initiative proceeds to the next phases, and by employing snowball sampling to identify other key informants. Additional case studies could also yield new insights. Careful selection of other states' animal identification initiatives can allow researchers to hold some of the enabling technologies and other factors reasonably constant and observe the impact of different managerial approaches on outcomes. Beyond animal identification, study of other interorganizational initiatives that involve new IT applications can lead to further insights gleaned from cross-case comparisons (e.g., Fedorowicz, et al., 2006).

Every organization faces the ongoing challenge of identifying and assessing useful new information technologies, choosing which ones to adopt, and making the necessary changes in administrative processes and other systems to maximize the attainment of expected benefits. Some technologies offer especially compelling benefits when organizations use them to collaborate with other organizations, including sharing data and managing interorganizational processes. Our study contributes to understanding this latter category of emerging technology opportunity. We encourage other researchers to gather additional data from field-based case studies, with an aim to developing further guidance for practitioners and further insights for theories of interorganizational collaboration, diffusion of innovations, and others.

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