Summary Results: Equine

Conducting a benefit-cost analysis of NAIS adoption in the equine industry was a significant challenge. Even published data on horse population in the United States have a wide range of estimates including from around five million to more than nine million horses. Collecting accurate equine data is a challenge because a considerable number of horse owners are not included in USDA surveys as many are not farm operations. As a result, we rely heavily on surveys and private industry data sources for information on equine population, animal movement and comingling activities, and industry characteristics in our analysis. Because of substantial data limitations in the equine industry analysis, unlike our analysis for livestock and poultry species, we did not estimate separate costs for varying NAIS adoption rates. Our estimates are for 100% of equine owners to adopt each NAIS practice. Rough estimates of varying adoption rates could be made by taking an adoption percentage times the 100% adoption cost.

Direct net present value of cost of 100% adoption of premises registration by equine owners is estimated at $2.7 million annually; adoption of individual horse micro-chipping is $34.5 million; and animal tracing is $38.7 million. The total annual estimated net present value of direct cost of 100% adoption of all three NAIS activities is $75.9 million per year.

Benefits of NAIS adoption in the equine industry are potentially numerous. However, the largest benefits appear to be from animal health surveillance, potential endemic disease eradication, and export market access in the event of a major equine disease outbreak. Annual costs of Equine Infectious Anemia (EIA) testing alone are $57.5 million (75% of total NAIS adoption costs). The equine export market represents some $460 million annually. Any major equine disease outbreak would adversely affect the equine export market. Though our analysis is unable to definitively conclude whether the benefits of full NAIS adoption in the equine industry exceed adoption costs, if adoption were able to eradicate diseases such as EIA and prevent major export market losses, benefits would quickly exceed adoption costs.

Dealing with Uncertainty in Estimates

Generally throughout our study, as assumptions were made especially where ranges of probable costs of NAIS adoption were available, we tended to use either the median or upper range of cost estimates. As such, our cost estimates are likely higher than what industry would experience especially as adjustments are made over time after adopting new technology. As benefits of NAIS adoption were estimated, we focused on benefits associated with animal disease management and likely market access (domestic and export demand impacts) affects of NAIS. Because many more benefits associated with NAIS are likely to accrue, we know that we underestimate potential benefits of adoption. Combined, this means net benefits (benefits minus costs) of adopting NAIS practices likely exceed those presented in our study.

1. Background

ANIMAL IDENTIFICATION HAS EXISTED in a variety of forms in the United States for a long time. For example, brands and brand registry, used primarily for animal ownership verification, have been in place in the United States since the late 1800s. Animal breed registries typically use some form of animal identification for maintaining individual animal records. Several federal and state disease surveillance and eradication programs such as the sheep scrapie, swine pseudorabies and brucellosis, cattle tuberculosis and brucellosis, and equine infectious anemia have required forms of animal identification and/or passports for many years. Most vertebrate animals imported into, or exported out of, the United States must have official identification. Permits are required in addition to Certificates of Veterinary Inspection (CVI) for interstate livestock movement. The vast array of animal identification systems and methods vary by state, by species, and by animal disease surveillance or eradication program. The variation in systems and ID protocols results in inconsistencies, duplication, and inadequate rapid animal tracing relative to a more unified and coordinated system.

Concerns about the overall inability of US animal health officials to rapidly trace animals in the event of an animal health issue motivated industry and government to design more standardized, effective, and efficient animal identification systems. In 2002, the National Identification Development team made up of some 100 animal and livestock industry professionals, brought together by USDA, presented an animal identification plan that became known as the US Animal Identification Plan (USAIP). Through work of numerous animal and livestock industry stakeholders, a plan was developed to establish the USAIP in 2003. The BSE discoveries in Canada and the United States in 2003 heightened interest in a national animal identification system. Since that time, the animal identification plan has been further developed and renamed the National Animal Identification System (NAIS).

NAIS is a voluntary federal program administered by the Animal and Plant Health Inspection Service (APHIS) of the United States Department of Agriculture (USDA). NAIS involves three dimensions of identification: 1) premises registration, 2) animal identification, and 3) animal movement tracking. The main purpose of NAIS is to enhance animal tracing to protect the health of US livestock and poultry. Additional goals of NAIS include monitoring vaccination programs, documenting affected and unaffected regions in a disease outbreak to maintain trade, providing timely animal movement information when needed, and establishing animal health inspection and certification programs. NAIS covers a broad array of animal species with the December 2007 APHIS *Business Plan to Advance Animal Disease Traceability*[1] designating bovine as highest priority for NAIS development; medium priority for porcine, equine, poultry, cervids, and caprine; and low priority for ovine and aquatics. With much of the NAIS designed, the next critically important step in implementation is an assessment of likely economic benefits and costs associated with adoption of the system. Before widespread industry adoption is likely, a better understanding of the types and magnitudes of benefits and costs and who will bear each as NAIS is adopted by industry is essential to understand the direct and indirect economic impacts of such an effort. The purpose of this study is to estimate the benefits and costs of NAIS.

[1] As of the publication date of this report, the most recent version of the *Business Plan to Advance Animal Disease Traceability* was published in September 2008 and is available at: http://animalid.aphis.usda.gov/nais/naislibrary/documents/plans_reports/TraceabilityBusinessPlan%20Ver%201.0%20Sept%202008.pdf.

2. Objectives

THE GENERAL PURPOSE OF THIS PROJECT was to conduct an assessment of the economic benefits and costs of a National Animal Identification System in the United States including premises registration; animal identification systems; and animal movement reporting for major species of cattle, hogs, sheep, poultry and horses and to a limited extent, minor species of bison, goats, cervids, and camelids. In particular, specific objectives were:

1. To determine similar and different attributes and methods of NAIS across species so benefit and cost estimates unique to accepted methods of adopting NAIS techniques could be completed (e.g., individual animal vs. group/lot identification methods).

2. To determine direct benefits and costs for livestock producers who adopt NAIS practices and standards. Different industry sub-sectors for each species are analyzed separately because benefits and costs can differ for different production phases (e.g., cow/calf, backgrounding, and feedlot producers in beef production). Furthermore, benefits and costs are estimated separately for different operation size categories for each major production phase because benefits and costs may not be scale neutral.

3. To determine direct benefits and costs for livestock marketing institutions (e.g., local auction and video markets) as applicable of adopting NAIS practices and standards. Benefits and costs are estimated by operation size category to evaluate differences across alternative operation sizes.

4. To determine direct benefits and costs to livestock slaughtering operations associated with adoption of NAIS practices and standards. Benefits and costs are estimated by operation size to assess scale neutrality.

5. To determine overall short- and long-run net benefits to society from NAIS adoption. We specifically estimate how benefits and costs would accrue to livestock producers, processors, consumers, and state and federal government agencies.

3. Procedure

To accomplish the objectives of this project, several phases of research were completed. These phases included collecting considerable amounts of information, data, and past research. A detailed assessment of costs of adoption and administration of NAIS technology was undertaken, and a sizeable modeling effort was employed to determine short- and long-run benefits and costs. The research process included:

3.1 Literature Review

We conducted a substantial literature review related to benefits and costs of animal ID and traceability systems. Past literature has been used to identify potential benefits and costs, develop estimates of benefits and costs, and parameterize models to analyze the distribution of net benefits across industry segments and society. Discussion of past literature is interspersed as relevant throughout this report and a reference section at the end of the report (section 15) provides a complete reference list. We compiled the body of literature and provided it to APHIS in electronic format to provide ease of investigating in further detail specific information and studies cited in our report and to help provide a foundation for future work.

3.2 Industry Stakeholder Meetings

Our research team conducted more than 50 meetings with more than 100 stakeholders representing a broad range of industry sectors, species, and professional leaders. A complete list of organizations represented in our meetings is provided in Appendix 3. The purpose of these meetings varied depending upon the specific organization or person visited. In general, we gathered information about anticipated costs, potential benefits, challenges, and opportunities associated with NAIS adoption from the perspectives of the stakeholders represented by each organization. Information gleaned from these meetings is integrated in a variety of places throughout this report. Additionally, in Section 13 we summarize related information gleaned from these meetings that is not necessarily incorporated directly into our benefit-cost estimation discussion and analyses.

3.3 Direct Industry Cost Estimation

Estimation of direct costs for premises registration, animal identification, and animal tracing was undertaken to develop a foundation of costs of NAIS adoption in each major directly affected sector by species. Care was taken to complete as accurate an industry-wide representation of these adoption costs as could be completed subject to available data. Detailed methods, assumptions, and estimates of NAIS adoption costs are presented in Sections 4 through 7.

3.4 Government Costs and Benefits

Costs to federal and state government of developing and operating NAIS as well as potential benefits government health organizations would gain from NAIS adoption were estimated to assess governmental impact. Results from these analyses are presented in Section 8.

3.5 Market and Societal Benefit and Cost Allocations

To determine how benefits and costs of premises registration, animal identification, and animal tracing would be reflected in short- and long-run industry sectors and consumers, we developed an economic model (equilibrium displacement model). The model and associated results are documented in Section 9. The equilibrium displacement model is used for estimation and allocation of benefits and costs specifically in the cattle, swine, poultry, and sheep industries.

3.6 Equine Industry Benefits and Costs

Equine represents a substantial economic industry, but one that is quite distinct from meat animal industries from a market supply and demand framework. As such, a separate independent analysis was conducted to estimate benefits and costs of NAIS in the equine industry. The approach used and resulting benefit and cost analysis of NAIS adoption in equine is presented in Section 10.

3.7 Minor Species Benefits and Costs

NAIS includes species that represent a much smaller direct economic impact than the major species addressed in other sections of our report. In particular, deer, elk, goats, bison, and aquatics are included within the NAIS program. Development of comprehensive benefit and cost analyses for these more minor species was not a focus of our study. We provide brief summaries of the extent of animal ID in selected minor species in Section 11.

Preface to Direct Cost Estimation

Before producers are likely to adopt an animal identification (AID) system, they need to know and understand the direct costs to compare with expected benefits. Likewise, if the government were to mandate an NAIS, it is important to understand direct costs that producers would incur. Direct costs are those costs that are incurred to adopt NAIS technology. Estimation of direct costs is the focus of the next four sections of this report. Who actually bears these costs and the associated benefits once market supply and demand adjust is evaluated and reported in a later section of this report (Section 9). This information is also important for policy decisions regarding cost-share, subsidies, etc. that might be put in place to help offset costs for producers.

To estimate direct costs associated with an AID system for bovine, porcine, ovine, and poultry, assumptions as to the type of identification system used were required. In the cattle (bovine) industry, it was assumed the technology used for animal identification would be electronic identification (eID) using Radio Frequency Identification (RFID) ear tags and identification would be on an individual animal basis. For the swine (porcine) industry it was assumed market hogs would be identified with a group/lot ID and cull breeding stock would be identified with a unique visual premises ear tag. Sheep (ovine) industry cost estimates were based on a scrapie program tag for breeding animals and group/lot ID for lambs. For the poultry industry it was assumed group/lot ID would be used for all poultry. These individual animal or group/lot identification methods by species were all based upon the general guidelines developed by the NAIS working groups for each species.

Costs were estimated at the producer level for all four species (beef and dairy cattle, swine, sheep, and poultry) and at the packer level for beef, dairy, swine, and sheep. Because of the integrated nature of the poultry industry, separate costs were not estimated at the packer level. With group/lot ID, additional costs incurred at the packer level are minimal as systems capable of group/lot ID are already in place allowing tracking and traceability of individual groups. Because a high percentage of cattle are sold through auction markets, costs also were estimated for auction markets for beef and dairy cattle. Total costs to the respective industries were estimated under three scenarios: 1) premises registration only; 2) bookend AID system, where animals are identified at birth and at termination (slaughter) without intermittent movement recording; and 3) animal ID with tracing of animal movements. Industry costs of each of these scenarios were estimated at adoption levels ranging from 10 to 100 percent in 10 percent increments. To aid the process of reporting direct costs in the preceding three scenarios, specific costs are categorized as (a) tags and tagging costs; (b) reading costs; and (c) premises registration costs. The next four sections discuss methods and assumptions for estimating NAIS implementation cost for the cattle, swine, sheep, and poultry industries, and include summaries of the cost analysis.

4. Direct Cost Estimates: Bovine

COSTS WERE ESTIMATED BY SEGMENTING the cattle industry into six main groups (referred to as operation types): 1) Beef Cow/Calf, 2) Dairy, 3) Backgrounder (also referred to as Stocker), 4) Feedlot, 5) Auction Yard, and 6) Packing Plant. Estimating costs separately for these different operations makes it possible to see how different segments of the cattle industry would be impacted by adopting NAIS practices.

The Beef Cow/Calf group was defined as all producers who breed cattle for the express purpose of raising and selling a calf crop. The Dairy group was defined as all producers who raise and breed cattle for the express purpose of raising and milking lactating cattle. The Backgrounding group refers to operations that feed weaned animals for a period of time prior to selling them to a feedlot where they are finished. In this analysis, only background operations that buy weaned cattle are included in the cost estimation. Operations that background their own weaned animals would not have the added costs associated with NAIS adoption that a backgrounder who buys market cattle would incur. Feedlot operations are defined as any operation that feeds a weaned animal a concentrated diet for the purpose of selling that animal to a packing plant. Auction yards were defined as any bonded company that sells cattle as a marketing service. Packing plants were defined as any operation that slaughters live animals under government inspection to produce meat products for sale to the public.

The Beef Cow/Calf and the Dairy groups were split into two subcategories: operations that currently identify calves individually and those that do not. Operations that currently identify calves individually use various methods of identification (e.g., plastic ear tags, metal tags, branding, tattoos, etc.). Of the various methods, plastic ear tags is the most common with 80.7% of operations identifying calves individually using this form of ID (USDA 2008q). For this report, all operations that currently identify calves individually are referred to as "tagging operations" and incremental costs associated with RFID are based on a "second tag" used. The breakdown of tagging operations for Cow/Calf producers was based on information reported in the National Animal Health Monitoring System (NAHMS) publication titled *Part 1: Reference of Beef Cow-Calf Management Practices in the United States, 2007-08* (USDA, 2008q). Similarly, the breakdown of tagging operations for Dairy producers was based on information found in the NAHMS report *Dairy 2007 Part I: Reference of Dairy Cattle Health and Management Practices in the United States* (USDA, 2007a). The methods of estimating costs hereafter discussed will apply to both subcategories unless stated otherwise.

The following discussion of cattle industry costs is partitioned according to the six operation types. The Beef Cow/Calf group is followed by the Dairy, Backgrounders, Feedlot, Auction and finally the Packing Plant groups. Each section describes the methods and assumptions used to estimate the cost for that sector. These six group subtotals were summed to find the total final cost for the cattle (bovine) industry. Because some methods and assumptions were employed for two or more groups, the Cow/Calf group will be explained fully; thereafter, if another industry sector uses the same approach as the Cow/Calf groups, the reader is referred to the appropriate subsection in the Cow/Calf section. Also, the following discussion pertains to costs associated with all cattle being identified and movements tracked (i.e., Scenario 3 listed above). Costs of just premises registration (Scenario 1) and just bookend systems (Scenario 2) are summarized separately later in this section.

4.1 Beef Cow/Calf

4.1.1 Tags and Tagging Costs

Operation Distributions

One of the objectives of this study was to determine if the implementation cost of an animal identification system varied by operation size. To determine if economies of size exist, costs of adopting animal identification were estimated for various operation sizes. The USDA National Agriculture Statistics Service (NASS) report most cattle data (e.g., number of operations, inventories, calf crop) by size groups. Thus, NASS size categories were used as breakpoints for this study. Cattle inventories (*Cows that Calved – Beef*) for January 2007 and July 2007, the 2007 percent of cattle by size of operation, and the number of operations per size group operating in 2007 were collected (USDA, 2008e). The total head of beef cows per operation for each size category was found by averaging the January and July inventories and multiplying this number by the respective percentage of cattle by size of operations. Dividing this cow inventory number by the total number of beef cow/calf producers in that size group revealed the average number of cows per operation for each size category. To estimate the number of breeding bulls per premises, the 1997 NAHMS Beef Report (USDA 1997a) estimate of one bull for every 25.3 cows was used. With these two pieces of information, the total breeding herd inventory was calculated for the seven different operation size categories.

RFID Tags Placed

To determine the number of tags purchased, the total number of animals tagged in a year needed to be calculated. The operation size subcategories were each assigned an adjusted calving rate of 94.6% and a cull rate of 11.0%. This adjusted calving rate does not represent the number of pregnant cows, but rather, the number of calves born alive per 100 cows after accounting for twinning. This value was calculated by taking the 2007 calf crop (USDA, 2008e) and subtracting the number of dairy calves, which was calculated by taking the 2007 dairy inventory (USDA, 2008e) and multiplying it by the percentage of dairy cows giving birth to weaned calves (USDA, 2007a). Adding parturition related deaths for beef calves (USDA, 2006d) to total beef calves weaned gave the total number of beef calves born alive. Dividing this by the total number of beef cows gave the calving rate, which was then adjusted to account for twinning. According to the 1997 NAHMS Beef Report (USDA, 1997a), the average pregnancy rate was approximately 92.6% and the cull rate was 11.9%. This indicates that the pregnancy and cull rates used in this analysis are reasonable, where the difference was small and likely due to differing years between the NAHMS report and the data used in this analysis.

To figure the number of replacements retained and kept in the breeding herd, the percentage of culls was added to the percentage of cow deaths and this percentage was multiplied by the average herd size. Table A4.1.1 in Appendix A4 reports the number of beef cow/calf operations and various production and inventory level values by size of operation.

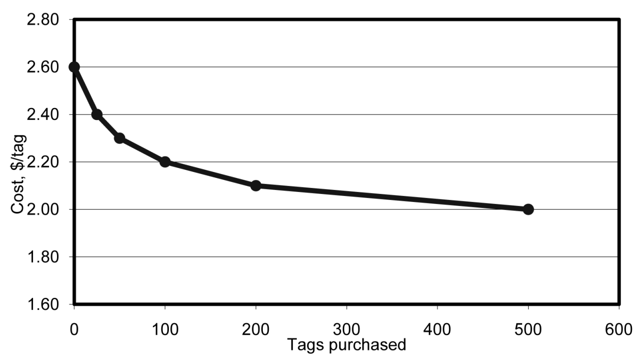
To calculate the number of RFID tags placed, different assumptions were used for the subcategories of operations currently tagging versus operations not tagging. For operations that currently tag, it was assumed that parturition-related deaths were not tagged and all calves that died after parturition were tagged. Death loss percentages from *Cattle Death Losses* (USDA, 2006d) were applied to the 2007 calf crop numbers. It was also assumed that these operations would incur a tag loss rate requiring some animals (calves and cull cows and bulls) to be retagged before shipping to buyers. For operations that do not currently tag, it was assumed that nothing was tagged until the animals were shipped to the auction yard where they were tagged by an auction yard crew for a fee.

The tag loss rate applied was 2.5%. This loss rate is higher than the 1% manufacturers' guidelines from the USDA (Walker, 2006). Research has revealed RFID tag loss rates vary from less than 1% to as much as 5% (Williams, 2006; Watson, 2002; Evans, Davy and Ward, 2005). The median value of 2.5% from the various research studies was used for this analysis.

RFID Tags and Applicator Cost

To find the cost of RFID tags, an internet search was conducted resulting in 12 companies located that offered RFID cattle tags. These businesses were located in the lower 48 states of the United States. The prices ranged from a high of $3.00 to a low of $2.00, with the average cost being $2.25. Based on discussion with industry participants, it was assumed that economies of size exist when RFID purchases are made resulting in lower tag cost with higher volumes. The high price of $3.00 per tag was considered to be an outlier and was excluded from the analysis. A non-linear relationship between volume (tags purchased) and cost was used where the high price was $2.60 per tag and the low price was $2.00 per tag. Figure 4.1 shows the tag prices used in the analysis as they relate to tags purchased (i.e., operation size).

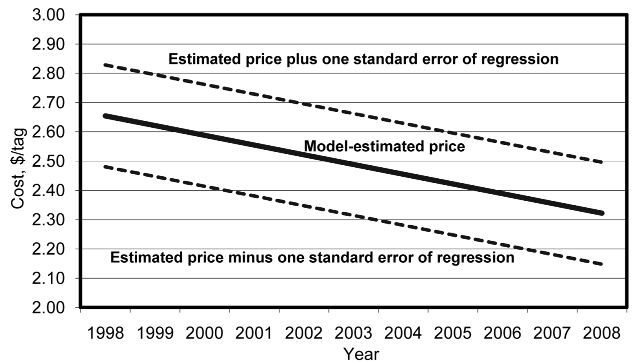
Figure 4.1. Assumed RFID Tag Purchase Price as Volume Varies



As technology improves over time and the use of electronic ID tags increases, the cost of this technology is expected to decline. Thus, the costs of tags and readers will likely fall over time, which implies tag costs used in this analysis likely represent an upper estimate. An attempt was made to quantify how the nominal (not inflation-adjusted) cost of individual electronic animal ID button tags has changed over time. To assess the change over time, a spectrum of electronic ID button ear tag prices were collected from several vendors over 1998-2008. Collecting consistent prices from a large number of the same vendors each year was not possible. Many tag supply companies entered and exited the market during this time frame. Also, tag price data were frequently unavailable because firms considered it confidential and because of the relative newness of this technology. Because price trends from the same consistent set of vendors were unavailable for a continuous 10-year period, prices were collected from as many vendors as possible for as many years as was available from each. The result was a total of 63 prices of button electronic ID tags (excluding visual tags), spread across the 11-year period, representing a total of 22 different vendors/sources. As much as possible, tag prices reflected an order of 100 or fewer tags, to not further complicate the analysis with volume-order discounts that can be sizeable. Ordinary least squares regression was used to estimate a model with dummy variables for vendors and a time trend for year using the 63 observed prices. A regression model with the time trend squared was also estimated to test whether the price over time was changing nonlinearly with time. The quadratic time trend term was not statistically significant and thus was not retained.

Results of the regression analysis indicated that, on average, the nominal cost of electronic ID button tags, after adjusting for vendor differences, has declined about $0.033 cents per year or $0.33 cents per tag over the past 10 years (this estimate was statistically different from zero with 95% confidence). The regression analysis also demonstrated statistically and economically important variation in tag prices across different vendors within a year. The regression-predicted electronic ID button tag price by year is illustrated in figure 4.2. Included in this figure are dashed lines illustrating the standard error of the regression-predicted price (these lines represent an approximate 68% confidence interval on expected tag price at the means of the data). The dashed lines demonstrate the magnitude of unexplained variation in tag price in the regression modeling exercise. We attempted to collect similar data on hand-held wand readers. However, we were not able to obtain sufficient numbers of observations and consistent technology over time to complete a reliable trend analysis in costs of readers.

FIGURE 4.2. REGRESSION-PREDICTED ELECTRONIC ID BUTTON TAG PRICE OVER TIME



While conventional, two-piece applicators might work with RFID tags, it is possible that the RFID button will be damaged during application with conventional tag applicators. Thus, it was assumed the incremental cost of implementing an RFID program included the full cost of RFID-specific applicators. That is, producers were assumed to have to purchase an RFID applicator in addition to whatever they currently use for identifying calves individually. To find the RFID applicator costs, an internet search was conducted to obtain estimates of applicator costs. The average cost of RFID applicators was $44.83, which compares to an average cost of $18.62 for conventional two-button applicators. Average life span of an applicator was assumed to be four years and the number of applicators required increased as the operation size increased. Tables A4.1.2 and A.4.1.3 in Appendix A4 report the number of tags and tag applicators required by size of operation for beef cow/calf operations that currently tag and those not currently tagging, respectively.

Labor and Chute Costs for Tagging Cattle

Producers who adopt RFID technology will have an additional time outlay in placing the RFID tag into a calf's ear. To account for this, it was assumed that it would take 30 seconds to insert a second tag for those operations currently tagging. Because producers that currently tag already incur the initial setup time and tagging costs associated with a conventional tag (or some other method of individual identification), only the extra time to tag an animal was considered as this reflects the incremental cost. The labor rate used was $9.80 per hour (US Department of Labor, 2007). Operations that do not currently tag will not incur this cost in their operations as they do not tag their animals, but they will incur a cost associated with tagging when their cattle are sold.

To account for the marginal labor and chute costs when tagging weaned and culled animals, setup time, tag time, number of employees, and chute charges were considered. For operations that tagged at birth, only the animals that lost their tags were considered (i.e., animals needing to be retagged). An article published at North Dakota State University indicated that it took 66 seconds to work an animal in a squeeze chute (Ringwall, 2005b). Using this value and an assumed setup time of 15 minutes along with the total number of cattle needing to be tagged, the total number of hours to tag/retag animals was estimated. This number was then multiplied by the number of employees and the labor rate to come to a total labor cost. The number of employees ranged from one to six and was assigned to the different size categories based on producer opinion.

The last component was the chute cost associated with tagging animals. For producers who already tag, a rate of $1.00 per head was used. This reflects the feedlot industry chute charge that ranges from $0.75-1.50 (Boyles, Frobose, and Roe, 2002; Ringwall, 2005b).

For producers who do not currently identify calves individually, i.e., non-tagging operations, it was assumed that the auction yard would charge these producers for a tagging service. Based on survey results on tagging costs from auction yards (Bolte, 2007) and Livestock Marketing Association (LMA) data regarding the distribution of auction market sizes in the US, it was estimated that the average chute and labor cost would be $2.54 per head. This did not include the cost of an RFID tag, but it did include added liability insurance premiums and human injury costs to the extent that auction markets incorporate these costs into their charges.

Injury Costs Associated with Tagging Cattle

Tagging cattle involves the risk of injury to both the people doing the tagging and to the cattle. Thus, human and animal injury cost was estimated on a per animal head basis. To estimate the cost of human injury associated with tagging cattle the total labor cost associated with tagging cattle was multiplied by 10% as an estimate of workman's compensation, which is used as a proxy for human injury costs.

To estimate the animal injury cost associated with tagging an animal, the total number of cattle (Beef Cow/Calf and Dairy) workings per year was estimated. Because many dairy cattle workings are routine in nature (e.g., milking each day), they are less likely to cause an injury and thus they were assigned a weight of 10% compared to beef cattle workings at 100%. In other words, from an injury standpoint, milking a cow 10 times was assumed to be equivalent to tagging a beef animal once. The USDA estimate of the total value of lameness and injury to cattle of $104,427,000 (USDA, 2006d) was divided by the estimate of total annual cattle workings. This provided an estimate of the animal injury cost per working, which was then used to estimate the marginal animal injury cost of working cattle associated with animal identification. While it is a strong assumption to assume all lame animals were caused by working them, it was the only estimate that could be found. This number, now on a per head basis, was then applied to the number of animals being sold that needed tags.

Cattle Shrink Associated with Tagging Cattle

When cattle are processed through a chute for tagging, they may incur weight loss or a short time of not gaining at the rate they were without processing. Many publications have shown the affects of shrink related to time off feed (Barnes, Smith and Lalman, undated; Gill et al. undated; Ishmael, 2002; Krieg, 2007; Richardson, 2005; Self and Gay, 1972). However, the complexity of the cow/calf industry and the published information available was such that it was impossible to determine a reliable average incremental shrink associated with tagging calves. Additionally, management style, working weights, and other factors that contribute to shrink costs vary considerably from operation to operation.

In order to calculate a shrink cost for those operations that tag, a two-pound loss was assumed for every weaned animal that needed to be retagged before they were shipped. While most of the literature suggests that total shrink is more than this, the literature points out that most of this shrink is feed and water. For those operations retagging their animals, the feed and water loss can be replaced as soon as the animals are turned back into their pen or pasture. However, what cannot be replaced is the loss of animal weight gain for that day (at least not by the seller). While operation dependant, most will have an average daily gain between one and three pounds for weaned animals. This study used the median point of two pounds as the shrink and used 25% of the average market price for calves ($121/cwt) to arrive at a cost per head. The reason only 25% of the lost weight was included was because of the compensatory gain that the buyer of the cattle would realize.[2] The cost associated with shrink for cull animals was figured in the same manner only a lost weight of 2.5 pounds and an average price of cull cows ($48/cwt) were used.

The shrink costs for operations currently not tagging was estimated in a similar fashion. However, the total pounds of shrink was assumed to be slightly higher than calves that are tagged at the ranch because calves tagged at the livestock auction market would not have the same

[2] While the seller might actually incur a higher cost than this, the buyer would receive a benefit associated with compensatory gain and thus the 25% reflects a net loss to the industry due to tagging. The 25% is generally consistent with the consensus of an informal survey of animal scientists, veterinarians and producers.

opportunity to eat or drink prior to being sold. For these operations the assumed shrink was 2.62 pounds, based on a shrink rate of 0.5% observed with 30 minutes of sorting animals (Richardson, 2005). Cull breeding animals needing to be tagged at the time of sale were assumed to shrink at a rate of 2.75 pounds. The total amount of shrink for both weaned and cull animals were multiplied by the group's respective average selling price to find the cost of shrink per head and ultimately per operation. Shrink costs varied slightly between operations that currently tag cattle versus those that do not, but they did not vary by operation size (i.e., operations of all sizes incurred the same per head shrink costs associated with tagging cattle). Tables A4.1.4 and A4.1.5 in Appendix 4 report the various tagging-related, i.e., cattle working, costs for beef cow/calf operations that currently tag and those currently not tagging, respectively.

4.1.2 Reading Costs

The RFID component and reading costs was a function of animals read, ownership and operating costs associated with the RFID technology (e.g., electronic readers (panel and wand), data accumulator, software), and database charges. The following is a brief discussion of these components.

Animals Purchased or Transferred

It was assumed that tags would not have to be read when they were initially applied as this information would be recorded by the seller of the tag. That is, cow/calf operations that tag calves will not have to read these tags, they only will have to read tags of calves brought onto their premises from outside sources. To estimate the cost of reading RFID tags, the average number of animals brought onto buying premises was determined by using information found in the 1997 NAHMS Beef Report (USDA, 1997a). This study reported the average percentage of animals brought onto buying premises for the study year. Using this information, the average number of animals bought per buying premises was determined by multiplying the total number of Cow/Calf operations by size with their corresponding percentages as shown in Table 4.1.

Bolte, Dhuyvetter, and Schroeder (2008) indicated that auction yards would likely install reading panels in their facilities as a service to customers. Thus, it was assumed that producers would not need to read electronic tags on any cattle purchased through an auction yard as they would already be read by the auction market. Schmitz, Moss, and Schmitz (2002) estimated that 72.2% of all cattle are sold through local and video auctions. Contained in that same report was a quote from a leading authority that suggested 67% of animals were sent through these two channels. The average of these two values (69.6%) was taken to attain the percentage of animals sold through an auction. The remaining cattle (30.4%) were assumed to be sold through channels other than auction markets (e.g., private treaty) and thus would need to have their RFID tags read at the time of sale.

The average number of cattle marketed through auction markets was applied uniformly to the number of cattle bought by operation size to find the number of cattle bought through the auction. [3] After this number was calculated, it was subtracted from the total number of animals brought onto the premises to find the total number of tags still needing to be read. For example table 4.1 shows that operations with 50-99 head bought an average of 18.2 head per year. If 69.6% of those were purchased through an auction market that would leave 5.5 head (30.4% × 18.2) that would need to have their tags read either at the farm or at some other location.

Panel readers miss up to 2.8% of all RFID tags (Reinholz et al., undated). To capture this and the extra time needed to ensure 100% read when using hand held readers, the number of animals needing to be read was increased by 2.8% to account for expected misreads. The combination of cattle needing to be read and misreads gives an estimate of the total tags read required for an operation on an annual basis.

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[3] We believe that smaller operations tend to sell a larger percentage of their cattle through auction markets compared to larger operations. However, information substantiating this could not be found and thus the uniform assumption was used.

Table 4.1. Estimates of the Number of Cattle Brought onto a Cow/Calf Operation Premises by Operation Size

	Operation Size, head				
	Less Than 50	50-99	100 -500	500 or More	All Operations
Percent of operations that brought any beef or dairy cattle or calves onto the operation in 1996 by class and herd size:					
A. Any cattle or calves	32.9%	48.7%	63.2%	74.5%	38.7%
Number of cattle and calves brought onto the operation in 1996 as a percent of January 1, 1997, total inventory by herd size:					
B. Cattle and calves	36.8%	27.9%	24.8%	15.0%	26.6%
Calculated Cattle Buying Operations by Size in 2007					
C. Number of beef cows, 2007	9,174,406	6,160,432	12,817,672	4,968,090	33,120,600
D. New cattle in herd (B × C)	3,376,181	1,718,760	3,178,783	745,214	9,018,938
E. Number of cattle operations, 2007	585,050	94,490	72,855	5,505	757,900
F. Number of cattle buying operations (A × E)	192,481	46,017	46,044	4,101	293,307
G. Cattle bought per year per operation (D / E)[1]	5.8	18.2	43.6	135.4	11.9
H. Cattle bought per year per operation (D / F)[2]	17.5	37.4	69	181.7	30.7

[1] Based on total operations.

[2] Based on only operations that brought cattle onto their premises.

ELECTRONIC READERS

A US government compliant RFID tag is assigned a unique, 15-digit number (USDA, 2006a; USDA 2007d). This number is printed on the outside of the tag so it can be read visually, and it is recorded in a memory chip inside the tag so it can also be read electronically. For the purpose of this study, it was assumed that a producer had three options to electronically read the animal's unique, 15-digit ID: (1) custom hire, (2) a wand reader, or (3) a panel reader. It should be noted that even though the unique ID is a 15-digit number, producers would not have to visually "read" all 15 digits given the numbering system used (e.g., first three digits are country code). Nonetheless, visually reading the individual number on the tag was not considered because of the substantial amount of time involved which would cost the producer more than it would if the producer employed one of the other three options. Additionally, the potential for error when reading and recording a small, printed 15-digit number would be high.

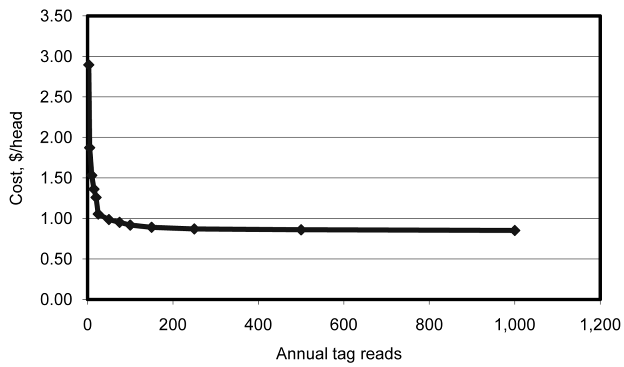
The system used to read RFID tags was based on the number of animals read. If the cost of the RFID components divided by the total number of reads was greater than a custom read rate, then the operator would hire someone to read the tags on the animals. If the rate was smaller than a custom read rate, then the operator would own the equipment needed to perform the task. The equipment assumed to be owned in this case was either a wand or a panel reader, whichever had a lower cost on a per head basis.

Based on work by Bass et al. (2007), the cost for RFID wand readers was based on an initial outlay of $1,091 and a useful life of three years. Using an interest rate of 7.75% along with the assumptions about initial outlay and useful life resulted in an annual cost of owning a wand reader of $422. RFID readers in this price category are able to capture and temporarily store RFID numbers until downloaded into a computer. While this type of reader is more expensive than those that do not store RFID data, some producers already own desktop computers and would not be able to move them to their chute area. Therefore, in order to account for computers already owned by producers, the system being used had to be flexible enough to allow interfacing with stationary or portable accumulators. Panel readers were also based on Bass et al. (2007) and were annualized over four years with an initial outlay of $3,580. Panel systems were assumed to incur a $500 installation cost, which was annualized over a 10-year life. The annualized cost of purchasing and installing a panel reader was $1,150. It was assumed that there would be an annual maintenance cost of $500 for operations that employed a panel reader. While the annualized costs for panel readers are considerably higher than wand readers, the reading cost per head can be lower given sufficient volume of reads because there is minimal labor associated with running panel readers once in place.

A search of the literature did not reveal any unsubsidized, custom rates for reading RFID tags; therefore a rate needed to be estimated. To estimate these rates, 10 states with 15 unique brand inspection fees were analyzed.[4] Some of the inspection fee schedules included hours, which were charged at an hourly wage of $9.80 per hour (US Department of Labor, 2007) and some schedules included mileage. For custom tag reading, we assumed a 50-mile round trip at the government recommended reimbursement rate of $0.485 (US General Services Administration, 2007). The 15 brand inspection fee rates were applied to groups of cattle ranging from three head to 20,000 head. After this was done for each of the 10 states and 15 brand inspection rates, individual costs were weighted by the number of operations in each state to get a weighted average cost. The weighted average cost associated with the different breakpoints was used to determine the custom read cost. Figure 4.3 shows the relationship between the custom reading cost per head and the number of reads. This schedule of custom read rates exhibits large economies of size (i.e., costs decrease as volume increases). However, costs drop rapidly and plateau such that there are only small gains with really large numbers of reads. For example, the cost of reading five head is $1.87 per head compared to $0.98 per head for 50 head and $0.86 for 500 head.

[4] The states with brand inspection rates used for this analysis are the following: CA, CO, ID, MT, NM, NV, OR, SD, UT, and WY.

FIGURE 4.3. ESTIMATED RFID CUSTOM TAG READING COST PER HEAD AS NUMBER OF READS INCREASES



DATA ACCUMULATOR AND SOFTWARE

The data accumulator cost represents the average price for laptop computers obtained from six internet web sites. This cost was annualized over four years with a $0 salvage value. Given an initial investment of $692, a 4-year life, and an interest rate of 7.75%, the annual cost of a data accumulator is $208. Of this total annual cost, 50% was allocated to an animal ID program as it was assumed that a computer would have other uses in the operation. According to the NAHMS Beef report (USDA, 2008q), some operations already own computers and thus, would not need to purchase one. Large operations were more likely than smaller operations to already own a computer. For example, only 15.3% of operations with less than 50 cows owned computers compared to 48.2% for operations with 200 or more cows (USDA, 2008q). To account for operations that currently own computers, the annual cost of the data accumulator (i.e., computer) was multiplied by one minus the proportion of operations that currently own computers resulting in a weighted average cost per operation for each size category.

Many different software packages are available that would satisfy the software requirement of an eID system. The value used here is the suggested retail price of Microsoft Office Professional (Microsoft, 2008). Because this software would have uses in addition to meeting the needs of an eID system, only 50% of the cost was allocated to the animal ID program. This software package includes Microsoft Office Word, Office Excel, Office PowerPoint, Office Access, and other programs. While most producers would not use some of the programs included in Office Professional, Microsoft Office Word and Microsoft Office Excel or Microsoft Office Access would need to be employed to keep track of reads and to write the necessary documents. Other software packages that also maintain management information likely would be utilized by producers, but the higher cost associated with these software packages are not appropriate to include in an animal ID system as these are providing value beyond that required by NAIS. In other words, producers might choose to spend more for additional management benefits, but this is not something they would need to adopt NAIS procedures. It was assumed that producers that already own computers would also own software that would satisfy the requirements of an eID system. Thus, as was done with data accumulators, the cost of software was reduced by the proportion of operations currently owning computers (USDA, 2008q).

Labor, Chute, and Other Costs Associated with Reading RFID Tags

In addition to the hardware and software required for reading RFID tags, other costs such as labor, chute, and human/animal injury would also be incurred. It was assumed that all Cow/Calf operations that buy cows run them through chutes for vaccinating, deworming, or other basic animal husbandry practices. Thus, the incremental labor cost of reading tags would only be the added time required given that the animal is already going through a chute. Therefore, the total number of animals that needed to be read on an operation was multiplied by 20 seconds to find the incremental time of reading RFID tags. The total time was multiplied by the labor rate of $9.80 per hour (US Department of Labor, 2007) and the total number of employees to find the cost of labor for reading tags. The number of employees needed to work cattle was broken into two groups: 1) the employee using the reader (if a panel reader was not used) and 2) other employees doing other tasks (herding, sorting, etc).

The other employee group had differing amount of people for different size operations, which was determined based on producer opinion.

The full chute charge was reduced by 75% because of the assumption that producers will already be working their animals when they read the RFID tags. The 25% applied towards the total cost represents the extra time the animals will spend in the chute.

Animal and human injury costs were added according to the amount of extra time the animal was in the chute being read. Shrink was not added to cows being read because these animals would be for breeding purposes. If operations brought animals in for purposes other than breeding (i.e., backgrounding or feedlot) a cost for shrink was included.

Database Charge

According to the NAIS business plan, "The most efficient, cost-effective approach for advancing the country's traceability infrastructure is to capitalize on existing resources—mainly, animal health programs and personnel, as well as animal disease information databases" (USDA, 2007f p. 4). As of May 2008, there were 17 approved Animal Tracking Databases or Compliant Animal Tracking Databases meeting the minimum requirements as outlined in the Integration of Animal Tracking Databases that were participating in the NAIS program and have a signed cooperative agreement with USDA Animal Plant Health Inspection Service (USDA, 2008d).

The research team attempted to contact multiple RFID database providers to obtain costs per head of their databases so an average cost for data storage could be ascertained. Not surprisingly, this information was not readily given out, and the information that was expressed was not specific enough for this study. To find a more accurate estimate, Kevin Kirk from Michigan's Department of Agriculture was contacted. Mr. Kirk, who oversees the Michigan State AID database, provided the total data storage cost for Michigan producers. Based on this information, a per-head charge of $0.085 was estimated. This per-head charge was included anytime an animal was assumed to have its RFID tag read.

Other/Fixed Charges

The time needed to submit the RFID reads to a central database and the internet fee was considered here. To determine clerical costs, the time required to submit a batch of RFID numbers and the number of batches submitted needed to be ascertained. The Wisconsin working group for pork found that it took 15 minutes to submit a batch (Wisconsin Pork Association (WPA), 2006). It was assumed that a minimum of four batches (one hour of clerical labor) would be assigned to the smallest size category operations and a total number of 16 batches (four hours of labor) would be assigned to the largest operations. Clerical labor was multiplied by the average secretary wage for the US (US Department of Labor, 2007) to find the total cost associated with recording and reporting animal ID information.

In order to be able to achieve a “48 hour trace back system” producers would need to submit their RFID numbers via an internet access point. An internet charge of $50 per month was assumed for 12 months. As with computers and software, the internet would have multiple uses and thus only 50% of the cost is allocated to the animal ID system. Additionally, because some operations already have a computer, it was assumed they likely also had internet access so a weighted cost of internet was used similar to what was done for the cost of data accumulators and software. Table A4.1.6 in Appendix A4 summarizes the costs associated with reading RFID tags by size of operation. In all cases the RFID system for reading eID tags is outsourced as opposed to owned in house (i.e., operations would rely on custom reading services to read their tags). This is because even the largest operations would not have sufficient numbers of cattle requiring their tags to be read annually to justify purchasing readers.

Premises Registration Costs

Currently premises registration is free and many states are trying to make the process as seamless as possible and NAIS reports that 33.8% of all operations with over $1,000 income have been registered as of September 29, 2008 (USDA, 2008d). While the premises registration is a free service, there are potential costs incurred with registering an operation's premises (e.g., management time, mileage, paperwork). To capture this cost, it was assumed that a producer would incur a cost of $20 associated with time, travel, and supplies to register his/her premises. Theoretically, once premises are registered the registration lasts for the life of the operation as well. However, many producers will need to renew or modify their premises registration on a regular basis as their operations change. Thus, it was assumed that the lifespan of premises registration would be three years. The cost of renewing premises registration every three years was assumed to be 50% of the initial cost, or $10 per operation. When accounting for the time value of money, the initial premises registration cost of $20 and the renewal every three years of $10 equates to a cost of $4.64 per operation annually in current dollars.

Interest Costs

Investments required for an animal ID system that have useful lives of more than one year (e.g., tag applicators, readers, premises registration) were annualized using an interest rate of 7.75%. Annual operating cost such as tags for calves, labor, internet, etc. were charged an interest cost at this same rate for the portion of the year a producer's money would be tied up. For example, for operations that buy tags, interest was included in the cost of calf tags to account for a period of nine months, which reflects the amount of time that a producer bought the ear tags to the time that the calf was sold.

Summary of Beef Cow/Calf Costs

Tables 4.2 and 4.3 summarize the costs associated with an individual animal ID system that has full traceability included (i.e., Scenario 3 discussed earlier) by size of operation for operations that currently tag and those that do not, respectively. The cost per animal sold ranges from a low of $2.48 per head (largest operation currently tagging, table 4.2) to a high of $7.17 per head (smallest operation not currently tagging, table 4.3). Figure 4.4 shows the cost per head sold graphically for the two types of operations by operation size. Two things are readily apparent from this figure. First, economies of size exist as larger operations have over a $2/head lower cost compared to the smallest operations. Second, operations that currently tag their cattle have lower costs. This is because the incremental cost of using their labor and facilities (i.e., chute) are lower than hiring tagging done by a third party and because of a higher shrink cost. Operations that tag calves at birth were assumed to have considerably lower costs associated with shrink compared to operations that tag their calves at sale time.

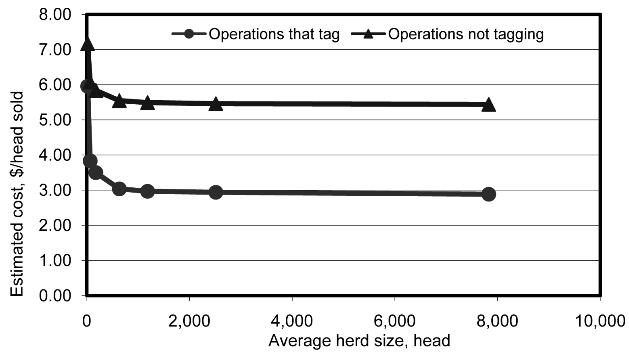
Table 4.2. Summary of RFID Costs for Beef Cow/Calf Operations by Size of Operation that Currently Tags Cattle

	Size of Operation, number of head						
	1-49	50-99	100-499	500-999	1000-1999	2000-4999	5,000+
Total annual cost, $/operation	$80	$215	$529	$1,655	$3,019	$6,350	$19,418
Total annual cost, $/head sold	$5.95	$3.83	$3.50	$3.04	$2.97	$2.94	$2.88
Total annual cost, $/cow	$5.12	$3.30	$3.01	$2.61	$2.55	$2.53	$2.48
Total number of operations	228,755	58,867	50,889	2,985	700	207	39
Total industry cost, thousand $	$18,365	$12,649	$26,944	$4,939	$2,112	$1,315	$763

Table 4.3. Summary of RFID Costs for Beef Cow/Calf Operations by Size of Operation Currently Not Tagging Cattle

	Size of Operation, number of head						
	1-49	100-499	500-999	1000-1999	2000-4999	5,000+	5,000+
Total annual cost, $/operation	$97	$340	$883	$3,022	$5,585	$11,792	$36,605
Total annual cost, $/head sold	$7.17	$6.07	$5.83	$5.55	$5.49	$5.46	$5.44
Total annual cost, $/cow	$6.16	$5.22	$5.02	$4.77	$4.72	$4.69	$4.68
Total number of operations	356,295	35,623	21,966	1,195	280	83	16
Total industry cost, thousand $	$34,436	$12,124	$19,385	$3,613	$1,565	$978	$576

FIGURE 4.4. ESTIMATED COST OF RFID FULL TRACEABILITY TECHNOLOGY ADOPTION FOR BEEF COW/CALF OPERATIONS BY OPERATION SIZE



4.2 DAIRY

4.2.1 TAGS AND TAGGING COSTS

OPERATION DISTRIBUTIONS

Similar to Beef Cow/Calf operations, dairy budgets were developed for different size category dairy operations and for operations that currently tag cattle versus those currently not tagging cattle. The distribution of Dairy operations and the average inventory of dairy operations were calculated using NASS statistics (USDA, 2008e) for the year 2007. For a more thorough discussion of the methods used to derive these numbers, see Section 4.1.1 in the Beef Cow/Calf section. While a similar procedure was used for determining the number of operations and average size of each operation for dairy as beef cow/calf operations, there were a couple of minor differences. USDA NASS reports eight size categories for dairy compared to only seven for beef. To maintain consistency regarding the budgets, the smallest two categories (1-29 head and 30-49) were combined. The cow inventory and operation numbers used for beef cow/calf operations were an average of January 1 and July 1, 2007 reported values. For the dairy budgets, only January 1, 2007 reported values were used for cow inventories and operation numbers.

To estimate the number of breeding bulls located on a dairy premises, Dr. Jason Lombard, contact for the 2007 NAHMS Dairy report (USDA, 2007a), was contacted and a special query was run on the 2007 NAHMS Dairy report data. The original request was for the number of bulls per operation by operation size; however, because of a large standard error, the query was adjusted to retrieve the average number of dairy breeding bulls for all operations. The average across all operations was 1.38 bulls per operation with a standard deviation of 0.07. This average was multiplied by the total number of operations to establish a total number of bulls used for dairy operations. Dividing this number with the 2007 inventory of dairy cattle, a bull to cow ratio was established at 92.8 cows per bull. This ratio was applied to the average number of dairy cows for the different size operations to find the average number of bulls per operation by operation size. Given the average number of cows per operation from the USDA NASS data and the estimated number of bulls, the total breeding herd inventory was calculated for the seven different size categories.

RFID Tags Placed

To calculate the number of tags purchased, the total number of animals tagged in a year was calculated. For operations that currently tag, total tags required is the sum of all calves born and alive within 48 hours after birth plus any re-tags required (calves, cows, and bulls) due to tags being lost. It was assumed that calves that died within 48 hours of birth were not tagged, but calves that died after 48 hours following birth were tagged. Death loss rates for heifer calves reported by NAHMS were used in this analysis. It was assumed that this rate plus an arbitrary one percent increase would apply to male animals (male calves are expected to have a slightly higher death loss rate because of more calving problems associated with male calves being larger than females). For operations that currently do not tag, the number of tags required is the total number of animals sold.

It was assumed that dairy operations will incur the same tag loss rate of 2.5% as the Beef Cow/Calf sector. Operations that currently tag will retag animals that lose tags before shipping to buyers. For operations that do not currently tag cattle, tag loss rate is irrelevant as such cattle are not tagged until sold and it was assumed they would be tagged by an auction yard crew for a fee of $2.54 per head.

The cull rate impacts the number of tags required and varied from 23.4% to 24.1% between the different size operations, with larger operations having slightly higher cull rates (USDA, 2007a). The percent heifers retained was calculated by dividing the average (January 1, 2007 and July 1, 2007) inventory of Dairy Heifers, 500+ lbs by the annual average inventory of total number of Milk Cows (USDA, 2008e). The calculated heifer retention rate of 44.8% was held constant for all size operations and when combined with the cull rate was used to calculate the number of heifer calves that would be available for sale. Total animals sold was the sum of cull cows and bulls plus total calves born, less death loss and the number of heifers required to maintain a constant herd size. Cow death loss and calf death loss, both within and post 48 hours of birth, as well as calving rate varied by operation size based on NAHMS data (USDA, 2007a). Table A4.2.1 in Appendix A4.2 reports the number of dairy operations and various production and inventory level values by size of operation.

The 2007 NAHMS Dairy study reported approximately 4.1% of all dairy operations currently used electronic identification (Pedometers, Bar Code, RFID, etc.) (USDA, 2007a). It was assumed that all 4.1% of these operations currently employed the use of RFID tags on their premises. [5] Thus, total costs estimated for dairy operations that currently tag were adjusted by this amount accordingly in the final reported cost estimate for the dairy industry.

RFID Tags and Applicator Cost

Costs of RFID tags varied by purchase volume and the same rates used for the Beef Cow/Calf sector were used for the dairy sector. For the

[5] It is recognized that not all dairies currently using electronic ID use RFID tags as the identification method. However, because RFID tags are generally less expensive than some of the alternative electronic identification methods being used (e.g., electronic collars), moving to the RFID tag technology actually represents a cost savings to these dairies. Because we did not allow for a reduction in costs with the adoption of RFID, this component of our costs are overestimated.

discussion of tag costs see Section 4.1.1 in the Beef Cow/Calf section. Similarly, the costs of RFID tag applicators for dairy operations were calculated using the same assumptions as for beef cow/calf operations (see Section 4.1.1 for more details). Tables A4.2.2 and A4.2.3 in Appendix A4.2 report the number of tags and tag applicators required by size of operation for dairy operations that currently tag and those not currently tagging, respectively.

Labor and Chute Costs for Tagging Cattle

Labor and chute costs associated with tagging cattle for dairy operations were calculated in the same manner and using the same assumptions as they were for beef cow/calf operations. Thus, for a more detailed discussion of these costs see Section 4.1.1 in the Beef Cow/Calf section.

Injury Costs Associated with Tagging Cattle

Human and animal injury costs associated with tagging cattle for dairy operations were calculated in the same manner and using the same assumptions as they were for beef cow/calf operations. Thus, for a more detailed discussion of these costs see Section 4.1.1 in the Beef Cow/Calf section.

Cattle Shrink Associated with Tagging Cattle

The costs of cattle shrink due to tagging cattle for dairy operations were calculated in the same manner and using the same assumptions as they were for beef cow/calf operations. Thus, for a more detailed discussion of these costs see section 4.1.1 in the Beef Cow/Calf Operations section. One assumption that varied for dairy operations is that it was assumed calves would not shrink (beef calves were assumed to shrink 2.0 pounds per head). This was because the dairy calves were assumed to be sold shortly after birth and thus the lost gain or cost of gain would be minimal compared to a beef calf weighing over 500 pounds. Shrink on dairy cull cows and bulls were calculated the same as for beef cattle, but the price used to value the shrink was slightly lower ($45/cwt for dairy cattle compared to $48/cwt for beef cattle). Tables A4.2.4 and A4.2.5 in Appendix A4.2 report the various tagging-related, or working cattle, costs for dairy operations that currently tag and those currently not tagging, respectively.

4.2.2 Reading Costs

The RFID component and reading costs for this study was a function of animals read, ownership and operating costs associated with the RFID technology (e.g., electronic readers (panel and wand), data accumulator, software), and database charges. The following is a brief discussion of each of the relevant components.

Animals Purchased or Transferred

As with beef cow/calf operations, dairy operations purchase cattle and bring them onto their premises. Cattle that are purchased through auction markets are assumed to have their tags read at the time of sale and thus only non-auction market purchase will be required to be read (see Section 4.1.2 in the Beef Cow/Calf section for additional discussion). However, the dairy industry is more complex in regards to animals moving between premises than the beef cow/calf industry because of how replacement heifers are raised. Dairy operations will at times hire people with off-site operations to raise their heifers. For producers that pursue this option, custom growers will raise a heifer until it is ready to calve and then return the bred heifer to the dairy. There are also those that choose to raise the heifer to 250-350 pounds, send it to another premises to have it finish the growing process and be bred, and then it is sent back to the premises of origin when it is ready to calve. In other words, it is not uncommon in the dairy industry for a replacement heifer to move to several premises before it ends up in the dairy herd as a lactating cow.

To account for these non-sale heifer movements, the percentage of operations that outsource any heifer growing (USDA, 2007a) was multiplied by the total number of dairy operations (USDA, 2008e) to find the total number of operations that outsource heifer management. This was broken further into two categories: 1) operations that have heifers move to one premises to grow, and 2) operations that move replacement heifers to multiple premises to grow.

It was assumed that heifers that move to multiple premises would have their eID tags read 3.5 times on average and heifers that were moved to a single premises and back would have tags read two times. Weighting these values by the percentage of operations in each of the categories resulted in a weighted-average of 2.3 reads per heifer. Multiplying the number of operations by the average number of head and by the number of times read gave a total number of reads for each size category. This number was divided by the total number of operations in each size category to achieve an average number of reads of non-sale replacement heifers per operation by operation size. The number of non-sale reads were added to the number of animals purchased needing to be read (animals purchased but not bought through auction markets) to come up with the total number of animals needing to have their RFID tags read. Using this information the total number of RFID tag reads required per year per operation was estimated for the different size dairy operations (table 4.4).

Electronic Readers

See Section 4.1.2 in the Beef Cow/Calf section for discussion.

Data Accumulator and Software

See Section 4.1.2 in the Beef Cow/Calf section for discussion on data accumulator (computer) and related software costs. As was done with beef cow/calf operations, data accumulator and software costs were adjusted to reflect operations that currently own computers. According to the NAHMS Dairy report (USDA, 2007a) over 90% of the large operations had computerized record-keeping systems compared to less than 15% of the smaller operations. To account for operations that currently own computers, the annual cost of the data accumulator (i.e., computer) and software was multiplied by one minus the proportion of operations that currently own computers resulting in a weighted-average cost per operation for each size category. Also, for operations that purchased computers and software, only 50% of the total cost was allocated to the animal ID program because it was assumed they would be used for other purposes as well.

Labor, Chute, and Other Costs Associated with Reading RFID Tags

Costs related to reading RFID tags for dairy operations were calculated in the same manner and with the same basic assumptions as for beef cow/calf operations. For a discussion of these costs see 4.1.2 in the Beef Cow/Calf section.

Database Charge

Charges for storing data for dairy operations were calculated in the same manner and with the same basic assumptions as for beef cow/calf operations. For a discussion of these costs see 4.1.2 in the Beef Cow/Calf section.

Other/Fixed Charges

Other identification-related costs for dairy operations were calculated in the same manner and with the same basic assumptions as for beef cow/calf operations. For a discussion of these costs see 4.1.2 in the Beef Cow/Calf section. Table A4.2.6 in Appendix A4.2 summarizes the costs associated with reading RFID tags by size of operation. Note that dairy operations having more than 500 cows would own an RFID system for reading tags, whereas smaller operations would outsource this function. This is because larger operations have a sufficient amount of tag reads required per year to justify owning readers and other associated computer hardware and software. The total RFID cost per read is considerably lower for the largest operations compared to the smallest operations ($0.31/head (2000+ cows) versus $1.62/head (1-49 cows)).

Table 4.4. Estimates of the Number of Cattle Brought onto Dairy Operation Premises by Size of Operation

	Size of Operation, number of head						
	1-49	50-99	100-199	200-499	500-999	1,000-1,999	2000+
Average cattle bought, head	2.9	9.5	19.3	43.9	134.4	264.2	709.6
Animals sold through auction, %[1]	69.6%	69.6%	69.6%	69.6%	69.6%	69.6%	69.6%
Average non-auction cattle bought, head	0.9	2.9	5.9	13.4	40.9	80.3	215.7
Heifers moved to new premises, head	9.6	31.9	62.5	142.3	319.8	628.8	1688.8
Average reads per heifer	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Total reads of replacement heifers	22.3	73.9	144.7	329.4	740.4	1455.8	3909.5
Non-auction cattle reads	23.2	76.8	150.6	342.8	781.3	1536.1	4125.2
Misread percentage	2.8%	2.8%	2.8%	2.8%	2.8%	2.8%	2.8%
Total animals misread	0.6	2.1	4.2	9.5	21.6	42.5	114.3
Total reads of RFID tags	23.8	78.9	154.7	352.2	802.9	1578.6	4239.5

[1] Cattle that are sold/purchased through an auction will have tags read at time of sale

Premises Registration Costs

Costs associated with registering dairy operation premises were calculated in the same manner and with the same basic assumptions as for beef cow/calf operations. For a discussion of these costs see Section 4.1.2 in the Beef Cow/Calf section.

Interest Costs

Interest costs for dairy operations were calculated in the same manner and with the same basic assumptions as for beef cow/calf operations. For a discussion of these costs see Section 4.1.2 in the Beef Cow/Calf section.

Summary of Dairy Costs

Tables 4.5 and 4.6 summarize the costs associated with an individual animal ID system that has traceability included (i.e., Scenario 3 discussed in Section 4 above) by size of operation for dairy operations that currently tag and those that do not, respectively. The cost per cow ranges from a low of $2.53 per head (largest operation currently tagging, table 4.5) to a high of $5.84 per head (smallest operation not currently tagging, table 4.5). Figure 4.5 shows the cost per cow graphically for the two types of operations at the various operation sizes. Several things are readily apparent from this figure. First, economies of size exist such that larger operations have considerably lower costs – larger operations have over a $2/head lower cost compared to the smallest operations. Second, operations that currently tag their cattle have slightly lower costs relative to those that do not tag. However, the difference between these two groups is not nearly as large as it was for beef cow/calf operations because a higher portion of the costs for dairy operations is associated with reading tags as opposed to tagging cattle. Furthermore, the cost for the smallest operations that currently tag is actually slightly higher than for the same sized operations that do not currently tag.

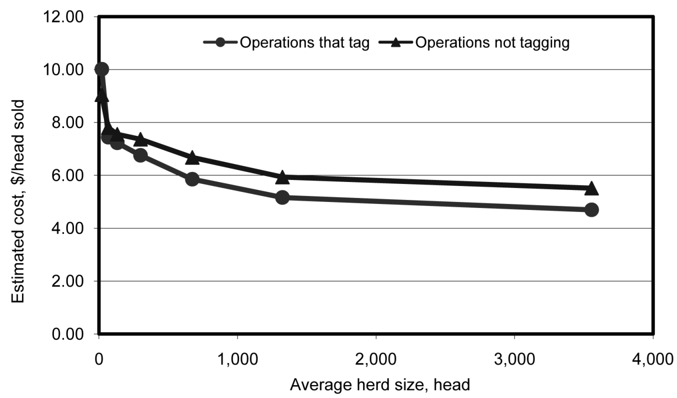
Table 4.5. Summary of RFID Costs for Dairy Operations by Size of Operation that Currently Tags Cattle

	Size of Operation, number of head						
	1-49	50-99	100-199	200-499	500-999	1,000-1,999	2000+
Total annual cost, $/operation	$118	$292	$525	$1,116	$2,126	$3,687	$9,007
Total annual cost, $/head sold	$10.01	$7.44	$7.23	$6.76	$5.85	$5.16	$4.70
Total annual cost, $/cow	$5.84	$4.34	$3.99	$3.72	$3.16	$2.78	$2.53
Total number of operations	28,921	18,148	8,066	3,940	1,471	796	515
Total industry cost, thousand $	$3,425	$5,299	$4,231	$4,397	$3,126	$2,934	$4,636

Table 4.6. Summary of RFID Costs for Dairy Operations by Size of Operation Currently Not Tagging Cattle

	Size of Operation, number of head						
	1-49	50-99	100-199	200-499	500-999	1,000-1,999	2,000+
Total annual cost, $/operation	$107	$306	$548	$1,216	$2,425	$4,237	$10,577
Total annual cost, $/head sold	$9.05	$7.80	$7.55	$7.36	$6.68	$5.93	$5.52
Total annual cost, $/cow	$5.28	$4.55	$4.16	$4.06	$3.60	$3.20	$2.97
Total number of operations	4,514	2,832	1,259	615	230	124	80
Total industry cost, thousand $	$483	$867	$690	$748	$557	$526	$850

FIGURE 4.5. COST OF RFID FULL TRACEABILITY TECHNOLOGY ADOPTION FOR DAIRY OPERATIONS BY OPERATION SIZE



4.3 BACKGROUNDING (STOCKERS)

4.3.1 TAGS AND TAGGING COSTS

OPERATION DISTRIBUTIONS

Information on the number of backgrounding operations or the average inventory number of stocker cattle in the US are not regularly reported by any governmental agency. In order to determine if economies of size exist regarding animal identification costs for backgrounding cattle operations, the number of backgrounding operations needed to be established along with a distribution of average inventory to serve as size estimations for this segment of the beef industry.

To estimate a number of operations, USDA NASS was queried for the total number of cattle operations in 2007 (USDA, 2008e). From this number, the total number of Cow/Calf, Dairy, and Feedlot operations were subtracted leaving approximately 50,870 "other" operations. This residual value represents operations that have multiple livestock sectors (i.e., beef and dairy cattle, cow/calf and feedlot, etc.) and backgrounding or stocker operations. Because information was not available to break this value down further, this residual number of operations was used for the total number of backgrounding operations.[6]

The 2002 census (USDA, 2002b) revealed that 73,509,165 head of cattle (beef and dairy) were sold in 2002. Dividing the 2007 total inventory by the 2002 inventory and multiplying it by the number of cattle sold in 2002 gives an estimated number of head sold for 2007. This derivation implicitly assumed that the number of head sold in a given year was directly related to the number of beef and dairy breeding animals. To estimate the number of stocker cattle bought for the purpose of backgrounding, known and calculated values of "non-stocker cattle" marketings were subtracted from the 2007-inventory-adjusted 2002 census value of total cattle marketings.

Non-stocker cattle marketings were assumed to be breeding animals (replacements and culls), cattle placed on feed, and fed cattle slaughtered. The total number of beef and dairy breeding animal culls (methods of calculating discussed in the previous sections) were added together and multiplied by a multiplier of 1.5. This adjustment was made to account for cull animals that are sold individually or in small groups to buyers who group them into larger lots and then resell them (i.e., adjustment accounts for culls that are marketed multiple times). The number of cattle brought into beef operations (see Section 4.1.2) was added to this cull number. In 2007, there were 553,900 mature bulls slaughtered (USDA, 2008e); therefore, it was assumed that an equal number of bulls were purchased to replace them. Thus, there would have been 1,107,800 bull marketings in 2007 (half being culls sent to slaughter and the other half being replacements entering the breeding herd). Other "non-stocker" cattle marketings are cattle placed on feed (for a discussion on this, see Section 4.4.1) excluding those in a retained ownership program. Retained ownership cattle are excluded as they would not be considered marketings since ownership does not change when they are placed on feed. The number of cattle placed on feed that were in a retained ownership program was based on the USDA APHIS feedlot management practices report (USDA, 2000). Adjusting total cattle placed on feed by the percentage of retained ownership cattle results in an estimate of net

[6] Because some of the operations in this residual value might actually be something other than backgrounding or stocker operations (e.g., cow/calf and feedlot), the estimated number of backgrounding operations is inflated relative to the actual number of operations. However, this also would imply that the number of other operations (e.g., cow/calf and feedlot) is under-estimated and thus this approach insures that the total number of beef operations is the U.S. is correct.

placements, which represents one of the categories of “non-stocker cattle” marketings.

Taking the total number of fed cattle marketed (USDA, 2008e) and adding the sum of cull cows sold, replacement stock bought by beef operations, cull and breeding bull sales, and net feedlot placements, revealed the total number of head sold by known sectors in 2007. Subtracting this total from the 2007-inventory-adjusted 2002 census value gives an estimate of 17,229,903 head for the number of stockers bought for backgrounding in 2007.

To calculate the number of operations and average inventories for different operation size groups several things were considered. To be consistent with other cattle sectors, the number of operations was assumed to decrease as the average herd size increased. Along with that assumption, the total number of backgrounding operations (50,870) and stocker cattle bought (17,299,903) were allocated over seven size categories. To arrive at a distribution where each successive size category had fewer operations than the previous one and total operations and inventory exactly equaled the target levels, Microsoft Excel Solver was employed. While it is recognized that there are many combinations of operations and inventories that will meet this requirement, the specific breakdown by size group is not as critical as making sure the total number of operations and inventory values match. The resulting number of operations and average animals purchased for the seven operation size categories are reported in table A4.3.1 in Appendix A4.3.

RFID Tags Placed

Under the current proposed NAIS, backgrounding operations will only have to replace RFID tags when they are lost. Therefore, the number of animals that backgrounders sell multiplied by the tag loss rate would give the total number of animals needing to be retagged. Assuming that death loss would be similar to those experienced by feedlots, the average number of calves purchased (i.e., inventory) was reduced by 1.3% (USDA, 2000) giving the total number of stockers sold by the backgrounders. Multiplying the number of cattle sold by 2.5%, the assumed tag loss rate (see Section 4.1.1), gives the number of backgrounded cattle worked (for RFID purposes) and RFID tags needing to be purchased.

RFID Tags and Applicator Cost

Costs of RFID tags varied by purchase volume and the same rates used for the beef cow/calf sector were used for the backgrounding sector. For the discussion of tags costs see Section 4.1.1 in the Beef Cow/Calf section. Similarly, the costs of RFID tag applicators for backgrounding operations were calculated using the same assumptions as for beef cow/calf operations (see Section 4.1.1 for more details). Table A4.3.2 in Appendix A4.3 reports the number of tags and tag applicators required by size of operation for backgrounding operations.

Labor and Chute Costs for Tagging Cattle

Labor and chute costs associated with tagging cattle for backgrounding operations were calculated in the same manner and using the same assumptions as they were for beef cow/calf operations. Thus, for a more detailed discussion of these costs see Section 4.1.1 in the Beef Cow/Calf section.

Injury Costs Associated with Tagging Cattle

Human and animal injury costs associated with tagging cattle for backgrounding operations were calculated in the same manner and using the same assumptions as they were for beef cow/calf operations. Thus, for a more detailed discussion of these costs see Section 4.1.1 in the Beef Cow/Calf section.

Cattle Shrink Associated with Tagging Cattle

The cost of cattle shrink due to tagging cattle for backgrounding operations were calculated in the same manner and using the same assumptions as they were for beef cow/calf operations. Thus, for a more detailed discussion of these costs see Section 4.1.1 in the Beef Cow/Calf Operations section. One assumption that varied for backgrounding operations is that it was assumed that the heavier feeder calves would shrink 2.75 pounds per head (beef calves were assumed to shrink 2.0 pounds per head). Because of the heavier weight cattle, the price used to calculate the cost of shrink was slightly lower than for beef cow/calf ($1.09/lb versus $1.21/lb). Table A4.3.3 in Appendix A4.3 reports the various tagging-related, or working cattle, costs for backgrounding operations.

4.3.2 Reading Costs

The RFID component and reading costs for this study was a function of animals read, ownership and operating costs associated with the RFID technology (e.g., electronic readers (panel and wand), data accumulator, software), and database charges. The following is a brief discussion of each of the relevant components.

Animals Purchased or Transferred

The nature of the backgrounding industry, as defined by this report, was to buy animals for the purpose of adding weight and reselling to a feedlot. Therefore, the average inventory for the different operation sizes reflects the average number of animals purchased. Cattle that are purchased through auction markets are assumed to have their tags read at the time of sale and thus only non-auction market purchases will be required to be read (see Section 4.1.2 in the Beef Cow/Calf section for additional discussion). Based on the assumption that 69.6% of cattle are sold through auctions, backgrounding operations would only have to read the RFID tags on 30.4% of the cattle they purchase annually.

Electronic Reader

See Section 4.1.2 in the Beef Cow/Calf section for discussion.

Data Accumulator and Software

See Section 4.1.2 in the Beef Cow/Calf section for discussion on cost of data accumulator (computer) and related software. It was assumed that a percentage of backgrounders would already own computers. Thus, as was done with beef cow/calf operations, data accumulator and software costs were adjusted to reflect operations that currently own computers. Because information specific to backgrounding operations was not available, proxies were substituted. It was assumed that the five smaller categories would follow an ownership distribution similar to the Cow/Calf sector (USDA, 1997); whereas, the two largest size categories were assumed to follow the percentage of feedlot owners who owned computers (USDA, 2000).

Labor, Chute, and Other Costs Associated with Reading RFID Tags

Costs related to reading RFID tags for backgrounding operations were calculated in the same manner and with most of the same basic assumptions as for beef cow/calf operations (see 4.1.2 in the Beef Cow/Calf section). However, there were several different assumptions used. Unlike beef and dairy operations, it was not assumed that all backgrounding operations would run their cattle through chutes to perform basic animal husbandry practices. Instead, it was assumed that backgrounders would follow the practice of beef feedlots. Less than a fourth (21.9%) of feedlots with an average inventory between 1,000-7,999 head do not work their cattle within 72 hours of receiving them (USDA, 2000). Thus, for a 48-hour traceability system to be realized, these animals would need to have their eID tags read before they are worked.

In order to comply with the 48-hour traceability goal, 21.9% of all backgrounding operations would incur the total cost of reading RFID tags. To calculate this cost, the number of animals that needed to be read on an operation was multiplied by 20 seconds to find the time required to read RFID tags. The total time was then multiplied by the labor rate and the total number of employees to find the total cost of RFID labor. The number of employees required to work the cattle was broken into two groups: 1) the reading employee and 2) other employees. The other employee group had differing amount of people for the different sized operations.

The full chute charge was reduced to 25% of the original charge because it was assumed that producers would not individually catch each animal, but they will take a group of animals and put them in a chute alley and read the tags from the alley via a wand or panel reader system. Animal and human injury costs were added according to the amount of time the animal was in the alley being read. A shrink of 2.25 pounds per head was added to the cost of reading the RFID tags to capture the missed weight gain of stocker animals.

The method of finding the costs for the other 78.1% of the operations (i.e., those that work their cattle upon arrival) are similar to those found in Section 4.1.2 in the Beef Cow/Calf section.

Database Charge

Charges for storing data for backgrounding operations were calculated in the same manner and with the same basic assumptions as for beef cow/calf operations. For a discussion of these costs see 4.1.2 in the Beef Cow/Calf section.

Other/Fixed Charges

Other identification-related costs for backgrounding operations were calculated in the same manner and with the same basic assumptions as for beef cow/calf operations. For a discussion of these costs see 4.1.2 in the Beef Cow/Calf section. Table A4.3.4 in Appendix A4.3 summarizes the costs associated with reading RFID tags by size of operation. Note that the largest size category of backgrounding operations, those purchasing about 3,000 head per year, would own the RFID system for reading tags, whereas the smaller operations would outsource this function. This is because the larger operations have a sufficient amount of tag reads required per year to justify owning readers and other associated computer hardware and software.

Premises Registration Costs

Costs associated with registering backgrounding operation premises were calculated in the same manner and with the same basic assumptions as for beef cow/calf operations. For a discussion of these costs see 4.1.2 in the Beef Cow/Calf section.

Interest Costs

Interest costs for backgrounding operations were calculated in the same manner and with the same basic assumptions as for beef cow/calf operations. For a discussion of these costs see 4.1.2 in the Beef Cow/Calf section.

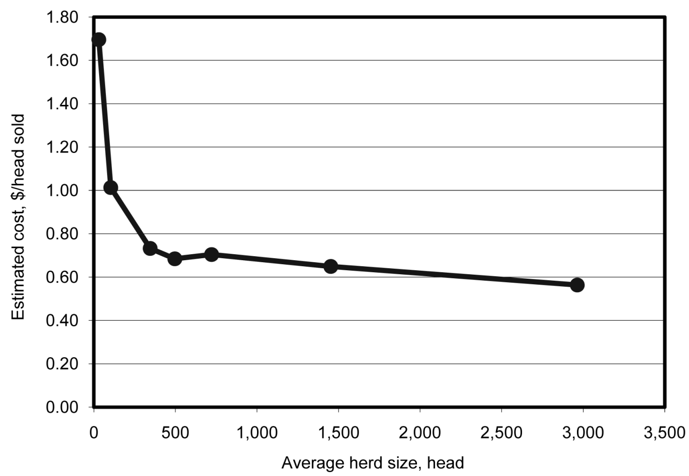
Summary of Backgrounding Costs

Table 4.7 summarize the costs associated with an individual animal ID system that has traceability included (i.e., Scenario 3 discussed in Section 4 above) by size of operation for backgrounding operations. The cost per head sold ranges from a low of $0.56 per head (largest operations) to a high of $1.70 per head (smallest operations). Figure 4.6 shows the cost per head sold graphically for backgrounding operations at the various operation sizes. Two things are readily apparent from this figure. First, cost per head sold for backgrounding operations is considerably lower than for cow/calf operations. This is due to the assumption that calves were tagged prior to coming into the backgrounding phase. Thus, the cost of tags and working cattle was only on cattle needing to be retagged. Second, economies of size exist such that larger operations have lower costs – larger operations have a lower cost of over $1.00/head compared to the smallest operations. However, most of the gains associated with operation size are captured quickly as size increases. That is, medium-sized operations have costs similar to the larger operations.

Table 4.7. Summary of RFID Costs for Backgrounding Operations by Size of Operation

	Size of Operation Size, number of head						
	31	104	345	496	722	1,453	2,963
Total annual cost, $/operation	$51	$104	$250	$335	$502	$931	$1,648
Total annual cost, $/head sold	$1.70	$1.01	$0.73	$0.68	$0.70	$0.65	$0.56
Total annual cost, $/head purchased	$1.67	$1.00	$0.72	$0.68	$0.69	$0.64	$0.56
Total number of operations	21,438	11,334	6,333	4,333	3,329	2,316	1,787
Total industry cost, thousand $	$1,096	$1,175	$1,580	$1,453	$1,670	$2,155	$2,944

Figure 4.6. Cost of RFID Technology for Cattle Backgrounding Operations by Operation Size



4.4 Feedlots

4.4.1 Tags and Tagging Costs

Operation Distributions

USDA NASS reports the total number of feedlot operations as well as the number of operations with 1,000+ head capacity (USDA, 2008e). Using this information, the number of operations with less than 1,000 head was calculated as the difference between total of all operations and the total of 1,000+ head operations (the number of feedlots for all size categories is also reported in the USDA NASS February *Cattle on Feed* report).

Average inventory distributions were found for feedlot operators similar to the other cattle sectors. Because USDA NASS does not report feedlot placements for operations with less than 1,000 head capacity, placements were estimated from fed cattle marketings, which are reported for feedlots with less than 1,000 head (USDA, 2008e). The difference between feedlot marketings and feedlot placements is a disappearance rate (cattlenetwork, 2006). For this analysis, disappearance is defined as any animal placed in a feedlot that (a) dies, (b) was returned to grazing forage, (c) was shipped to another feedlot, (d) was stolen, or (e) lost for other reasons. In 1999, NAHMS conducted a feedlot survey (USDA, 2000) that indicated 3% of animals placed in feedlots disappeared. Using this 3% disappearance rate, marketings were divided by 97% to estimate the total placements for all operations. table A4.4.1 in Appendix A4.4 reports the number of feedlot operations and various production and inventory level values by size of operation.

RFID Tags Placed

Similar to backgrounding operations, it was assumed that feedlots will only have to replace RFID tags when they are lost (see Section 4.1.3). Therefore, the number of animals that feedlots market multiplied by a tag loss rate would give the total number of animals needing to be retagged. Based on a feedlot death loss rate of 1.3% (USDA, 2000), the average number of calves placed on feed (i.e., placements) was reduced by 1.3% giving the total number of fed cattle sold by the feedlots. Multiplying the number of fed cattle sold by 2.5%, the assumed tag loss rate (see Section 1.2), gives the number of feedlot cattle worked (for RFID purposes) and RFID tags needing to be purchased.

RFID Tags and Applicator Cost

Costs of RFID tags varied by purchase volume and the same rates used for the beef cow/calf sector were used for the feedlot sector. For the discussion of tags costs see 4.1.1 in the Beef Cow/Calf section. Similarly, the costs of RFID tag applicators for feedlot operations were calculated using the same assumptions as for beef cow/calf operations (see Section 4.1.1 for more details). Table A4.4.2 in Appendix A4.4 reports the number of tags and tag applicators required by size of operation for feedlot operations.

Labor and Chute Costs for Tagging Cattle

Labor and chute costs associated with tagging cattle for feedlot operations were calculated in the same manner and using the same assumptions as they were for beef cow/calf operations. Thus, for a more detailed discussion of these costs see 4.1.1 in the Beef Cow/Calf section.

Injury Costs Associated with Tagging Cattle

Human and animal injury costs associated with tagging cattle for feedlot operations were calculated in the same manner and using the same assumptions as they were for beef cow/calf operations. Thus, for a more detailed discussion of these costs see 4.1.1 in the Beef Cow/Calf section.

Cattle Shrink Associated with Tagging Cattle

The cost of cattle shrink due to tagging cattle for feedlot operations were calculated in the same manner and using the same assumptions as they were for beef cow/calf operations. Thus, for a more detailed discussion of these costs see 4.1.1 in the Beef Cow/Calf Operations section. One assumption that varied for feedlot operations is that it was assumed that the heavier fed cattle would shrink 3.25 pounds per head (beef calves were assumed to shrink 2.0 pounds per head). Because of the heavier weight cattle, the price used to calculate the cost of shrink was slightly lower than for beef cow/calf ($0.95/lb versus $1.21/lb). Table A4.3.4 in Appendix A4.4 reports the various tagging-related, or working cattle, costs for feedlot operations.

4.4.2 Reading Costs

The RFID component and reading costs for this study was a function of animals read, ownership and operating costs associated with the RFID technology (e.g., electronic readers (panel and wand), data accumulator, software), and database charges. The following is a brief discussion of each of the relevant components.

Animals Purchased or Transferred

All animals placed into a feedlot were considered to be read at either the auction yard or the feedlot premises. Cattle that are purchased through auction markets are assumed to have their tags read at the time of sale and thus only non-auction market purchases will be required to be read (see 4.1.2 in the Beef Cow/Calf section for additional discussion). Based on the assumption that 69.6% of cattle are sold through auctions, feedlot operations would only have to read the RFID tags on 30.4% of the cattle they place on feed annually.

Electronic Reader

See 4.1.2 in the Beef Cow/Calf section for discussion.

Data Accumulator and Software

See 4.1.2 in the Beef Cow/Calf section for discussion on cost of data accumulator (computer) and related software. It was assumed that a percentage of feedlot operations would already own computers. Thus, as was done with beef cow/calf operations, data accumulator and software costs were adjusted to reflect operations that currently own computers. Information regarding computer usage in feedlots came from the 1999 NAHMS Feedlot report (USDA, 2000). Given that the NAHMS feedlot survey was conducted in 1999, it likely underestimates the percentage of feedlots that currently own computers and thus the costs estimated are likely biased upward (i.e., costs based on current computer ownership would likely be lower).

Labor, Chute, and Other Costs Associated with Reading RFID Tags

Costs related to reading RFID tags for feedlot operations were calculated in the same manner and with most of the same basic assumptions as for beef cow/calf operations (see Section 4.1.2 in the Beef Cow/Calf section). However, there were several different assumptions used. Unlike beef and dairy operations, it was not assumed that all feedlot operations would run their cattle through chutes to perform basic animal husbandry practices. According to the 1999 NAHMS feedlot report, 21.9% of feedlot operations with an average inventory between 1,000-7,999 head and 12.5% with more than 7,999 head did not work their cattle within 72 hours of receiving them (USDA, 2000). Therefore, in order to comply with the 48-hour trace-back goal, 21.9% of operations with less than 8,000 head and 12.5% of operations with more than 7,999 head would incur the total cost reading RFID tags.

To calculate this cost, the number of animals read on an operation was multiplied by 20 seconds to find the time required to read RFID tags. The total time was then multiplied by the labor rate and the total number of employees to find the total cost of RFID labor. The number of employees needed to work the cattle was broken into two groups: the reading employee and the other employees. The other employee group had differing amount of people for different operations sizes.

The full chute charge was reduced to 25% of the original charge because it was assumed that producers would not individually catch each animal, but they will take a group of animals and put them in a chute alley and read the tags from the alley via a wand or panel reader system.

Animal and human injury costs were added according to the amount time the animal was in the alley being read. A shrink of 2.75 pounds per head was added to the cost of reading the RFID tags to capture the missed weight gain of the feeder cattle.

The method of finding the costs for the other 78.1% of operations with less than 8,000 head and for the other 87.5% of operations with more than 7,999 head (i.e., those that work their cattle upon arrival) are similar to those found in section 4.1.2 in the Beef Cow/Calf section.

Database Charge

Charges for storing data for feedlot operations were calculated in the same manner and with the same basic assumptions as for beef cow/calf operations. For a discussion of these costs see Section 4.1.2 in the Beef Cow/Calf section.

Other/Fixed Charges

Other identification-related costs for feedlot operations were calculated in the same manner and with the same basic assumptions as for beef cow/calf operations. For a discussion of these costs see Section 4.1.2 in the Beef Cow/Calf section. Table A4.4.4 in Appendix A4.4 summarizes the costs associated with reading RFID tags by size of feedlot operation. Note that feedlots with more than 4,000 head capacity would own the RFID system for reading tags, whereas operations smaller than this would outsource this function. This is because the larger operations have a sufficient amount of tag reads required per year to justify owning readers and other associated computer hardware and software.

Premises Registration Costs

Costs associated with registering feedlot operation premises were calculated in the same manner and with the same basic assumptions as for beef cow/calf operations. For a discussion of these costs see 4.1.2 in the Beef Cow/Calf section.

Interest Costs

Interest costs for feedlot operations were calculated in the same manner and with the same basic assumptions as for beef cow/calf operations. For a discussion of these costs see 4.1.2 in the Beef Cow/Calf section.

Summary of Feedlot Costs

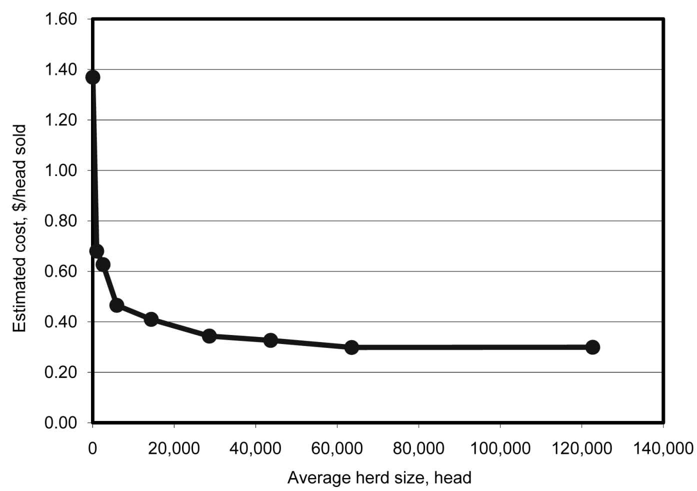
Table 4.8 summarize the costs associated with an individual animal ID system that has full traceability included (i.e., Scenario 3 discussed in Section 4 above) by size of operation for beef feedlot operations. The cost per head sold ranges from a low of $0.30 per head (largest operations) to a high of $1.37 per head (smallest operations). Figure 4.7 shows the cost per head sold graphically for feedlot operations at the various operation sizes. Two things are readily apparent from this figure.

First, cost per head sold for feedlot operations is considerably lower than for cow/calf operations. This is due to the assumption that calves were tagged prior to being placed on feed in the feedlot sector. Thus, the cost of tags and working cattle was only on cattle needing to be retagged. Second, economies of size exist such that larger operations have lower costs – larger operations have a cost advantage of over $1.00/head compared to the smallest operations. However, most of the gains associated with operation size are captured quickly. For example, the cost advantage for the largest feedlots (50,000+ head capacity) decreases to less than $0.40/head when compared to the second smallest size category (1,000-1,999 head capacity).

Table 4.8. Summary of RFID Costs for Feedlot Operations by Size of Operation

	Size of Operation, feedlot capacity (head)								
	1-999	1000-1999	2000-3999	4000-7999	8000-15999	16000-23999	24000-31999	32000-49999	50000+
Total annual cost, $/operation	$61	$670	$1,583	$2,736	$5,805	$9,701	$14,058	$18,706	$36,216
Total annual cost, $/head sold	$1.37	$0.68	$0.63	$0.47	$0.41	$0.34	$0.33	$0.30	$0.30
Total annual cost, $/head purchased	$1.36	$0.67	$0.62	$0.46	$0.40	$0.34	$0.32	$0.29	$0.30
Total number of operations	85,000	809	564	343	182	78	55	71	58
Total industry cost, thousand $	$5,174	$542	$893	$939	$1,057	$757	$773	$1,328	$2,101

Figure 4.7. Cost of RFID Full Traceability Technology Adoption for Cattle Feedlots by Operation Size



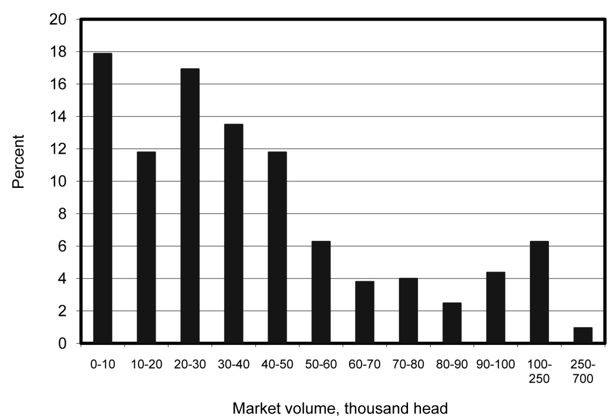
4.5 Auction Markets

The costs incurred at auction markets will vary depending on many factors, size of auction market, species, services offered, etc. While auction markets may be able to pass increased costs associated with an animal ID system on to their customers (i.e., cattle producers), these costs still have an impact on the industry. Furthermore, if different size auction markets have different costs (i.e., if economies of size exist) some of these added costs may not be able to be passed on to customers due to competition within the industry. For this analysis three costs at the auction market level were considered: 1) cost of tagging calves, 2) cost of reading RFID tags, and 3) cost of data storage.

Operation Distributions

In order to determine how a national animal identification system might impact auction markets of various sizes, a distribution of markets was required. Information on auction market volume was obtained from the Livestock Marketing Association (LMA, 2008). LMA provided 2006 market volume data for 526 auction markets in the US and indicated this was representative of the variability of the estimated 1,050 auction markets in the US. Figure 4.8 shows the distribution of the 526 auction markets identified by LMA. Over 70% of the auction markets sell less than 50,000 head of cattle through their facilities annually.

Figure 4.8. Distribution of Livestock Auction Markets by Head of Cattle Sold Annually



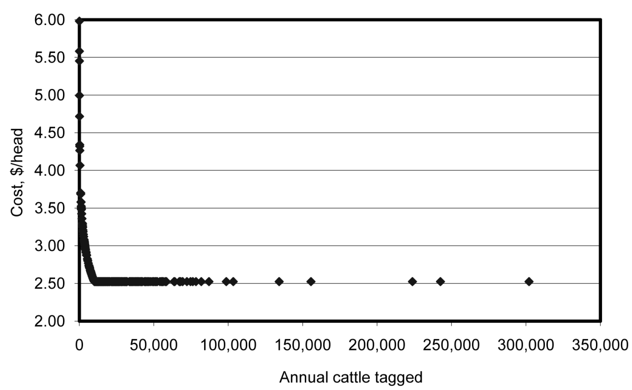
Costs of Tagging Service

It was assumed that auction markets might provide tagging services to their customers if an animal identification system were adopted. The fee charged by an auction market for tagging was estimated as a function of the number of cattle tagged annually based on survey results from auction yards (Bolte, 2007). The estimated relationship between reported fees and market volume was not particularly strong (R^2 of 0.116), but it exhibited a decreasing cost as volume increased as expected and was relatively consistent with values observed in Michigan (Kirk, 2007). Figure 4.9 shows the estimated tagging fees for each of the 526 auction markets depicted in figure 4.8 assuming that 44.8% of cattle going through facility would be tagged (average of responses in Bolte survey). There are large economies of size as the very smallest markets have estimated costs twice as high as larger auction markets. However, the costs decrease rapidly and plateau at approximately 10,000 head of cattle tagged annually). The volume-weighted average of the 526 auction markets is $2.54 per head, which is the value used for this analysis. The cost of tagging was included in the livestock budgets directly and thus this cost shows up as a cost to producers and not to auction markets.

Cost of Reading Tags

It was assumed that cattle marketed through auction markets would have RFID tags read and thus they would not have to be read at another location (see Section 4.1.2). The type of reading system an auction market might use (i.e., wand reader versus panel reader) will depend somewhat on their volume and the actual design and layout of their facilities. The cost associated with reading RFID tags at auction markets was estimated as a function of the number of cattle being read annually based on survey results from auction yards (Bolte, 2007). The estimated cost function represents a mixture of reader types, with the smaller auctions generally using wand readers and the larger auctions using panel readers. Also, these costs did not include backup systems such that 100% reads could be guaranteed. While 100% read rate would be required for a system that relied upon this for inventory control, invoicing and payment, NAIS would not require that level of accuracy. The estimated relationship between tag reading cost and market volume was not particularly strong (R^2 of 0.179). As expected, reading cost per head decreased as volume increased. Figure 4.10 shows the estimated costs of reading RFID tags for each of the 526 auction markets depicted in figure 4.8 assuming that 100% of cattle going through the facilities would be read. There are large economies of size as the very smallest markets have estimated costs significantly higher than larger auction markets.

Figure 4.9. Estimated Auction Market Fee for Tagging Cattle Sold through the Market by Head Tagged Annually

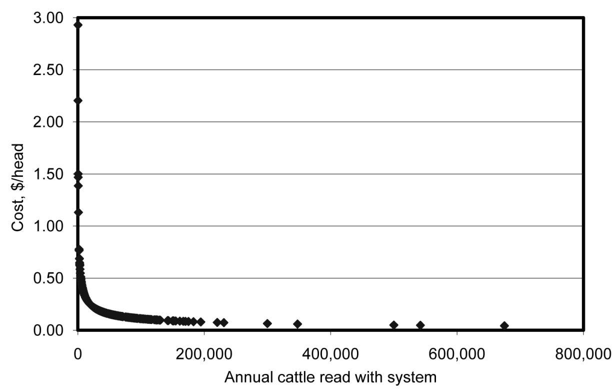


The simple average of the 526 markets is $0.27 per head, however, the volume-weighted average is $0.145 per head. The volume-weighted average is the value used for this analysis to estimate the total cost to the industry. While the cost of reading RFID tags would likely be passed on directly to producers through higher commissions, this cost was not included directly in the livestock budgets and thus is included here.

Cost of Data Storage

A per-head charge of $0.085 was included as a cost to auction markets for every animal read (see Section 4.1.2 for additional discussion of database costs). While the cost of data storage would likely be passed on to producers through higher commissions, this cost was not included directly in the livestock budgets and thus is included in this section.

Figure 4.10. Estimated Cost to Auction Market for Reading RFID Tags by Number of Cattle Read Annually



Summary of Auction Market Costs

Based on 69.6% of cattle being marketed through auctions, it was estimated there would be 38,128,769 cattle marketed through auctions annually. Based on an average cost of reading RFID tags of $0.145 per head and a data storage cost of $0.085 per head, there would be an estimated cost of slightly over $8.7 million. Assuming there are 1,050 auction markets in the US (LMA, 2008), this equates to over $8,000 per auction market per year.

4.6 PACKERS

The costs incurred at cattle packing plants will depend on numerous factors, but primarily on size of the plant. While packing plants may be able to pass increased costs associated with an animal ID system on to their customers (i.e., cattle producers), these costs still have an impact on the industry. Furthermore, if different size packing plants have different costs (i.e., if economies of size exist) some of these added costs may not be able to be passed on to producers because of competition within the industry. For this analysis the costs at packing plants was based on the costs of reading RFID tags.

OPERATION DISTRIBUTIONS

In order to determine how a national animal identification system might impact packing plants of various sizes, a distribution of plant sizes was required. Information on the number and size of steer and heifer, cow and bull, and calf packing plants was obtained from USDA GIPSA (USDA, 2007g). Average values for 2001-2005 were used for the analysis and then adjusted to 2007 marketings. Figures 4.11-4.13 show the distribution of the number of plants and their shares of cattle slaughtered for steer and heifer plants, cow and bull plants, and calf plants, respectively. Patterns in these figures are consistent with the distribution of cattle production operations and auction markets. That is, there are a relatively large number of small operations, but the few largest operations account for the majority of the production.

FIGURE 4.11. SIZE DISTRIBUTION AND MARKET SHARE OF STEER AND HEIFER SLAUGHTER PLANTS BY PLANT SIZE, 2001-05 AVERAGE

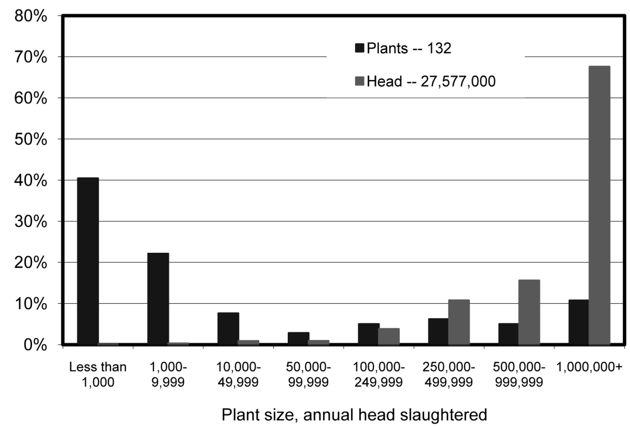


FIGURE 4.12. SIZE DISTRIBUTION AND MARKET SHARE OF COW AND BULL SLAUGHTER PLANTS BY PLANT SIZE, 2001-05 AVERAGE

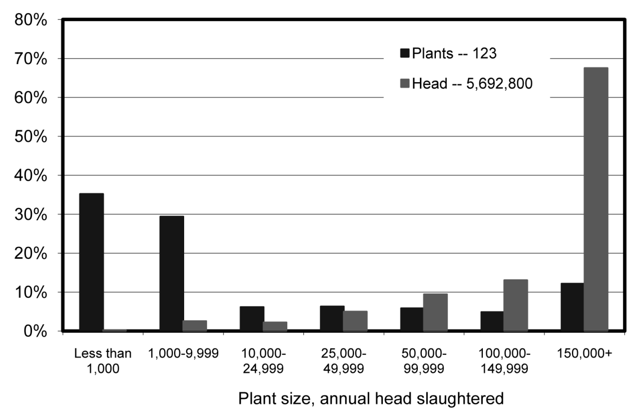
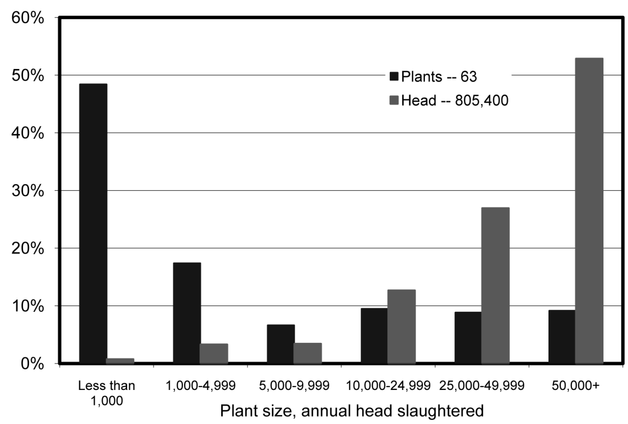


FIGURE 4.13. SIZE DISTRIBUTION AND MARKET SHARE OF CALF SLAUGHTER PLANTS BY PLANT SIZE, 2001-05 AVERAGE.



COST OF READING TAGS

It was assumed that all cattle processed through a packing plant would have RFID tags that need to be read. The type of reading system a packing plant would use (i.e., wand reader, panel reader, visual recording of data) will depend somewhat on their volume and the actual design and layout of their facilities. Specifically, very small plants might find it more economical to simply record the 15-digit ID manually rather to invest in an electronic reader. The cost associated with reading RFID tags at packing plants was estimated as a function of the number of cattle being processed annually based on survey results from packing plants of various sizes (Bass et al., 2008). Figures 4.14-4.16 show the estimated costs per head for reading RFID tags for steer and heifer, cow and bull, and calf packing plants, respectively, as size of plant varies. In all cases, costs decrease as volume increases indicating economies of size exist. In addition to the cost per head, the respective figures report the volume-weighted cost per head and the total cost to the industry assuming 2007 slaughter levels. Bass et al. (2008) included a cost of $0.085 per head for data storage in their estimates, however, this cost likely will be covered by the government rather than the plants (USDA, 2008g). That is, packing plants will submit animal ID data they read to the government and they will enter it into a database and incur the cost of data storage. Because it was assumed that data storage was a fixed cost of $0.085 per head, the economies of size relationships estimated would still exist, but costs would simply be lower everywhere (i.e., the lines in figures 4.14-4.16 would simply shift down by $0.085 per head).

FIGURE 4.14. ANNUAL COST OF ADOPTING RFID TECHNOLOGY FOR STEER AND HEIFER SLAUGHTER PLANTS BY PLANT SIZE

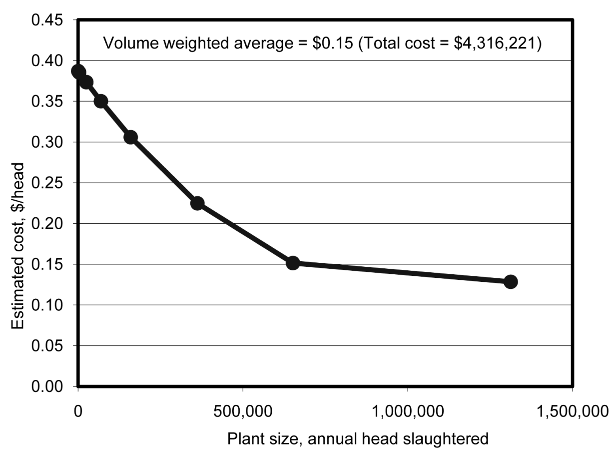


FIGURE 4.15. ANNUAL COST OF ADOPTING RFID TECHNOLOGY FOR COW AND BULL SLAUGHTER PLANTS BY PLANT SIZE

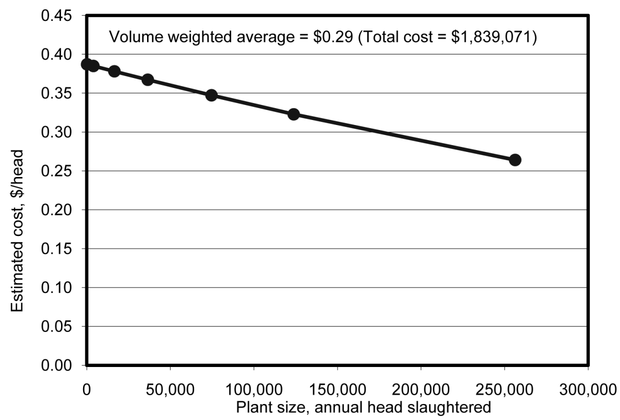
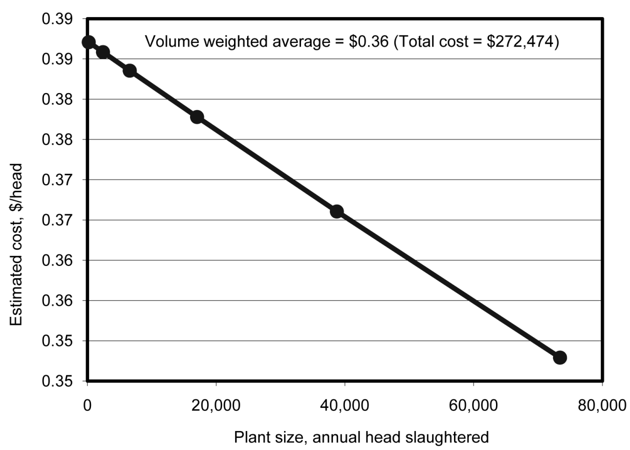


FIGURE 4.16. ANNUAL COST OF ADOPTING RFID TECHNOLOGY FOR CALF SLAUGHTER PLANTS BY PLANT SIZE



Summary of Packing Plant Costs

Based on reading 100% of cattle being slaughtered in 2007 (35,017,500 head), the total costs of reading RFID tags to the 318 beef packing plants in the US is estimated at just under $3.5 million, or an average of almost $11,000 per plant.

4.7 Cattle Industry Summary

Table 4.9 summarizes the total costs to the cattle industry by sector under scenario #3 (full traceability). Total costs are estimated at slightly over $209 million of which two-thirds of that amount is incurred in the beef cow/calf sector. Table 4.10 reports the sector totals with a partial breakdown by type of cost. On a percentage basis, just under half (46.7%) of the total costs to the industry are the costs of RFID tags. Keep in mind as technology increases this cost would be expected to decline (see figure 4.2 in Section 4.1.1). The next largest cost is chute charges, which basically represents working cattle. However, chute costs were not particularly high for operations that currently tag. This indicates that current management practices of a producer can have sizable impact on their cost of adopting an animal ID system. Collectively, about 17% of the costs were due to reading tags (e.g., readers, labor, injuries, data storage). However, this percent varied depending on which sector was considered. For example, reading costs were a big portion of the costs for backgrounders and feedlots because they only had to purchase tags for animals that needed to be retagged. Based on assumptions used in this analysis, a full traceability animal identification program in the cattle industry would add about $5.97 per head to the cost of cattle marketed.

Within each of the sectors in the cattle industry, economies of size associated with an animal identification system were present. Thus, smaller operations likely will be slower to adopt identification systems because they incur higher per unit costs. However, as a general rule for most sectors, most of the economies of size were typically captured quite quickly such that average incremental costs for mid-sized producers were similar to costs of the largest operations.

Table 4.11 reports the total costs to the cattle industry by sector under the three different scenarios: 1) premises registration only, 2) bookend animal ID system, and 3) full traceability ID system for various adoption rates. The costs are reported for both a uniform adoption rate and a lowest-cost-first adoption rate. Given that animal identification is a voluntary program, the lowest-cost-first adoption rate likely better reflects what costs would be to the industry with something less than 100% adoption. Note that at 100% adoption the two methods are equal. The premises registration scenario (#1) reflects only costs associated with registering premises (see Section 4.1.2) for a discussion about how premises registration costs were estimated), which is significantly below the other two scenarios. However, it is also important to recognize that this represents no animal identification and no ability to trace animal movements. It can be seen in the lowest-cost-first adoption column that costs increase at an increasing rate with higher levels of adoption. This suggests that getting lower rates of adoption may not be that difficult with a voluntary program because costs are relatively low. However, to get a high adoption rate will be more difficult because this requires the higher cost operations to also participate.

The premises registration scenario (#1) reflects only costs associated with registering premises (see Section 4.1.2 for a discussion about how premises registration costs were estimated), which is significantly below the other two scenarios. However, it is also important to recognize that this represents no animal identification and no ability to trace animal movements.

Scenario #2 represents an animal identification system that reflects what is referred to as a bookend system. A bookend system simply means the cattle are identified at both ends of their lives (birth and death), but movements in between are not tracked. Because tags were a big portion of the total industry costs (table 4.9) and the bookend system still requires tags (and retags), this system has a total cost of approximately $165 million, which is 79% of the full traceability system (Scenario #3). The bookend system for cow/calf producers requires nearly the same costs (93% of full tracing costs) as the full tracing system because for cow/calf producers the bookend and full tracing systems are nearly identical only differing by reading and recording costs when animals leave the farm.

Table 4.9. Summary of Cattle Industry Costs Under Scenario #3 (full traceability)

	Beef Cow/Calf	Dairy	Background	Feedlot	Auction Yards	Packers	Industry Total
% of Animals	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Number of Operations	757,900	71,510	50,870	87,160	1,050	318	967,440
Average Inventory	33,120,600	9,158,000	17,229,903	26,964,948	38,128,769	35,017,500	100,953,011
Total Annual Cost, $	$139,764,146	$31,437,688	$12,072,978	$13,562,885	$8,765,395	$3,467,081	$209,070,173
Cost Per Animal in Inv.	$4.22	$3.43	$0.70	$0.50	$0.23	$0.10	$2.07
Cost Per Animal Marketed	$4.91	$6.21	$0.71	$0.51	$0.23	$0.10	$5.97
Total Cost Per Operation	$184	$440	$237	$156	$8,348	$10,889	$216

Table 4. 10. Breakdown of Cattle Industry Costs Under Scenario #3 (full traceability)

	Beef Cow/Calf	Dairy	Background	Feedlot	Auction Yards	Packers	Industry Total
Breakdown of Costs ($)							
Tags and Tagging Cost	**$126,277,143**	**$22,287,953**	**$3,722,199**	**$5,038,490**	**$0**	**$0**	**$157,325,784**
RFID Tag	$77,109,181	$17,953,248	$1,090,262	$1,474,334			$97,627,025
Applicator	$5,427,448	$1,041,849	$1,180,971	$1,267,772			$8,918,038
Labor	$3,001,888	$829,613	$581,894	$916,294			$5,329,689
Chute	$29,826,991	$2,073,135	$425,148	$666,169			$32,991,443
Shrink	$8,652,018	$145,099	$318,047	$516,229			$9,631,394
Injury	$2,259,617	$245,009	$125,878	$197,691			$2,828,195
Reading Costs	**$9,971,412**	**$8,831,629**	**$8,114,813**	**$8,120,096**	**$8,765,395**	**$3,467,081**	**$47,270,426**
RFID Capital	$7,520,444	$6,566,466	$5,172,111	$4,137,436			
Labor/Chute	$1,985,228	$2,029,050	$1,703,611	$2,757,631			
Shrink/Injury	$465,741	$236,113	$1,239,091	$1,225,028			
Premises Registration	**$3,515,591**	**$318,106**	**$235,965**	**$404,300**	**$0**	**$0**	**$4,473,962**
TOTAL	**$139,764,146**	**$31,437,688**	**$12,072,978**	**$13,562,885**	**$8,765,395**	**$3,467,081**	**$209,070,173**
Breakdown of Costs (%)							
Tags and Tagging Cost	**90.4%**	**70.9%**	**30.8%**	**37.1%**	**0.0%**	**0.0%**	**75.3%**
RFID Tag	55.2%	57.1%	9.0%	10.9%			46.7%
Applicator	3.9%	3.3%	9.8%	9.3%			4.3%
Labor	2.1%	2.6%	4.8%	6.8%			2.5%
Chute	21.3%	6.6%	3.5%	4.9%			15.8%
Shrink	6.2%	0.5%	2.6%	3.8%			4.6%
Injury	1.6%	0.8%	1.0%	1.5%			1.4%
Reading Costs	**7.1%**	**28.1%**	**67.2%**	**59.9%**	**100.0%**	**100.0%**	**22.6%**
RFID Capital	5.4%	20.9%	42.8%	30.5%			
Labor/Chute	1.4%	6.5%	14.1%	20.3%			
Shrink/Injury	0.3%	0.8%	10.3%	9.0%			
Premises Registration	**2.5%**	**1.0%**	**2.0%**	**3.0%**	**0.0%**	**0.0%**	**2.1%**
TOTAL	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table 4.11. Total Cattle Industry Cost versus Adoption Rate Under Alternative Scenarios

Scenario #1 -- Premises Registration Only

Industry Sector	Premises Registration	Adoption rate	Uniformly adopted	Lowest cost adopted first
Beef cow/calf	$3,515,591	10%	$449,391	$17,923
Dairy	$331,706	20%	$898,782	$78,209
Background	$235,965	30%	$1,348,173	$171,464
Feedlot	$404,300	40%	$1,797,564	$269,120
Auction yards	$4,871	50%	$2,246,955	$369,892
Packers	$1,477	60%	$2,696,346	$576,690
TOTAL COST	$4,493,910	70%	$3,145,737	$853,119
		80%	$3,595,128	$1,724,410
		90%	$4,044,519	$2,915,856
		100%	$4,493,910	$4,493,910

Scenario #2 -- Bookend Animal ID System

Industry Sector	Book End Cost	Adoption rate	Uniformly adopted	Lowest cost adopted first
Beef cow/calf	$129,792,734	10%	$16,526,259	$11,042,459
Dairy	$22,601,817	20%	$33,052,517	$23,173,569
Background	$3,958,165	30%	$49,578,776	$35,408,252
Feedlot	$5,442,789	40%	$66,105,034	$47,857,435
Auction yards	$0	50%	$82,631,293	$61,313,638
Packers	$3,467,081	60%	$99,157,551	$79,128,199
TOTAL COST	$165,262,586	70%	$115,683,810	$98,289,501
		80%	$132,210,068	$118,145,015
		90%	$148,736,327	$140,285,046
		100%	$165,262,586	$165,262,586

Scenario #3 -- Full Traceability Animal ID System

Industry Sector	Traceability Cost	Adoption rate	Uniformly adopted	Lowest cost adopted first
Beef cow/calf	$139,764,146	10%	$20,907,017	$13,269,613
Dairy	$31,437,688	20%	$41,814,035	$28,030,002
Background	$12,072,978	30%	$62,721,052	$43,179,355
Feedlot	$13,562,885	40%	$83,628,069	$58,940,210
Auction yards	$8,765,395	50%	$104,535,087	$76,084,734
Packers	$3,467,081	60%	$125,442,104	$98,847,876
TOTAL COST	$209,070,173	70%	$146,349,121	$122,563,473
		80%	$167,256,139	$147,191,641
		90%	$188,163,156	$175,868,526
		100%	$209,070,173	$209,070,173

5. Direct Cost Estimates: Porcine

DIRECT COSTS OF NAIS ADOPTION WERE ESTIMATED for the swine (porcine) industry by breaking the industry into six main groups (referred to as operation types): 1) Farrow-to-Wean, 2) Farrow-to-Feeder, 3) Farrow-to-Finish, 4) Wean-to-Feeder (Nursery), 5) Feeder-to-Finish (Grow/Finish), and 6) Packers. The first five are referred to as production-type operations. The cattle industry included an auction market sector; however, because the vast majority of hogs are marketed direct this sector is not included for the swine industry. Estimating costs separately for different types of operations makes it possible to see how different sectors of the swine industry would be impacted with the adoption of an animal identification system.

The Farrow-to-Wean group was defined as producers who own gilts and sows and produce baby pigs that are sold as weaner pigs at weaning. Farrow-to-Feeder operations own gilts and sows and produce pigs that are held through the nursery phase and sold as feeder pigs (i.e., they feed the weaned pigs to weights of 50-60 pounds). Farrow-to-Finish operations own gilts and sows and produce pigs that are raised to slaughter weight at which time they are sold as market hogs to packers. Wean-to-Finish operations buy weaned pigs from Farrow-to-Wean operations and feed these pigs until they reach 50-60 pounds at which time pigs are sold to another producer for finishing. Feeder-to-Finish operations buy feeder pigs (either from Farrow-to-Feeder or Wean-to-Feeder operations) and feed them to final weight selling these market hogs to packers. Packers are defined as any operation that slaughters live animals, either market hogs or cull breeding stock, under government inspection to produce meat products for sale to the public.

The three production-type operations that include farrowing sell both pigs raised and cull breeding stock, while the other two production-type operations only market pigs/hogs (either as feeder pigs or market hogs) as they do not own breeding animals. This is an important distinction because consistent with current NAIS guidelines it was assumed that cull breeding stock would be required to be individually identified with a visual premises tag, whereas other pigs (weaned, feeder, or market) are identified with a single group/lot ID.

The following discussion of swine industry costs is partitioned by the different types of costs and according to the six operation types. Also, the following discussion pertains to costs associated with all swine being identified, either individually (cull breeding stock) or as groups (weaned, feeder, and market pigs/hogs) and movements tracked (i.e., Scenario 3 discussed in Section 4). Costs of just premises registration (Scenario 1) and just bookend (Scenario 2) systems are summarized separately later in this section.

5.1 Swine Operations

5.1.1 Operation Distributions and Production Levels

One of the objectives of this study was to determine if the implementation cost of an animal identification system varied by operation type and size. To determine if economies of size exist, costs of adopting animal identification were estimated for various operation sizes. The USDA NASS reports the number of swine operations and the percent of inventory by size groups. However, other data are only reported in aggregate (e.g., pig crop, farrowings, inventories by class). More importantly for this analysis, USDA does not routinely report any of this information specifically by operation type. Thus, rather than using USDA NASS operation size groupings directly, the total number of operations for 2007 (USDA 2008e) which includes contract operations, was disaggregated by operation type and size using data from the 2004 USDA ERS Agricultural Resource Management Survey (ARMS) (Tonsor and Featherstone, 2008). Because of this approach, operation size categories do not match up exactly with those reported by USDA NASS. That is, the four size classes used for operations in this analysis are < 500 head; 500-1,999; 2,000-4,999; and 5000+ head. This compares to six size classes in NASS data. Size classes represent the maximum number of hogs in inventory at any time during the year (McBride, Ney, and Mathews, 2008).

The swine industry has been changing rapidly and thus using the 2004 ARMS data to identify current operation types and sizes may be problematic. For example, Nigel and McBride (2007) pointed out that "In 1992, 65 percent of hogs came from farrow-to-finish operations, while only 22 percent came from specialized hog-finishing operations. By 2004, only 18 percent came from farrow-to-finish operations, while 77 percent came from specialized hog finishers" (p. 14). While using the 2004 ARMS data to disaggregate USDA NASS totals is not without problems, it was the best information that could be obtained that identified the different types of operations.

Because data used to estimate the number and size of operations, by operation type, came from two sources and time periods (2004 ARMS and 2007 NASS), estimating the average inventory and production levels of the different sized operations was not straightforward. This was especially true when trying to get production numbers to reconcile with total marketings. For operations that farrow, a number of breeding sows was "picked" for the first three size categories (i.e., < 500; 500-1,999; and 2,000-4,999), where this number of sows when combined with farrowings/sow/year and pigs/litter resulted in an average inventory on the farm that approximately matched the respective size category. The number of sows for the fourth category was solved for to reconcile the total number of pigs produced in the sector. Using this approach ensured that the total number of pigs produced by sector, and ultimately the number of market hogs slaughtered, exactly matched the NASS reported values for 2007. However, the average inventories of some of the individual size categories deviated slightly from what was expected in some cases. [7]

Average inventories for Wean-to-Feeder and Feeder-to-Finish operations were calculated in a similar fashion as the operations that included farrowing. That is, the number of pigs purchased (weaned or feeders) for the first three size categories was simply "picked" such that the average inventory matched up with the respective size categories while taking

[7] This approach does not explicitly account for pigs (weaners, feeders, and market) that are imported from Canada. However, because we worked from total marketings in 2007 we have implicitly captured the Canadian pigs, but we have possibly over estimated the costs to U.S. swine producers (i.e., some of the data recording and reporting costs would be paid by Canadian producers).

into account the number of turns these operations will have per year (i.e., groups going through facilities annually). The number of pigs purchased by operations in the fourth size category was calculated such that the total feeder pigs (Wean-to-Feeder) and market hogs (Feeder-to-Finish) coming out of the sector reconciled with totals for the industry after accounting for death loss in the nursery and finishing phases. Table 5.1 reports the average death loss rates by production phase and size of operation reported in the 2006 NAHMS swine report (USDA, 2008f) that were used in this analysis.

Table 5.2 reports the number of operations, average inventories, and production levels for the different production-type operations by size. Breeding herd inventories were based on the given number of sows (either "picked" or solved for) and a sow-to-boar ratio of 39.9. This ratio was based on a combination of NASS sows bred and boar slaughter data (USDA, 2008e) and inventory data for sows and gilts versus boars from Canada (Statistics Canada, 2008).[8] Pigs per litter varied by operation size (average sow inventory) and were based on data from the 2006 NAHMS swine report (USDA, 2008f). Farrowings per sow per year were calculated using 2007 data on total farrowings and average breeding herd inventories (USDA, 2008e) and were held constant across operation size. Total pigs produced annually for Farrow-to-Wean operations were calculated as the number of sows × pigs/litter × farrowings/sow/year. To determine feeder pigs produced for Farrow-to-Feeder operations, the number of weaned pigs produced (i.e., number of sows × pigs/litter × farrowings/sow/year) was reduced by death loss in the nursery, which varied by operation size (table 5.1). The annual number of market hogs produced by Farrow-to-Finish operations was calculated the same as feeder pig production in Farrow-to-Feeder operations with an additional adjustment to account for death loss in the grow/finish phase (table 5.1).

5.1.2 Number of Tags and Groups

To adopt NAIS, cull breeding stock (i.e., sows and boars) are assumed to be individually identified with a visual premises tag. This type of tag will have an identification (ID) number that is unique to the premises selling

[8] USDA NASS reports an inventory number for all breeding hogs, but does not report inventory data for sows and boars separately.

the hog, but not necessarily unique to the individual animal. Non culls that are marketed (i.e., weaner, feeder, and market pigs) are assumed to be identified with a unique group/lot ID number.

To determine the annual number of tags purchased, the total number of cull sows and boars needed to be calculated. Cull sow rates by size of operation from the 2006 NAHMS swine report (USDA, 2008f) were adjusted such that the total number of sows culled annually was exactly equal to the total reported sow slaughter for 2007 (USDA, 2008e). The number of cull boars was a proportion of cull sows (similar to inventory) and at a cull rate that resulted in total cull boars being equal to the boar and stag slaughter reported for 2007 (USDA, 2008e). The sum of cull sows and cull boars equaled the total visual premises tags required. It was assumed that cull breeding stock would be tagged as they were marketed and thus there would be a 100% retention rate (i.e., no tags would be lost prior to, or during marketing).

The number of lots for cull breeding stock was based on inventory levels and how often culls would be sold. It was assumed that operations with less than 50 sows would market culls twice per year; operations with 50-150 sows would market culls quarterly; operations with 150-500 sows market culls every eight weeks; and operations with more than 500 sows would market culls monthly. Thus, the number of lots of cull animals was based on the average inventory of the operation. Lot sizes for weaner, feeder, and market pigs in farrowing operations was based on the minimum of pigs produced per group of sows farrowing or 1,200 head, where the pigs produced per group was based on average inventory and pigs/litter.[9] Lot sizes for feeder and market pigs in the non-farrowing operations were based on the number of pigs purchased per turn or 1,200 head, whichever was less. Table 5.3 reports the number of tags and group/lot IDs that would be required for the different types and sizes of operations.

[9] Sows farrowing as a group were calculated as 18.3% of total sow inventory (Dhuyvetter, Tokach, and Dritz, 2007). The maximum group size was set at 1,200 head as this coincides with the size of many nursery and finishing buildings and it was assumed producers would use an all-in all-out approach if possible.

Table 5.1. Death Loss Rate Assumptions Used in Swine NAIS Adoption Analysis

Farrowing				
Size of operation (number of sows)	Small < 250	Medium 250-499	Large 500+	All sites
Breeding age female death loss, %	2.5%	2.4%	5.0%	4.7%
Preweaning pig death loss, %	8.8%	12.2%	13.2%	12.9%

Feeding				
Size of operation (number of sows)	Small < 2,000	Medium 2,000-4,999	Large 5,000+	All sites
Death loss in nursery, %	3.4%	4.1%	4.0%	3.9%
Death loss in grow/finish, %	4.3%	4.8%	7.8%	6.0%

Table 5.2. Number of Swine Operations and Inventory and Production Levels by Type and Size of Operation

	Size of Operation, number of head				
	< 500	500-1999	2000-4999	5000+	Total/Avg
Farrow-to-Wean					
Number of operations	299	3,348	1,435	897	5,979
Average breeding herd inventory	20.5	184.5	676.6	1,845.7	3,249,807
Average inventory before death loss	55.0	494.7	2,007.6	5,476.6	9,464,705
Pigs/litter	9.2	9.2	10.3	10.3	10.2
Average farrowings/sow/year	1.96	1.96	1.96	1.96	1.96
Total farrowings/year	39.1	352.0	1,290.5	3,520.6	6,199,087
Weaned pigs sold	361.3	3,251.4	13,308.2	36,305.1	62,647,364
Total pigs sold (including breeding stock)	371.4	3,342.2	13,772.4	37,571.3	64,755,701
Farrow-to-Feeder					
Number of operations	1,805	1,418	387	688	4,297
Average breeding herd inventory	20.5	143.5	615.0	1,668.7	1,625,665
Average inventory before death loss	72.2	505.4	2,430.0	6,593.0	6,319,749
Pigs/litter	9.2	9.2	10.3	10.3	10.2
Average farrowings/sow/year	1.96	1.96	1.96	1.96	1.96
Total farrowings/year	39.1	273.8	1,173.2	3,183.1	3,100,997
Feeder pigs sold	349.0	2,442.9	11,602.3	31,511.4	30,246,388
Total pigs sold (including breeding stock)	359.1	2,513.5	12,024.3	32,656.2	31,314,955
Farrow-to-Finish					
Number of operations	8,605	6,761	3,073	2,049	20,489
Average breeding herd inventory	10.3	41.0	123.0	242.1	1,239,516
Average inventory before death loss	91.9	367.6	1,102.8	2,170.4	11,112,720
Pigs/litter	9.2	9.2	9.2	9.2	9.2
Average farrowings/sow/year	1.96	1.96	1.96	1.96	1.96
Total farrowings/year	19.6	78.2	234.6	461.8	2,364,409
Market hogs sold	167.0	668.0	1,979.0	3,775.8	19,771,901
Total pigs sold (including breeding stock)	172.0	688.1	2,039.5	3,894.9	20,381,497
Wean-to-Feeder					
Number of operations	262	1,046	2,302	1,622	5,231
Average inventory before death loss	108.9	522.7	1,519.2	3,081.0	9,068,570
Weaned pigs purchased	750.0	3,600.0	10,500.0	21,284.0	62,647,364
Feeder pigs sold	724.5	3,477.6	10,069.5	20,432.7	60,141,077
Feeder-to-Finish					
Number of operations	3,557	10,079	10,079	5,929	29,644
Average inventory before death loss	31.8	238.3	792.2	3,026.2	28,440,684
Feeder pigs purchased	100.0	750.0	2,500.0	9,698.9	90,614,814
Market hogs sold	95.7	717.8	2,380.0	8,942.4	84,579,799

Table 5.3. Number of Tags and Group/lot IDs Required by Type and Size of Operation

	Size of Operation, number of head				
	< 500	500-1999	2000-4999	5000+	Total/Avg
Farrow-to-Wean					
Cull sows sold, head	8.5	76.3	411.3	1,122.1	1,854,676
Cull boars sold, head	1.6	14.4	52.8	144.1	253,661
Total visual premises tags required	10.1	90.7	464.1	1,266.2	2,108,337
Weaned pigs sold	361	3,251	13,308	36,305	62,647,364
Average lot size, head	33.9	304.9	1,200.0	1,200.0	465.4
Number of lots sold per year	12.7	17.2	24.1	43.3	134,613
Farrow-to-Feeder					
Cull sows sold, head	8.5	59.4	373.9	1,014.6	941,677
Cull boars sold, head	1.6	11.2	48.0	130.2	126,890
Total visual premises tags required	10.1	70.6	422.0	1,144.8	1,068,567
Feeder pigs sold	349	2,443	11,602	31,511	30,246,388
Average lot size, head	33.9	237.1	1,134.3	1,200.0	385.5
Number of lots sold per year	12.3	14.3	23.2	39.3	78,462
Farrow-to-Finish					
Cull sows sold, head	4.2	17.0	50.9	100.2	512,846
Cull boars sold, head	0.8	3.2	9.6	18.9	96,749
Total visual premises tags required	5.0	20.2	60.5	119.1	609,596
Market hogs sold	167	668	1,979	3,776	19,771,901
Average lot size, head	16.9	67.7	203.2	400.0	76.9
Number of lots sold per year	11.9	11.9	13.7	15.9	257,131
Wean-to-Feeder					
Feeder pigs sold, head	725	3,478	10,070	20,433	60,141,077
Average lot size, head	109	523	1,200	1,200	1,081
Number of lots sold per year	6.7	6.7	8.4	17.0	55,628
Feeder-to-Finish					
Market hogs sold, head	96	718	2,380	8,942	84,579,799
Average lot size, head	32	238	792	1,200	732
Number of lots sold per year	3.0	3.0	3.0	7.5	115,537

Tags and Tagging Costs

5.1.3 Visual Premises Tags and Applicator Cost

In determining the cost associated with tagging cull sows and boars it was assumed that operations with average breeding herd inventories greater than 200 head already tag breeding animals for management purposes. To find the cost of visual premises tags, an internet search was conducted resulting in 20 companies located that offered visual tags. The prices ranged from a high of $1.10 to a low of $0.52, with the average cost being $0.75. The average cost was used for farrowing operations with less than 200 breeding animals (sows and boars). Farrowing operations with a breeding herd average inventory greater than 200 head were charged $0.17 per tag, which reflects the incremental cost of the NAIS premises ID tag compared to management tags currently being used (Webb, 2008). That is, because it was assumed that operations of this size are already using management tags, the unique premises ID tag could be used in place of tags currently being used for management purposes and thus only the incremental cost is included.

As this study focused on the additional cost of implementing an animal identification program, the cost of tag applicators were not included if operations were already tagging breeding animals. It was assumed that operations with less than 200 breeding animals (sows and boars) did not currently tag their animals and thus an animal identification program would require the purchase of a tag applicator. On the other hand, operations with average inventories of breeding animals exceeding 200 head were assumed to already tag sows and boars and thus there would be no additional tag applicator required.

An internet search was conducted to obtain cost estimates of conventional, plastic tag applicators. The costs of conventional applicators were obtained from multiple companies with prices ranging from a low of $15.25 to a high of $21.19, with an average of $18.62. It was assumed that the average life span of an applicator was four years and only one applicator would be needed (operations with breeding herd inventories exceeding 200 did not need any additional tag applicators). Based on an investment of $18.62, a useful life of four years, and an interest rate of 7.75%, the annual cost of an applicator was $5.59.

5.1.4 Labor and Costs for Tagging Cull Breeding Hogs

In addition to tag and tag applicator costs, producers who need to tag cull breeding hogs for an animal identification program will incur labor costs and potentially injuries related to tagging animals. It was assumed that it would take 15 minutes to setup for tagging and an additional one minute per animal tagged (Wisconsin Pork Association, 2006). The labor rate used for this study was $9.80 per hour (US Department of Labor, 2007). When tagging hogs there is a risk of injury to both the people doing the tagging and possibly to the hogs. However, because the animals needing to be tagged would typically be in a crate, it was assumed injury to the animals would be minimal and thus is not considered here. The cost of human injury associated with tagging hogs was calculated as the total labor cost times 10% as an estimate of workman's compensation. Table 5.4 reports the incremental costs related to tagging (tags, applicators, and labor) cull breeding sows and boars for the three farrowing operations by size of operation. As expected, total costs per operation increase as operation size increases, but the cost per pig sold decreases for larger operations indicating economies of size exist in tag adoption.

Table 5.4. Tag-Related Costs for Swine Operations by Type and Size of Operation.[1]

	Size of Operation, number of head				
	< 500	500-1999	2000-4999	5000+	Total/Avg
Farrow-to-Wean					
Total tags placed	10.1	90.7	464.1	1,266.2	2,108,337
Tag cost, $/tag	$0.75	$0.75	$0.17	$0.17	$0.29
Annual tag cost, $/operation	$7.58	$68.21	$79.41	$216.65	$615,910
Annual cost of tag applicators	$5.59	$5.59	$0.00	$0.00	$20,389
Setup time for tagging, minutes	15.00	15.00	15.00	15.00	89,679
Time to tag, minutes/animal	1.00	1.00	1.00	1.00	5,979
Total time to tag, hours	0.42	1.52	7.11	18.95	32,414
Total labor cost, $/operation	$4.10	$14.92	$69.64	$185.73	$317,656
Total injury cost, $/operation	$0.41	$1.49	$6.96	$18.57	$31,766
Operations that currently tag, %	0.0%	0.0%	100.0%	100.0%	
Total tagging labor cost, $/operation	$4.54	$16.52	$0.00	$0.00	$56,656
Total costs associated with tags, $/operation	$17.71	$90.32	$79.41	$216.65	$692,955
Total costs associated with tags, $/pig sold	$0.048	$0.027	$0.006	$0.006	$0.011
Farrow-to-Feeder					
Total tags placed	10.1	70.6	422.0	1,144.8	1,068,567
Tag cost, $/tag	$0.75	$0.75	$0.17	$0.17	$0.24
Annual tag cost, $/operation	$7.58	$53.05	$72.20	$195.87	$251,500
Annual cost of tag applicators	$5.59	$5.59	$0.00	$0.00	$18,018
Setup time for tagging, minutes	15.00	15.00	15.00	15.00	64,457
Time to tag, minutes/animal	1.00	1.00	1.00	1.00	4,297
Total time to tag, hours	0.39	1.24	6.48	17.16	16,769
Total labor cost, $/operation	$3.84	$12.15	$63.53	$168.16	$164,335.3
Total injury cost, $/operation	$0.38	$1.21	$6.35	$16.82	$16,434
Operations that currently tag, %	0.0%	0.0%	100.0%	100.0%	
Total tagging labor cost, $/operation	$4.25	$13.45	$0.00	$0.00	$26,736
Total costs associated with tags, $/operation	$17.42	$72.09	$72.20	$195.87	$296,253
Total costs associated with tags, $/pig sold	$0.049	$0.029	$0.006	$0.006	$0.009
Farrow-to-Finish					
Total tags placed	5.0	20.2	60.5	119.1	609,596
Tag cost, $/tag	$0.75	$0.75	$0.75	$0.17	$0.52
Annual tag cost, $/operation	$3.79	$15.16	$45.47	$20.37	$316,589
Annual cost of tag applicators	$5.59	$5.59	$5.59	$0.00	$103,094
Setup time for tagging, minutes	15.00	15.00	15.00	15.00	307,337
Time to tag, minutes/animal	1.00	1.00	1.00	1.00	20,489
Total time to tag, hours	0.32	0.53	1.10	1.92	13,670
Total labor cost, $/operation	$3.14	$5.22	$10.76	$18.81	$133,963.3
Total injury cost, $/operation	$0.31	$0.52	$1.08	$1.88	$13,396
Operations that currently tag, %	0.0%	0.0%	0.0%	100.0%	0.0%
Total tagging labor cost, $/operation	$3.48	$5.78	$11.92	$0.00	$105,644
Total costs associated with tags, $/operation	$12.86	$26.53	$62.98	$20.37	$525,327
Total costs associated with tags, $/pig sold	$0.075	$0.039	$0.031	$0.005	$0.026

[1] Only applies to operations with breeding stock (i.e., operations farrowing)

DATA RECORDING, REPORTING AND STORAGE COSTS

Because the technology assumed for the swine industry is different than the cattle industry, costs of NAIS adoption will differ. For example, it was assumed that the cattle industry would use radio frequency identification (RFID) and thus hardware and software for reading RFID tags was included. However, in the swine industry it is assumed that individual animal identification will be with visual premises ID tags for cull breeding stock and other pigs/hogs can be identified with group/lot identification. Thus, electronic readers are not required, but there will still be costs associated with recording, reporting, and storing data. The following is a brief discussion of these components.

5.1.5 DATA ACCUMULATOR AND SOFTWARE

The data accumulator cost represents the average cost of six internet websites prices for laptop computers. This cost was annualized over four years and had a $0 salvage value. Given an initial investment of $692, a 4-year life, and an interest rate of 7.75%, the annual cost is $208. It was assumed that many operations, and especially the larger ones, would already own a computer and thus charging this cost to animal identification would not be appropriate. Data indicating computer usage by type and size of swine operations could not be found. Thus, it was assumed that computer ownership trends reported for the dairy industry in the NAHMS dairy report (USDA, 2007a) might be similar for hog operations. It was assumed that 12% of operations with less than 500 head; 49% of those with 500-1,999; 71% of operations with 2,000-4,999; and 93% of operations with 5,000+ head currently own computers and thus would not need to purchase one. To account for operations that currently own computers, the annual cost of the data accumulator (i.e., computer) was multiplied by one minus the proportion of operations that currently own computers resulting in a weighted-average cost per operation for each size category. The calculated annual cost of computers was multiplied by 50% to account for the fact that the entire cost of the computer likely should not be allocated to an animal identification program (i.e., swine operators would use the computer for other management or personal uses).

Many different software packages are available that would satisfy the software requirement of an eID system. The value used here is the suggested retail price of Microsoft Office Professional (Microsoft, 2008). This software package includes Microsoft Office Word, Office Excel, Office PowerPoint, Office Access, and other programs. While most producers would not use some of the programs included in Office Professional, Microsoft Office Word and Microsoft Office Excel or Microsoft Office Access would need to be employed to keep track of reads and to write the necessary documents. Other software packages that also maintain management information likely would be utilized by producers, but the higher cost associated with these software packages are not appropriate to include in an animal ID system as these are providing value beyond that required by NAIS. In other words, producers might choose to spend more for additional management benefits, but this is not something they would need to adopt NAIS procedures. As with data accumulators, annual software costs were adjusted by the percent of operations currently owning equipment. That is, it was assumed that if computers were already owned, software for managing the data would also be owned. Additionally, when software was purchased (i.e., those operations not currently owning computers), only 50% of the cost was allocated to the animal ID system.

5.1.6 Printing Costs Associated with Recording / Reporting Data

In addition to the hardware and software required for data analysis and reporting, it was assumed bar codes would be printed that could be sent with groups of hogs as they are marketed, i.e., affixed to bills of lading. These preprinted bar codes or labels would contain the group/lot ID required for NAIS. The cost per sheet of paper and labels that could be printed on were obtained from multiple internet sites and averaged $0.24 per lot, assuming two labels were printed per lot.

5.1.7 Other/Fixed Charges

The time needed to submit the group/lot ID numbers to a central database and internet fees were considered here. To determine clerical costs, the time submitting a group/lot ID number and the number of groups submitted needed to be ascertained. The Wisconsin working group for pork found that it took 15 minutes to submit data (Wisconsin Pork Association, 2006). Thus, it was assumed that each lot would require 15 minutes of time to submit the data. Clerical labor was multiplied by the average secretary wage of $14.60 per hour for the US (US Department of Labor, 2007) to find the total cost associated with recording and reporting a group/lot animal ID number.

In order to be able to achieve a “48 hour trace back system” producers would need to submit their animal identification numbers (AIN) and/or group identification numbers (GIN) via an internet access point. An internet charge of $50 per month was assumed for 12 months. However, because some operations already have a computer, it was assumed they likely also had internet access so a weighted cost of internet was used similar to as done for the cost of data accumulators. As with computers and software, the calculated annual cost of internet fees was multiplied by 50% to account for the fact that the entire cost likely should not be allocated to an animal identification program (i.e., swine operators would use the internet for other management or personal uses).

5.1.8 Database Charge

According to the NAIS business plan, “The most efficient, cost-effective approach for advancing the country’s traceability infrastructure is to capitalize on existing resources—mainly, animal health programs and personnel, as well as animal disease information databases” (USDA, 2007f, p. 4). As of May 2008, there were 17 approved Animal Tracking Databases or Compliant Animal Tracking Databases meeting the minimum requirements as outlined in the Integration of Animal Tracking Databases that were participating in the NAIS program and have a signed cooperative agreement with USDA Animal Plant Health Inspection Service (USDA, 2008d).

The research team attempted to contact multiple database providers to obtain costs/head (or lot) of their databases so an average cost for data storage could be ascertained. This information was not readily given out, and the information that was expressed was not specific enough for this study. To find a more accurate estimate, Kevin Kirk from Michigan's Department of Agriculture was contacted. Mr. Kirk, who oversees the Michigan State AID database, provided the total data storage cost for Michigan producers (Kirk, 2007). Based on this information, a per-head charge of $0.085 was estimated and this same value was applied to group/lot records. This charge was included for the total number of lots that were sold by an operation as opposed to the number of animals they sold.

5.1.9 Premises Registration Costs

Currently premises registration is free and many states are trying to make the process as seamless as possible and NAIS reports that 33.8% of all operations with over $1,000 income have been registered (USDA, 2008d). While the premises registration is a free service, there are potential costs incurred with registering an operation's premises (e.g., time, mileage, paperwork). To capture this cost, it was assumed that a producer would incur a cost of $20 associated with management time, travel, and supplies to register his/her premises. Theoretically, once premises are registered the registration lasts for the life of the operation as well. However, many producers will need to renew or modify their premises registration on a regular basis as their operations change. Thus, it was assumed that the lifespan of the premises registration would be three years. The cost of renewing the premises every three years was assumed to be 50% of the initial cost $10 per operation. When accounting for the time value of money, the initial premises registration cost of $20 and the renewal every three years of $10 equates to a cost of $4.64 per operation annually in current dollars.

5.1.10 Interest Costs

Investments required for an animal ID system that have useful lives of more than one year (e.g., tag applicators, computers, premises registration) were annualized using an interest rate of 7.75%. Annual operating costs such as tags for cull sows and boars, labor, internet, etc. were charged an interest cost at this same rate for the portion of the year a producer's money would be tied up.

5.1.11 Summary of Swine Costs

Table 5.5 reports fixed costs related to data recording and reporting that are similar across operation types, but vary by operation size. Fixed costs are defined as costs that do not vary based on the number of groups marketed. Because it is assumed that a higher percentage of larger operations own computers, the costs associated with data accumulator (computer), software, and internet are lower per operation for larger operations. Costs associated with premises registration were the same for all operation sizes. Table 5.6 reports the fixed and variable costs related to data recording, storage, and reporting. [10] Variable costs are defined as costs that increase as the number of groups increase. The variable costs reported in the top portion of the table are constant on a per lot basis across operation types and sizes. In the final analysis, the cost per lot was not allowed to exceed $7.39 as this would represent one-half an hour of clerical time ($14.60/hour) plus the cost of data storage per lot. It was assumed that swine producers likely would not invest in computers, software, etc. if the costs are significantly higher than what they could do manually. Thus, any of the values in the “Total data cost, $/lot” rows in table 5.6 that exceed $7.39 are replaced with $7.39 in the final analysis.

Table 5.7 summarizes total costs, both as dollars per operation and cost per pig sold, by type and size of operation. Also reported are sector totals and average cost per pig sold for each sector. The average cost per pig sold for the different sectors ranges from a low of $0.01 for Wean-to-Feeder operations to a high of $0.13 per pig for Farrow-to-Finish operations. However, within each production sector there are relatively large economies of size. For example, in the three operation types that include farrowing, costs for the largest operations are below $0.04 per pig sold but they increase to about $0.30 to $0.60 per pig sold for the smallest size operations. Likewise, in the operations that feed pigs, costs are approximately $0.01 per pig sold for the largest operations but

[10] No attempt was made to differentiate costs between operations that own swine versus contract operations. To the extent that contract operations are not responsible for data recording and reporting (i.e., this would likely be done by the owner of the pigs) our total costs of data recording/reporting for the industry are likely overestimated.

increase to $0.07 to $0.28 for the smallest Wean-to-Finish and Feeder-to-Finish operations, respectively. Figures 5.1 and 5.2 show this same data graphically for the farrowing and feeding operations, respectively.

Table 5.5. Fixed Costs Related to Data Recording and Reporting for Swine by Size of Operation[1]

	Size of Operation, number of head			
	< 500	500-1999	2000-4999	5000+
Data accumulator (computer)				
Initial investment, $/operation	$692	$692	$692	$692
Ownership adjustment, %	12.0%	48.7%	70.7%	92.7%
Adjusted investment, $/operation	$609	$355	$203	$51
Annual cost, $/operation	$183	$107	$61	$15
Percent to NAIS	50%	50%	50%	50%
Annual cost, $/operation	$91	$53	$30	$8
Software				
Initial investment, $/operation	$400	$400	$400	$400
Ownership adjustment, %	12.0%	48.7%	70.7%	92.7%
Adjusted investment, $/operation	$352	$205	$117	$29
Annual cost, $/operation	$106	$62	$35	$9
Percent to NAIS	50%	50%	50%	50%
Annual cost, $/operation	$53	$31	$18	$4
Internet				
Annual cost	$600	$600	$600	$600
Ownership adjustment, %	12.0%	48.7%	70.7%	92.7%
Adjusted annual cost, $/operation	$569	$332	$189	$47
Percent to NAIS	50%	50%	50%	50%
Annual cost, $/operation	$284	$166	$95	$24
Fixed data cost, $/operation	$429	$250	$143	$36
Premises registration				
Annual cost, $/operation	$5	$5	$5	$5

[1] Applies to all five production-type operations.

Table 5.6. Data Storage and Reporting Costs for Swine by Operation Type and Size of Operation

	Size of Operation, number of head			
	< 500	500-1999	2000-4999	5000+
Cost, $/lot				
Printing cost	$0.24	$0.24	$0.24	$0.24
Data storage cost	$0.09	$0.09	$0.09	$0.09
Clerical labor	$3.93	$3.93	$3.93	$3.93
Total variable data cost, $/lot	$4.26	$4.26	$4.26	$4.26
Farrow-to-Wean				
Number of lots sold per year	12.7	17.2	24.1	43.3
Variable data cost, $/operation	$54	$73	$103	$184
Fixed data cost, $/operation	$429	$250	$143	$36
Total data cost, $/operation	$483	$323	$245	$220
Total data cost, $/lot*	$38.11	$18.82	$10.19	$5.08
Farrow-to-Feeder				
Number of lots sold per year	12.3	14.3	23.2	39.3
Variable data cost, $/operation	$52	$61	$99	$167
Fixed data cost, $/operation	$429	$250	$143	$36
Total data cost, $/operation	$481	$311	$242	$203
Total data cost, $/lot	$39.11	$21.74	$10.41	$5.17
Farrow-to-Finish				
Number of lots sold per year	11.9	11.9	13.7	15.9
Variable data cost, $/operation	$51	$51	$59	$68
Fixed data cost, $/operation	$429	$250	$143	$36
Total data cost, $/operation	$479	$300	$201	$103
Total data cost, $/lot	$40.41	$25.34	$14.65	$6.49
Wean-to-Feeder				
Number of lots sold per year	6.7	6.7	8.4	17.0
Variable data cost, $/operation	$28	$28	$36	$73
Fixed data cost, $/operation	$429	$250	$143	$36
Total data cost, $/operation	$457	$278	$179	$108
Total data cost, $/lot	$68.71	$41.83	$21.27	$6.35
Feeder-to-Finish				
Number of lots sold per year	3.0	3.0	3.0	7.5
Variable data cost, $/operation	$13	$13	$13	$32
Fixed data cost, $/operation	$429	$250	$143	$36
Total data cost, $/operation	$442	$263	$156	$67
Total data cost, $/lot	$146.59	$87.23	$51.78	$9.03

* If this cost exceeds $7.39, it was assumed data recording/reporting would be done manually at a cost of $7.39/lot.

Table 5.7. Summary of ID Costs for Swine Operations by Type and Size of Operation

	Size of Operation, number of head				
	< 500	500-1999	2000-4999	5000+	Total/Avg
Farrow-to-Wean					
Number of lots sold per year	12.7	17.2	24.1	43.3	134,613
Number of pigs sold per year	371	3,342	13,772	37,571	64,755,701
Tag-related costs (table 5.4)	$18	$90	$79	$217	$615,910
Data-related costs*	$94	$127	$178	$220	$905,444
Premises registration costs	$5	$5	$5	$5	$27,732
Total cost, $/operation	$116	$222	$262	$441	$1,549,086
Total cost, $/pigs sold	$0.31	$0.07	$0.02	$0.01	$0.02
Farrow-to-Feeder					
Number of lots sold per year	12.3	14.3	23.2	39.3	78,462
Number of pigs sold per year	349	2,443	11,602	31,511	30,246,388
Tag-related costs (table 5.4)	$17	$72	$72	$196	$296,253
Data-related costs*	$91	$106	$172	$203	$519,906
Premises registration costs	$5	$5	$5	$5	$19,933
Total cost, $/operation	$113	$182	$249	$403	$836,092
Total cost, $/pigs sold	$0.32	$0.07	$0.02	$0.01	$0.03
Farrow-to-Finish					
Number of lots sold per year	11.9	11.9	13.7	15.9	257,131
Number of pigs sold per year	167	668	1,979	3,776	19,771,901
Tag-related costs (table 5.4)	$13	$27	$63	$20	$525,327
Data-related costs*	$88	$88	$102	$103	$1,871,146
Premises registration costs	$5	$5	$5	$5	$95,041
Total cost, $/operation	$105	$119	$169	$129	$2,491,514
Total cost, $/pigs sold	$0.63	$0.18	$0.09	$0.03	$0.13
Wean-to-Feeder					
Number of lots sold per year	6.7	6.7	8.4	17.0	55,628
Number of pigs sold per year	725	3,478	10,070	20,433	60,141,077
Tag-related costs (table 5.4)	$0	$0	$0	$0	$0
Data-related costs*	$49	$49	$62	$108	$382,420
Premises registration costs	$5	$5	$5	$5	$24,266
Total cost, $/operation	$54	$54	$67	$113	$406,686
Total cost, $/pigs sold	$0.07	$0.02	$0.01	$0.01	$0.01
Feeder-to-Finish					
Number of lots sold per year	3.0	3.0	3.0	7.5	115,537
Number of pigs sold per year	96	718	2,380	8,942	84,579,799
Tag-related costs (table 5.4)	$0	$0	$0	$0	$0
Data-related costs*	$22	$22	$22	$55	$853,949
Premises registration costs	$5	$5	$5	$5	$137,506
Total cost, $/operation	$27	$27	$27	$60	$991,455
Total cost, $/pigs sold	$0.28	$0.04	$0.01	$0.01	$0.01

* Based on minimum of $7.39/lot or Total data cost reported in table 5.6 times number of lots sold per year.

FIGURE 5.1. ESTIMATED COST OF ANIMAL IDENTIFICATION FOR SWINE FARROWING OPERATIONS BY OPERATION SIZE

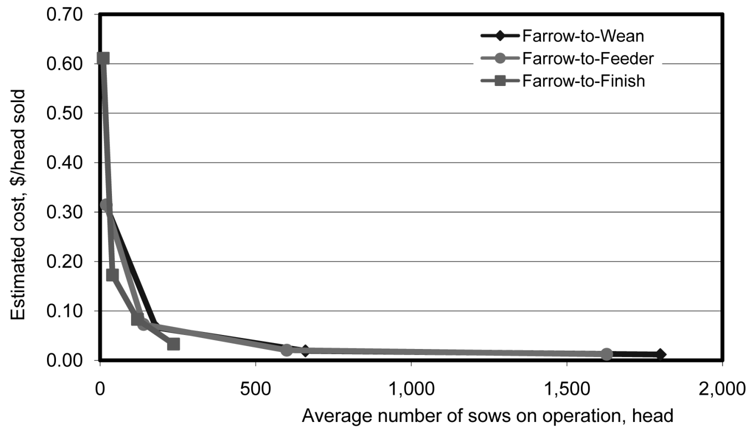
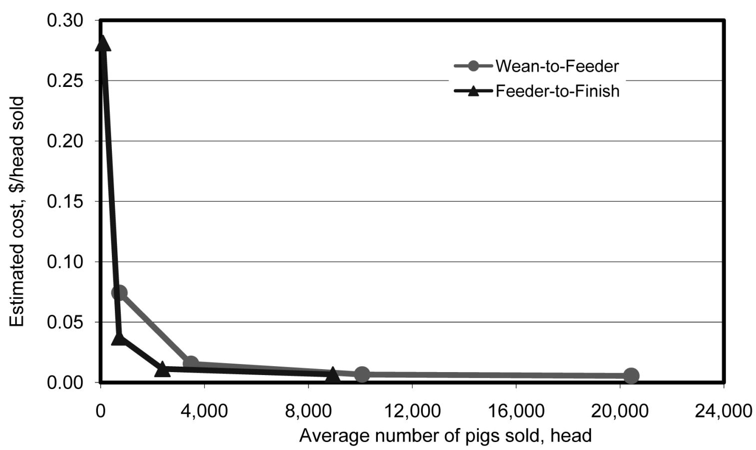


FIGURE 5.2. ESTIMATED COST OF ANIMAL IDENTIFICATION FOR SWINE FEEDING OPERATIONS BY OPERATION SIZE



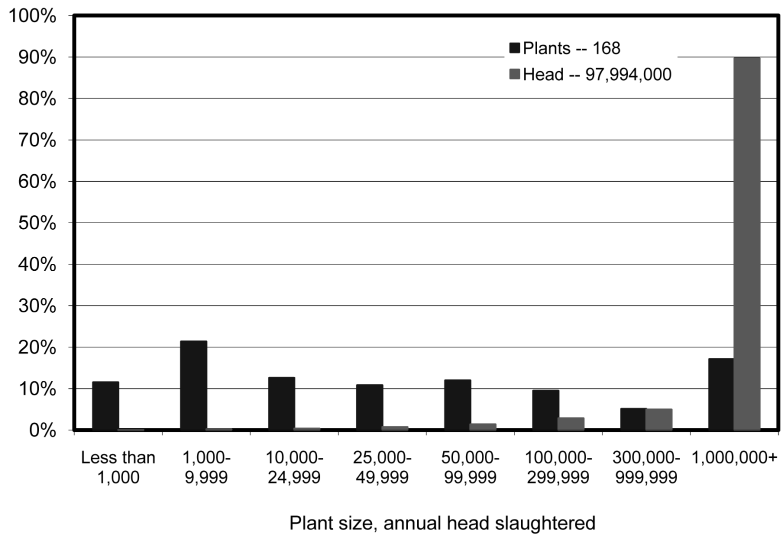
5.2 Packers

THE COSTS INCURRED AT SWINE PACKING PLANTS will depend on numerous factors, but primarily on size of the plant. While packing plants may be able to pass costs associated with an animal ID system on to their suppliers (i.e., swine producers), these costs impact the industry. Furthermore, if different size packing plants have different costs (i.e., if economies of size exist) some of these added costs may not be able to be passed on to producers due to competition within the industry. For this analysis the costs at packing plants were based on the costs of recording and reporting data pertaining to group/lot IDs, however, for very small plants "groups" might actually represent individual hogs.

5.2.1 Operation Distributions

In order to determine how a national animal identification system might impact packing plants of various sizes, a distribution of plant size was required. Information on the number and size of hog slaughter plants was obtained from USDA GIPSA (USDA, 2007g). Average values for 2001-2005 were used for the analysis and then adjusted to 2007 marketings. Figure 5.3 shows the distribution of the number of plants and their shares of hogs slaughtered. The distribution of the number of plants is relatively uniform, i.e., there are a similar number of plants of all size categories. However, the largest plants (those with over a million head slaughtered per year) account for approximately 90% of all hogs slaughtered indicating that market share is heavily skewed to the largest plants.

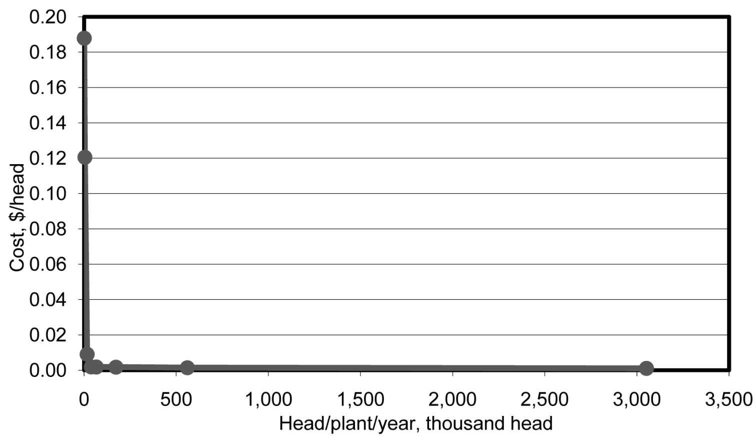
FIGURE 5.3. SIZE DISTRIBUTION AND MARKET SHARE OF HOG SLAUGHTER PLANTS BY PLANT SIZE, 2001-05 AVERAGE



5.2.2 COST OF RECORDING AND REPORTING INFORMATION

It was assumed that swine processed through a packing plant would have identification information that would need to be recorded and reported to a central database. Information can generally be handled on a group basis, but for small packing plants that buy animals individually a group ID is the same as an individual ID. Packing plant costs were estimated as a function of plant size based on survey results from packing plants of various sizes (Bass et al., 2007). For large plants, costs were estimated as a function of the groups of hogs slaughtered per year and for small plants costs were estimated based on the number of head slaughtered per year. Ultimately, the relevant measure is costs per head slaughtered. Figure 5.4 shows how the cost per head associated with reading, recording, and reporting data varies as plant size increases. The impact of plant size on cost (i.e., economies of size) is economically significant. However, most of the gain to plant size is realized at relatively small plants. Basically, for all but the smallest two sized plants (those slaughtering less than 10,000 head per year), the cost is economically insignificant.

FIGURE 5.4. ANNUAL COST OF ADOPTING ANIMAL IDENTIFICATION FOR SWINE SLAUGHTER PLANTS BY PLANT SIZE



5.2.3 SUMMARY OF PACKING PLANT COSTS

Based on recording and reporting group/lot ID information on 100% of swine being slaughtered in 2007 (109,171,600 head), the total costs to the 168 swine packing plants in the US is estimated at under $150,000, or less than $1,000 per plant.

5.3 SWINE INDUSTRY SUMMARY

TABLE 5.8 SUMMARIZES THE TOTAL COSTS to the swine industry by sector under scenario #3 (full traceability). Total costs are estimated at just under$6.5 million of which almost 40% of that is incurred in the farrow-to-finish sector. From the partial breakdown by type of cost, it can be seen that the majority of the cost (72.9%) is associated with recording/reporting data. This is not surprising given that tagging only applies to cull breeding animals using visual tags (as opposed to electronic ID). To the extent that swine operations already have data management systems in place, some of the costs assumed for recording/reporting might already be incurred and thus the actual incremental cost would be lower than the estimate provided here. Also reported in table 5.8 is the cost per pig sold by sector and the total for the industry (based on total slaughter in 2007). Based on assumptions used in this analysis, a full traceability animal identification program in the swine industry would add about $0.06 per head to the cost of hogs produced.

Within each of the sectors in the swine industry, economies of size associated with an animal identification system were generally present. Thus, smaller operations likely will be slower to adopt identification systems because they incur higher per unit costs. However, as a general rule for most sectors, most of the economies of size were typically captured quite quickly such that costs for mid-sized operations were similar to costs of the largest operations.

Table 5.9 reports the total costs to the swine industry by sector under the three different scenarios: 1) premises registration only, 2) bookend animal ID system, and 3) full traceability ID system for various adoption rates. The costs are reported for both a uniform adoption rate and a lowest-cost-first adoption rate. Given that animal identification is a voluntary program, the lowest-cost-first adoption rate likely better reflects what costs would be to the industry with something less than 100% adoption. Note that at 100% adoption the two methods have equal costs. It can be seen in the lowest-cost-first adoption column that costs increase at somewhat of an increasing rate with higher levels of adoption. This suggests that getting lower rates of adoption may not be that difficult with a voluntary program because costs are relatively low. However, to get a high adoption rate will be more difficult because this requires the higher cost operations to also participate.

The premises registration scenario (#1) reflects only costs associated with registering premises (see Section 5.1.9 for a discussion about how premises registration costs were estimated), which is significantly below the other two. However, it is also important to recognize that this represents no animal identification and no ability to trace animal movements.

Scenario #2 represents an animal identification system that reflects what is referred to as a bookend system. A bookend system simply means the swine are identified at both ends of their lives (birth and death), but movements in between are not tracked. Because recording and reporting data were a big portion of the total industry costs (table 5.8) and the bookend system would not require this information, this system has a total cost of less than $2 million, which is less than 30% of the full traceability system (Scenario #3).

Table 5.8. Summary of Annualized Animal ID Costs to Swine Industry

	Farrow-to Wean	Farrow-to-Feeder	Farrow-to-Finish	Wean-to-Feeder (Nursery)	Feeder-to-Finish (Grow/Finish)	Packers	Total
Total Operations	5,979	4,297	20,489	5,231	29,644	168	65,640
Pigs sold per year	64,755,701	31,314,955	20,381,497	60,141,077	84,579,799	109,171,600	109,171,600
Breakdown of costs ($)							
Tagging cost	$615,910	$296,253	$525,327	$0	$0		$1,437,491
Recording/reporting cost	$905,444	$519,906	$1,871,146	$382,420	$853,949	$147,489	$4,680,355
Premises registration	$27,732	$19,933	$95,041	$24,266	$137,506		$304,477
Total Annualized Cost	$1,549,086	$836,092	$2,491,514	$406,686	$991,455	$147,489	$6,422,323
Breakdown of costs (%)							
Tagging cost	39.8%	35.4%	21.1%	0.0%	0.0%	0.0%	22.4%
Recording/reporting cost	58.5%	62.2%	75.1%	94.0%	86.1%	100.0%	72.9%
Premises registration	1.8%	2.4%	3.8%	6.0%	13.9%	0.0%	4.7%
Total Annualized Cost	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Cost per pig sold, $/head*	$0.0239	$0.0267	$0.1222	$0.0068	$0.0117	$0.0014	$0.0588

* Total for industry is based on hogs slaughtered

Table 5.9. Total Swine Industry Cost versus Adoption Rate Under Alternative Scenarios

Scenario #1 -- Premises Registration Only

Industry Segment	Premises Registration	Adoption rate	Uniformly adopted	Lowest cost adopted first
Farrow-to-Wean	$27,732	10%	$30,526	$18,638
Farrow-to-Feeder	$19,933	20%	$61,052	$38,153
Farrow-to-Finish	$95,041	30%	$91,578	$58,248
Wean-to-Feeder	$24,266	40%	$122,103	$82,833
Feeder-to-Finish	$137,506	50%	$152,629	$116,895
Packers	$781	60%	$183,155	$153,609
TOTAL COST	$305,259	70%	$213,681	$190,792
		80%	$244,207	$228,349
		90%	$274,733	$266,447
		100%	$305,259	$305,259

Scenario #2 -- Bookend Animal ID System

Industry Segment	Book End Cost	Adoption rate	Uniformly adopted	Lowest cost adopted first
Farrow-to-Wean	$643,642	10%	$188,946	$115,895
Farrow-to-Feeder	$316,186	20%	$377,891	$238,321
Farrow-to-Finish	$620,368	30%	$566,837	$366,074
Wean-to-Feeder	$24,266	40%	$755,783	$524,582
Feeder-to-Finish	$137,506	50%	$944,729	$707,976
Packers	$147,489	60%	$1,133,674	$915,093
TOTAL COST	$1,889,457	70%	$1,322,620	$1,132,818
		80%	$1,511,566	$1,351,754
		90%	$1,700,512	$1,609,870
		100%	$1,889,457	$1,889,457

Scenario #3 -- Full Traceability Animal ID System

Industry Segment	Traceability Cost	Adoption rate	Uniformly adopted	Lowest cost adopted first
Farrow-to-Wean	$1,549,086	10%	$642,232	$556,877
Farrow-to-Feeder	$836,092	20%	$1,284,465	$1,132,810
Farrow-to-Finish	$2,491,514	30%	$1,926,697	$1,715,790
Wean-to-Feeder	$406,686	40%	$2,568,929	$2,315,409
Feeder-to-Finish	$991,455	50%	$3,211,162	$2,925,519
Packers	$147,489	60%	$3,853,394	$3,572,658
TOTAL COST	$6,422,323	70%	$4,495,626	$4,249,410
		80%	$5,137,859	$4,936,530
		90%	$5,780,091	$5,668,691
		100%	$6,422,323	$6,422,323

6. Direct Cost Estimates: Ovine

Ovine Operations

Costs of NAIS adoption were estimated for the sheep (ovine) industry by breaking the industry into two operation types or groups – producers and packers. Attempts were made to break production sectors into those that have breeding flocks and sell lambs and those that primarily feed lambs (feedlots), however, disaggregated data generally were not available to allow this. In addition to producers and packers, the cattle industry analysis included an auction market sector; however, because a large majority of lambs are marketed direct, and due to data availability issues, this sector is not included for the sheep industry.

Producers are defined as any operation that produces sheep or purchases and feeds sheep to slaughter weight. Packers are defined as any operation that slaughters live animals, either market lambs or cull breeding stock, under government inspection to produce meat products for sale to the public.

Because most breeding animals including culls are required to be individually identified under the current scrapie program, it was assumed that breeding sheep including culls would be individually identified and lambs moving to commercial feedlots or direct to slaughter would be identified as group/lots. The following discussion of sheep industry costs is partitioned by the different types of costs and according to the two operation types. Also, the following discussion pertains to costs associated with all sheep being identified, either individually (breeding stock) or as groups (lambs) and movements tracked (i.e., Scenario 3 discussed in Section 4). Costs of just premises registration (Scenario 1) and just bookend (Scenario 2) systems are summarized separately later in this section.

6.1 Operation Distributions

ONE OF THE OBJECTIVES OF THIS STUDY was to determine if the implementation cost of an enhanced animal identification system for sheep beyond what is currently provided by the scrapie program varied by operation size. To determine if economies of size exist, costs of adopting enhanced animal identification were estimated for various operation sizes. The USDA NASS regularly report sheep industry information statistics such as number of operations, inventories, lamb crop, etc. (USDA, 2008e). Additionally, they report a percentage breakdown of operations and total inventory for four different operation sizes: < 100 head; 100-499; 500-4,999; and > 5,000 head (USDA, 2008h). Thus, these four size categories were used as breakpoints in this study. Sheep inventories, by class, for January 2007 and 2007 total lamb crop were extracted from NASS (USDA, 2008e). These data were matched with information on the 2006 and 2007 average percentage of operations and inventory by size group (USDA, 2008h). The total head of sheep per operation for each size category was found by multiplying the total sheep in the US by the respective percentage of inventory by size of operation. A similar procedure was done to determine the number of operations for each of the size categories (i.e., total operations were multiplied by percent of operations within each category). Dividing inventory by the number of operations provided an estimate of the average number of sheep per operation for each size category.

To estimate the number of rams located per premises it was assumed that operators would have the same percentage of the total ram inventory (USDA, 2008e) as they did sheep. Multiplying these together and dividing by the number of operations in each size category the total breeding herd inventory was calculated for the four different size categories.

Table 6.1 reports the number of operations, average inventories, and production levels by size of operation. Inventory values were taken directly from NASS data and allocated to the different size operations as previously discussed. Ewe and ram lambs retained for replacement were based on NASS reported data, but then were adjusted to maintain a static herd size. That is, replacements were set equal to breeding herd disappearance (culls sold and death loss). Pre-weaning death loss on lambs and death loss on breeding stock were based on data reported in *Sheep and Lamb Predator Death Loss in the United States, 2004* (USDA, 2007h). Post-weaning death loss on lambs was imputed to attempt to reconcile total slaughter lamb numbers. Cull ewes and rams sold were calculated from inventories and cull rates reported in *Part I: Reference of Sheep Management in the United States, 2001* (USDA, 2002d).

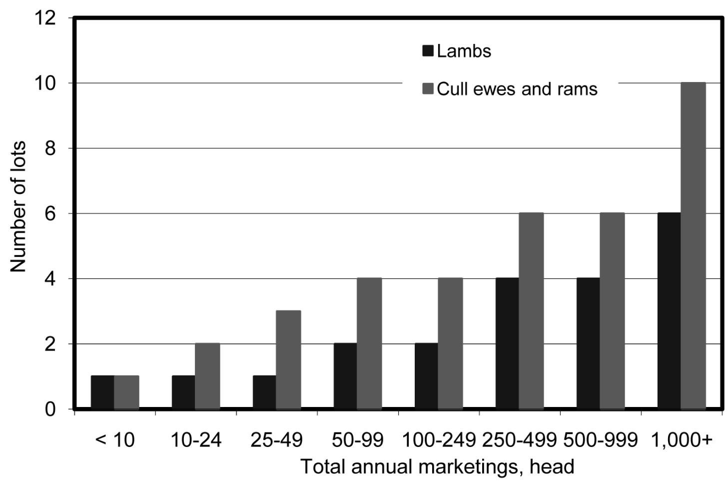
Table 6.1. Number of Sheep Operations, Inventory and Production Levels by Size of Operation

	Size of Operation, number of head				
	<100	100-499	500-4,999	5,000+	Total/Avg
Number of operations	64,202	5,294	1,024	71	70,590
Average sheep and lamb inventory, head	28.6	274.2	1,960.5	12,357.9	6,165,000
Total breeding herd inventory, head	21.4	205.1	1,466.0	9,240.9	4,610,000
Breeding ewes, head	17.1	164.4	1,175.4	7,408.8	3,696,000
Rams, head	0.9	8.7	62.0	390.9	195,000
Lamb crop before death loss, head	18.8	180.2	1,287.9	8,118.4	4,050,000
Ewe lambs retained or bought, head	4.3	40.9	292.1	1,841.5	918,651
Rams held back for replacement	0.3	2.8	19.8	124.9	62,287
Pre-weaning lamb death loss	1.8	16.9	121.1	763.1	380,700
Market lambs sold at weaning	12.5	119.6	854.9	5,388.9	2,688,362
Post-weaning lamb death loss	0.2	2.1	14.7	92.7	46,239
Market lambs sold for slaughter	12.2	117.5	840.2	5,296.2	2,642,123
Total breeding stock sold	3.3	32.2	229.9	1,448.8	722,778
Cull ewes sold, head	3.1	30.1	215.1	1,355.8	676,368
Cull rams sold, head	0.2	2.1	14.8	93.0	46,410
Total death loss, head	1.2	11.5	82.1	517.5	258,160
Total breeding stock left herd	4.5	43.6	311.9	1,966.3	980,938

6.1.2 Number of Tags and Groups

The National Scrapie Eradication Program mandates with some exceptions that any sheep that is sold other than into slaughter channels or that is older than 18 months and may be used for breeding must be individually identified with an official scrapie program identification device or tattoo (Sheep Working Group, 2006). Based on recommendations from the Sheep Working Group (2006), it was assumed that the NAIS program for sheep would follow the same rules when determining if a producer will need to individually identify sheep and the AID tag used would be the metal or plastic scrapie program sheep tag. Thus, it was assumed that breeding stock including culls (i.e., ewes and rams) would be required to be individually identified with a scrapie program tag. It was assumed that all current breeding stock are already identified with scrapie tags and thus tags required would only be for replacement breeding stock and to replace lost tags. Table 6.1 reported the number of ewe and ram lambs held for replacement breeding stock and the average breeding stock inventories by operation size. Estimates of annual loss rate for plastic ear tags in breeding sheep vary widely. Ghirardi et al. (2005) report an annual loss rate of 3.3%; compared to annual losses of 8.3 to 12.8% reported by Saa, et al. (2005). Tags required annually were thus calculated as the total number of lambs held for replacement plus 6.93% (average tag loss rate) times the average breeding herd less an adjustment for death loss. Even though breeding stock needs to be individually identified with tags, cull breeding stock still will typically be sold in groups and thus the number of groups for both culls and lambs also needs to be identified. The number of group/lots was assumed to be a function of the number of sheep (culls and market lambs) sold and was based on producer opinion. Figure 6.1 shows the number of group/lots assumed for lambs (feeder and market) and cull ewes and rams at various levels of annual sheep marketings.

FIGURE 6.1. NUMBER OF GROUP/LOTS OF SHEEP MARKETED BY TOTAL ANNUAL MARKETINGS



TAGS AND TAGGING COSTS

6.1.3 TAGS AND APPLICATOR COST

Currently scrapie program tags and applicators are provided by USDA free of charge to sheep producers. The cost to USDA is approximately $0.08 per tag for metal tags and $0.27 per tag for plastic tags including costs of applicators, shipping and handling (Sutton, 2008). If the scrapie program did not exist or if USDA stopped providing tags, it is expected that tag costs would increase slightly due to increased handling costs and smaller individual orders associated with direct tag purchases by producers. To be consistent with the other species, it was assumed that producers would have to bear the cost of purchasing tags in the future, but they could do so in a similar fashion as the current scrapie program as it is considered compliant with NAIS. An average tag cost of $0.27 per tag was used, which was adjusted for volume of purchases using percentage differences from the cattle tag cost assumptions (see Section 4.1.1 in the bovine cost chapter). It was assumed that lambs (feeder and market) could be identified with unique group/lot ID and thus there were no tag costs for lambs. Because cull breeding animals are currently tagged as part of the scrapie program, the incremental cost in the short-run associated with tag applicators would be zero (i.e., they already own applicators). However, producers would have to buy their own applicators in the future as current applicators provided through the scrapie program wear out. Thus, the cost of a conventional plastic ear tag applicator of $18.62 was included with larger operations owning multiple applicators.

6.1.4 Labor and Costs for Tagging Cull Breeding Sheep

Tagging breeding sheep (replacement and retags) would take time thus incurring labor costs and potentially injuries related to tagging animals. It was assumed that producers would spend 30 minutes to setup and prepare for tagging and one minute per animal tagging. Larger operations were assumed to have more employees involved with the tagging process. Table 6.2 reports the incremental costs related to tagging (tags, applicators, and labor) breeding stock (replacement ewes and ram lambs and breeding stock that lost their tags) by size of operation. The total costs per animal sold decreases as size of operation increases because of slightly lower tag costs, but primarily due to spreading tag applicator and labor costs over more head.

Table 6.2. Tag-Related Costs for Cull Breeding Sheep by Size of Operation.

	Size of Operation, number of head				
	<100	100-499	500-4,999	5,000+	Total/Avg
Total tags placed*	5.9	57.0	407.8	2,570.4	1,282,303
Tag cost, $/tag	$0.31	$0.27	$0.25	$0.23	$0.31
Annual tag cost**	$2.09	$17.79	$116.10	$696.98	$396,678
Annual cost of tag applicators	$6	$6	$11	$61	$404,318
Total tagging labor costs*	$7	$54	$363	$2,158	$1,289,952
Total costs associated with tags, $/operation	$15	$78	$491	$2,917	$2,090,948
Total costs associated with tags, $/animal sold	$0.958	$0.511	$0.452	$0.427	$0.613

* Total tags placed equals number of replacement ewe and ram lambs (table 6.1) and replacement tags on 6.93% of breeding herd inventory (adjusted for death loss).

** Annual tag cost includes an interest charge on tag investment.

Data Recording, Reporting and Storage Costs

Because the technology assumed for the sheep industry is different than the cattle industry, costs differ. For example, it was assumed that the cattle industry would use radio frequency identification (RFID) and thus hardware and software for reading RFID tags was included. However, in the sheep industry it is assumed that individual animal identification will be with visual ID tags (e.g., scrapie program tags) for breeding stock and lambs can be identified with group/lot identification. Thus, electronic readers are not required, but there are costs associated with recording, reporting, and storing data. The following is a brief discussion of these components.

6.1.5 Data Accumulator and Software

The data accumulator cost represents the average cost of six internet websites prices for laptop computers. This cost was annualized over four years and had a $0 salvage value. Given an initial investment of $692, a 4-year life, and an interest rate of 7.75%, the annual cost is $208. It was assumed that many operations, and especially the larger ones, would already own a computer and thus charging this cost to animal identification would not be appropriate. Data regarding computer usage was based on the 2001 Sheep NAHMS report (USDA, 2002d). This report indicated that 9.6%, 12.1%, 16.3%, and 26.5% of operations from smallest to largest, respectively, used computers. These data were increased by 50% to account for increases over time. To account for operations that currently own computers, the annual cost of the data accumulator (i.e., computer) was multiplied by one minus the proportion of operations that currently own computers resulting in a weighted-average cost per operation for each size category. Additionally, the calculated annual cost of computers was multiplied by 50% to account for the fact that the entire cost of the computer likely should not be allocated to an animal identification program (i.e., operators would use the computer for other management or personal uses).

Many different software packages are available that would satisfy the software requirement of an eID system. The value used here is the suggested retail price of Microsoft Office Professional (Microsoft, 2008). This software package includes Microsoft Office Word, Office Excel, Office PowerPoint, Office Access, and other programs. While most producers would not use some of the programs included in Office Professional, Microsoft Office Word and Microsoft Office Excel or Microsoft Office Access would need to be employed to keep track of reads and to write the necessary documents. Other software packages that also maintain management information likely would be utilized by producers, but the higher cost associated with these software packages are not appropriate to include in an animal ID system as these are providing value beyond that required by NAIS. In other words, producers might choose to spend more for additional management benefits, but this is not something they would need to adopt NAIS procedures. As with data accumulators, annual software costs were adjusted by the percent of operations currently owning equipment. That is, it was assumed that if computers were already owned, software for managing the data would also be owned. Additionally, when software was purchased (i.e., those operations not currently owning computers), only 50% of the cost was allocated to the animal ID system.

6.1.6 Printing Costs Associated with Recording / Reporting Data

In addition to the hardware and software required for data analysis and reporting, it was assumed bar codes would be printed that could be sent with groups of sheep or lambs as they are marketed, i.e., affixed to bills of lading. That is, when selling group/lots, the seller will need to send papers with the shipment of sheep which contain the required information; this information was assumed to be contained both in text and a bar code format. This assumption was made based on the fact that auction yards and feedlots have high transaction volumes and these entities will require sellers to have bar codes on the identification papers to reduce transaction costs and human error.

This cost was calculated by finding label costs via the internet and multiplying by the cost of printing on a conventional printer. It was assumed that the producer would print two labels per group sold: one for the operator's record and one for the buyer's record. The cost per sheet of paper and labels that could be printed on were obtained from multiple internet sites and averaged $0.24 per lot, assuming two labels were printed per lot. This was then multiplied by the number of groups to be sold to find the total bar code cost.

6.1.7 OTHER/FIXED CHARGES

The time needed to submit the group/lot ID numbers to a central database and internet fees were considered here. To determine clerical costs, the time submitting a group/lot ID number and the number of groups submitted needed to be ascertained. The Wisconsin working group for pork found that it took 15 minutes to submit data (Wisconsin Pork Association (WPA), 2006). Thus, it was assumed that each lot would require 15 minutes of time to submit the data. Clerical labor was multiplied by the average secretary wage of $14.60 per hour for the US (US Department of Labor, 2007) to find the total cost associated with recording and reporting a group/lot animal ID number.

In order to be able to achieve a "48 hour trace back system" producers would need to submit their animal identification numbers (AIN) or group identification numbers (GIN) via an internet access point. [11] An internet charge of $50 per month was assumed for 12 months. However, because some operations already have a computer, it was assumed they likely also had internet access, so a weighted cost of internet was used similar to was done for the cost of data accumulators and software. Also, as with computers and software, the calculated annual cost of internet fees was multiplied by 50% to account for the fact that the entire cost likely should not be allocated to an animal identification program (i.e., operators would use the internet for other management or personal uses).

[11] It should be pointed out that achieving 48-hour traceback could be difficult for operations with large numbers of individual animal numbers on breeding stock that have to be reported if this information is not available electronically. That is, the internet would allow the information to be submitted timely, however, this would still require somebody to enter the data into computer program. This is not an issue with group lot identification.

6.1.8 Database Charge

According to the NAIS business plan, "The most efficient, cost-effective approach for advancing the country's traceability infrastructure is to capitalize on existing resources—mainly, animal health programs and personnel, as well as animal disease information databases" (USDA, 2007f). As of May 2008, there were 17 approved Animal Tracking Databases or Compliant Animal Tracking Databases meeting the minimum requirements as outlined in the Integration of Animal Tracking Databases that were participating in the NAIS program and have a signed cooperative agreement with USDA Animal Plant Health Inspection Service (USDA, 2008d).

The research team attempted to contact multiple database providers to obtain costs/head (or lot) of their databases so an average cost for data storage could be ascertained. This information was not readily given out, and the information that was expressed was not specific enough for this study. To find a more accurate estimate, Kevin Kirk from Michigan's Department of Agriculture was contacted. Mr. Kirk, who oversees the Michigan State AID database, provided the total data storage cost for Michigan producers (Kirk, 2007). Based on this information, a per-head charge of $0.085 was estimated and this same value was applied to group/lot records. This charge was assessed to every GIN (group identification number) or AIN (animal identification number) stored into the database.

6.1.9 Premises Registration Costs

Currently premises registration is free and many states are trying to make the process as seamless as possible and NAIS reports that 33.8% of all operations with over $1,000 income have been registered (USDA, 2008c). While the premises registration is a free service, there are potential costs incurred with registering an operation's premises (e.g., time, mileage, paperwork). To capture this cost, it was assumed that a producer would incur a cost of $20 associated with time, travel, and supplies to register his/her premises. Theoretically, once premises are registered the registration lasts for the life of the operation as well. However, many producers will need to renew or modify their premises registration on a regular basis as their operations change. Thus, it was assumed that the lifespan of the premises registration would be three years. The cost of renewing the premises every three years was assumed to be $10 per operation. When accounting for the time value of money, the initial premises registration cost of $20 and the renewal every three years of $10 equates to a cost of $4.64 per operation annually in current dollars.

6.1.10 Interest Costs

Investments required for an animal ID system that have useful lives of more than one year (e.g., tags in breeding stock, tag applicators, computers, premises registration) were annualized using an interest rate of 7.75%. Annual operating cost such as tags for breeding ewes and rams, labor, internet, etc. were charged an interest cost at this same rate for the portion of the year a producer's money would be tied up.

6.1.11 Summary of Sheep Costs

Table 6.3 reports fixed costs related to data recording and reporting that are similar across operation types, but vary by operation size. Fixed costs are defined as costs that do not vary based on the number of groups marketed. Because it is assumed that a higher percentage of larger operations own computers, the costs associated with data accumulator (computer), software, and internet are lower per operation for larger operations. Costs associated with premises registration were the same for all operation sizes. Table 6.4 reports the fixed and variable costs related to data recording, storage, and reporting. Variable costs are defined as costs that increase as the number of groups increase. The variable costs reported in the top portion of the table are constant on a per lot basis across operation types and sizes. In the final analysis, the data-related cost per lot was not allowed to exceed $7.39 as this would represent approximately one-half hour of clerical time plus the cost of data storage. It was assumed that sheep producers would not invest in computers, software, etc. if the costs are significantly higher than what they could do manually. Thus, any of the values in the "Total data cost, $/lot" rows in table 6.4 that exceed $7.39 are replaced with $7.39 in the final analysis.

Table 6.5 summarizes the total costs, both as total dollars per operation and total cost per animal (combination of lambs, ewes, and rams) sold, by size of operation. The average cost per animal sold ranges from a low of $0.44 for the largest operations to a high of $2.19 per head for the smallest operations indicating there are relatively large economies of size. Figure 6.2 shows these same data graphically.

Table 6.3. Fixed Costs Related to Data Recording and Reporting for Sheep by Size of Operation

	Size of Operation, number of head			
	<100	100-499	500-4,999	5,000+
Data accumulator (computer)				
Initial investment, $/operation	$692	$692	$692	$692
Ownership adjustment, %	14.4%	18.2%	24.5%	39.8%
Adjusted investment, $/operation	$592	$567	$523	$417
Annual cost, $/operation	$178	$170	$157	$125
Percent to NAIS	50%	50%	50%	50%
Annual cost, $/operation	$89	$85	$79	$63
Software				
Initial investment, $/operation	$400	$400	$400	$400
Ownership adjustment, %	14.4%	18.2%	24.5%	39.8%
Adjusted investment, $/operation	$342	$327	$302	$241
Annual cost, $/operation	$103	$98	$91	$72
Percent to NAIS	50%	50%	50%	50%
Annual cost, $/operation	$51	$49	$45	$36
Internet				
Annual cost	$600	$600	$600	$600
Ownership adjustment, %	14.4%	18.2%	24.5%	39.8%
Adjusted annual cost, $/operation	$514	$491	$453	$362
Percent to NAIS	50%	50%	50%	50%
Annual cost, $/operation	$277	$265	$244	$195
Fixed data cost, $/operation	$417	$399	$368	$294
Premises registration				
Annual cost, $/operation	$5	$5	$5	$5

Table 6.4. Data Storage and Reporting Costs for Sheep by Size of Operation

	Size of Operation, number of head			
	<100	100-499	500-4,999	5,000+
Cost, $/lot				
Printing cost	$0.24	$0.24	$0.24	$0.24
Data storage cost	$0.09	$0.09	$0.09	$0.09
Clerical labor	$3.65	$3.65	$3.65	$3.65
Total variable data cost, $/lot	$3.98	$3.98	$3.98	$3.98
Number of lots sold per year	2.0	5.0	8.0	16.0
Variable data cost, $/operation	$8	$20	$32	$64
Fixed data cost, $/operation	$417	$399	$368	$294
Total data cost, $/operation	$425	$419	$400	$357
Total data cost, $/lot*	$212.50	$83.73	$49.99	$22.33

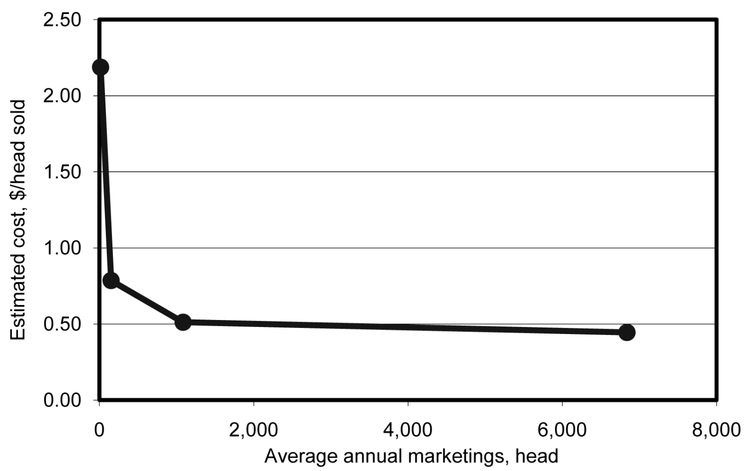
* If this cost exceeds $7.39, it was assumed data recording/reporting would be done manually at a cost of $7.39/lot.

Table 6.5. Summary of ID Costs for Sheep Operations by Type and Size of Operation

	Size of Operation, number of head				
	<100	100-499	500-4,999	5,000+	Total/Avg
Number of lots sold per year	2.0	5.0	8.0	16.0	164,192
Number of sheep sold per year	16	152	1,085	6,838	3,411,140
Tag-related costs (table 6.2)	$15	$78	$491	$2,917	$2,090,948
Data-related costs*	$15	$37	$59	$118	$1,213,562
Premises registration costs	$5	$5	$5	$5	$327,438
Total cost, $/operation	$35	$119	$554	$3,040	$3,631,949
Total cost, $/animal sold	$2.19	$0.79	$0.51	$0.44	$1.06

* Based on minimum of $7.39/lot or Total data cost reported in table 6.4 times number of lots sold per year.

FIGURE 6.2. ESTIMATED COST OF ANIMAL IDENTIFICATION FOR SHEEP OPERATIONS



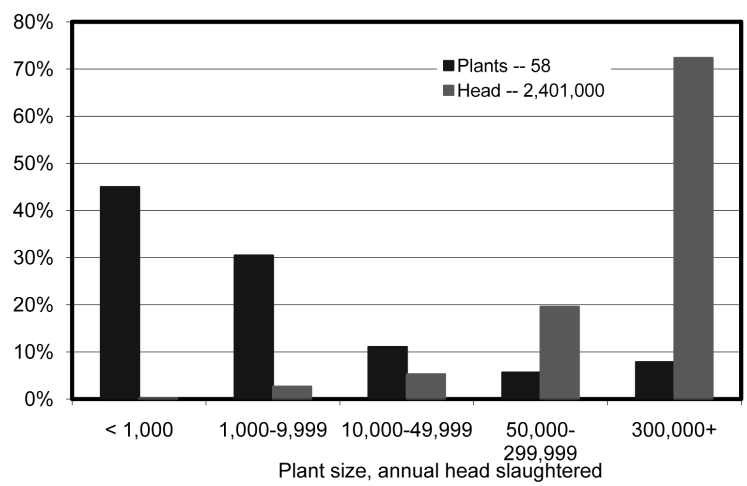
6.2 PACKERS

THE COSTS INCURRED AT LAMB PACKING PLANTS will depend on numerous factors, but primarily on size of the plant. While packing plants may be able to pass costs associated with an animal ID system on to their suppliers (i.e., sheep and lamb producers), these costs impact the industry. Furthermore, if different size packing plants have different costs (i.e., if economies of size exist) some of these added costs may not be able to be passed on to customers due to competition within the industry. For this analysis the costs at packing plants was based on the costs of recording and reporting data pertaining to group/lot IDs, however, for very small plants "groups" might actually represent individual sheep.

6.2.1 OPERATION DISTRIBUTIONS

In order to determine how a national animal identification system might impact packing plants of various sizes, a distribution of plant size was required. Information on the number and size of sheep and lamb slaughter plants was obtained from USDA GIPSA (USDA, 2007g). Average values for 2001-2005 were used for the analysis and then adjusted to 2007 marketings. Figure 6.3 shows the distribution of the number of plants and their shares of sheep slaughtered. Approximately 75% of the plants slaughter less than 10,000 head annually, but they account for only about 3% of total marketings. The largest two plants sizes represent about 13.5% of all the plants, but they account for over 90% of the total slaughter. The distribution of the number of plants is relatively uniform, i.e., there are a similar number of plants of all size categories.

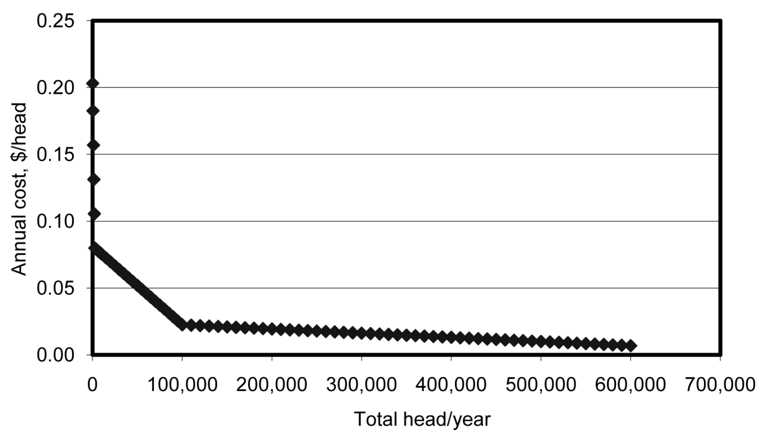
Figure 6.3. Size Distribution and Market Share of Sheep and Lamb Slaughter Plants by Plant Size, 2001-05 Average



6.2.2 Cost of Recording and Reporting Information

It was assumed that sheep processed through a packing plant would have identification information that would need to be recorded and reported to a central database. Information can generally be handled on a group basis, but for small packing plants that buy animals individually a group ID is the same as an individual ID. Packing plant costs were estimated as a function of plant size based on survey results from packing plants of various sizes (Bass et al., 2007). Costs were estimated as a function of the number of animals slaughtered per year (large plants were lambs and small plants tended to be cull breeding stock). Figure 6.4 shows how the cost per head associated with reading, recording, and reporting data varies as plant size increases. The impact of plant size on cost (i.e., economies of size) is economically significant.

FIGURE 6.4. ANNUAL COST OF ADOPTING ANIMAL IDENTIFICATION FOR SHEEP AND LAMB SLAUGHTER PLANTS BY PLANT SIZE



6.2.3 SUMMARY OF PACKING PLANT COSTS

Based on recording and reporting group/lot ID information on 100% of sheep and lambs being slaughtered in 2007 (2,693,700 head), the total costs to the 58 sheep and lamb packing plants in the US is estimated at approximately $32,000, or about $550 per plant.

Sheep Industry Summary

Table 6.6 summarizes the total costs to the sheep industry by sector (producers and packers) under scenario #3 (full traceability). Total costs are estimated at slightly over $3.6 million. From the partial breakdown by type of cost, it can be seen that over half of the cost is based on tagging costs with slightly over a third associated with recording/reporting data. Tagging was only assumed for breeding stock, similar to what currently exists for the scrapie program. However, the costs of the tags, applicators and labor for tagging were included here even though some of these costs are currently provided by the government (e.g., tags and applicators). Costs associated with reading/reporting data were based on group lots and individual animal data handled “manually” as opposed to electronic readers. To the extent that sheep operations already have data management systems in place, some of the costs assumed for recording/reporting might already be in place and thus the actual incremental cost would be lower than the estimate provided here. Also reported in table 6.6 is the cost per head sold by sector and the total for the industry (based on total slaughter in 2007). Based on assumptions used in this analysis, a full traceability animal identification program in the sheep industry would add $1.06 cost per animal (lambs, ewes, and rams) producers sell and $1.39 per animal slaughtered. The reason the producer cost is lower per head is because it reflects the fact that sheep are sold multiple times before being slaughtered. This cost is relevant for producers analyzing how their costs are impacted with an animal identification program. However, from an industry perspective, the $1.39 is the relevant cost as this indicates how the cost of lamb (and mutton) is impacted relative to competing protein sources.

In both the production and packer sectors, economies of size associated with an animal identification system were generally present. Thus, smaller operations likely will be slower to adopt identification systems because they incur higher per unit costs. However, as a general rule for most sectors, most of the economies of size were typically captured quickly such that costs for mid-sized operations were similar to costs of the largest operations.

Table 6.7 reports the total costs to the sheep industry by sector under the three different scenarios: 1) premises registration only, 2) bookend animal ID system, and 3) full traceability ID system for various adoption rates. The costs are reported for both a uniform adoption rate and a lowest-cost-first adoption rate. Given that NAIS is a voluntary program, the lowest-cost-first adoption rate likely better reflects what costs would be to the industry with something less than 100% adoption. Note that at 100% adoption the two methods have equal costs.

The premises registration scenario (#1) reflects only costs associated with registering premises (see Section 6.1.9 for a discussion about how premises registration costs were estimated), which is significantly below the other two. However, it is also important to recognize that this represents no animal identification and no ability to trace animal movements. The scrapie program that currently exists allows for better traceability of sheep than only premises registration.

Scenario #2 represents an animal identification system that reflects what is referred to as a bookend system. A bookend system simply means the sheep and lambs are identified at both ends of their lives (birth and death), but movements in between are not tracked. Because recording and reporting data were a relatively large portion of the total industry costs (table 6.6) and the bookend system would not require this information, the costs of this system are only about two-thirds of the costs of the full traceability system (Scenario #3). Scenario #2 would be similar to the current scrapie program in terms of tracing breeding sheep and it would somewhat enhance the traceability of slaughter lambs, which currently are not identified at all. Scenario #3 would enhance the traceability further for both breeding and slaughter sheep by recording and reporting animal movement.

Table 6.6. Summary of Annualized Animal ID Costs to Sheep Industry Under Scenario #3 (full traceability)

	All Operations	Packers	Total
Total operations	70,590	58	70,590
Sheep and lambs sold per year	3,411,140	2,642,123	2,642,123
Breakdown of costs ($)			
Tagging Cost	$2,090,948		$2,090,948
Reader/Reading Cost	$1,213,562	$32,012	$1,245,574
Premises Registration	$327,438		$327,438
Total Cost, Annualized	$3,631,949	$32,012	$3,663,961
Breakdown of costs (%)			
Tagging Cost	57.6%	0.0%	57.1%
Reader/Reading Cost	33.4%	100.0%	34.0%
Premises Registration	9.0%	0.0%	8.9%
Total Cost, Annualized	100.0%	100.0%	100.0%
Cost per sheep sold, $/head*	$1.06	$0.01	$1.39

* Includes lambs and cull ewes and rams, total for industry is based on total head slaughtered

Table 6.7. Total Sheep Industry Cost versus Adoption Rate Under Alternative Scenarios

Scenario #1 -- Premises Registration Only

Industry Segment	Premises Registration	Adoption rate	Uniformly adopted	Lowest cost adopted first
All Operations	$327,438	10%	$35,945	$14,865
Packers	$32,012	20%	$71,890	$33,298
TOTAL COST	$359,450	30%	$107,835	$70,474
		40%	$143,780	$111,757
		50%	$179,725	$153,039
		60%	$215,670	$194,321
		70%	$251,615	$235,603
		80%	$287,560	$276,886
		90%	$323,505	$318,168
		100%	$359,450	$359,450

Scenario #2 -- Bookend Animal ID System

Industry Segment	Book End Cost	Adoption rate	Uniformly adopted	Lowest cost adopted first
All Operations	$2,418,387	10%	$245,040	$165,603
Packers	$32,012	20%	$490,080	$331,206
TOTAL COST	$2,450,398	30%	$735,119	$496,809
		40%	$980,159	$662,412
		50%	$1,225,199	$828,015
		60%	$1,470,239	$993,618
		70%	$1,715,279	$1,159,220
		80%	$1,960,319	$1,344,147
		90%	$2,205,358	$1,617,275
		100%	$2,450,398	$2,450,398

Scenario #3 -- Full Traceability Animal ID System

Industry Segment	Traceability Cost	Adoption rate	Uniformly adopted	Lowest cost adopted first
All Operations	$3,631,949	10%	$366,396	$286,959
Packers	$32,012	20%	$732,792	$573,918
TOTAL COST	$3,663,961	30%	$1,099,188	$860,877
		40%	$1,465,584	$1,147,837
		50%	$1,831,980	$1,434,796
		60%	$2,198,376	$1,721,755
		70%	$2,564,772	$2,008,714
		80%	$2,931,168	$2,314,996
		90%	$3,297,564	$2,709,481
		100%	$3,663,961	$3,663,961

7. Direct Cost Estimates: Poultry

Poultry Operations

DIRECT COSTS OF NAIS ADOPTION WERE ESTIMATED for the poultry industry by breaking the industry into three main groups (referred to as operation types): 1) Layers, 2) Broilers, and 3) Turkeys. The vast majority of poultry are marketed direct so an auction market sector is not included in the poultry industry cost estimation. Estimating costs separately for different types of operations makes it possible to see how different sectors of the poultry industry would be impacted with adoption of an animal identification system.

The Layer group was defined as producers who raise hens and produce eggs that are sold to the public. Broiler and Turkey operations raise meat poultry that are either owned privately or contracted by an integrator to feed. Packers are defined as any operation that slaughters live animals, either broilers, turkeys, or cull breeding stock, under government inspection to produce meat products for sale to the public. However, due to the vertically integrated nature of the poultry industry, costs were not estimated separately for packers. Hence the cost of recording and reporting group/lots at the packer level is already accounted for at the production level.

Layer operations market both eggs and cull hens, while the other two production-type operations only market poultry ready to be slaughtered as they do not typically own breeding animals. The game bird industry, family (backyard) flocks, road-side auctions, and hatcheries were not included in cost estimates here as the complexity and lack of information on these types of operations prevented any type of reliable analysis.

The following discussion of poultry industry costs is partitioned by the different types of costs and according to the three operation types. Also, the following discussion pertains to costs associated with all poultry group/lots being identified and movements tracked (i.e., Scenario 3 listed above). Costs of just premises registration (Scenario 1) are summarized later in this section. The bookend scenario (Scenario 2) is not considered for poultry due to the integrated nature of the industry.

7.1 Operation Distributions

Table 7.1 reports the number of operations, average inventories, annual purchases and sales, and average number of lots for the different types of operations by operation size. Data on average lot size were not readily available. Thus birds per lot were estimated by operation size after accounting for death loss, length of production cycle (i.e., inventory turns/year) and based on the assumption that larger layer operations would generally sell spent hens in larger lot sizes.

7.1.1 Layers

The average number of layers a producer had was calculated using data from the 2002 Census (USDA, 2002b). The Census reported the number of poultry operations, which includes contract operations, and the total 20-weeks-or-older inventory of layers for these operations grouped by operation size. To estimate the average number of layers for each size category, total inventories were divided by the respective numbers of operations.

The number of group/lots was estimated based on the number of spent (culled) hens sold and an average turnover rate. To find the number of culled hens sold, the average number of dead hens (NAHMS, 1999) was subtracted from the average laying hen inventory and this was multiplied by the average turnover of layers in a year. Hen turnover was calculated by dividing the number of weeks in a year by the average number of weeks a layer is in production (Meunier and Latour, undated), adding a week to account for downtime. The following rules were used to determine number of lots sold by operation size, where the first value is birds sold per year and the value in parenthesis is maximum birds per lot: 0-499 (100), 500-2,499 (500), 2,500-4,999 (1,000), 5,000-49,999 (5,000), 50,000 and above (10,000). Using these rules the average number of lots sold per operation, by operation size, was estimated.

7.1.2 Broilers

The average number of broilers a producer had was calculated using data from the 2002 Census (USDA, 2002b) along with information on the average length of feeding period. The Census reported the number of operations and the total broilers sold by operation grouped by size. The total number sold was divided by 6.5 turns per year to provide an estimate of the average inventory, where the 6.5 was based on an average feeding period of seven weeks (Jacob and Mather, 2003; National Chicken Council, 2008) plus one week of cleanup time between groups. Dividing the estimated inventory by the number of operations provided an average broiler inventory for each size category.

The average number of lots sold per operation was estimated based on the 6.5 turns per year (52 weeks divided by eight weeks) assumption and setting a maximum lot size of 20,000 birds per lot. This maximum of 20,000 birds per group was based on the size of a typical grow-out house (National Chicken Council, 2008). Therefore, for operations that had more than 20,000 broilers per group, the total number of broilers per group was divided by 20,000 to find the number of lots that would require a unique GIN.

7.1.3 Turkeys

The average number of turkeys a producer had was calculated using data from the 2002 Census (USDA, 2002b) along with information on the average feeding period length. The Census reported the number of operations, which includes contract growers and the total turkeys sold by the operations grouped by size. The total number sold was divided by 2.3 turns per year to provide an estimate of the average inventory, where the 2.3 was based on an average feeding period of 151 days plus allowing one week cleanup time between groups. Dividing this estimated total inventory by the number of operations provided an estimate of the average turkey inventory for each operation size category.

The average number of lots sold per operation was estimated based on the 2.3 turns per year (365 days divided by 158 days) assumption and setting a maximum lot size of 10,000 birds per lot. Thus, for operations that had more than 10,000 turkeys per group, the total number of turkeys was divided by 10,000 to find the number of lots that would require a unique GIN.

7.2 GROUP/LOTS

IT WAS ASSUMED THAT POULTRY OPERATIONS would employ a Group Identification Number (GIN) to adopt NAIS, and that no physical animal identification or group identification tags would be applied to the animals. The average size of group/lots was estimated as described in the preceding section and the average number of lots sold per operation are reported in table 7.1. To estimate the cost of recording/reporting group lot movement information, the number of lots reported in table 7.1 was doubled to account for producers first receiving groups of poultry and then subsequently shipping them to a processor.

Table 7.1. Summary of Poultry Industry Operations and Operation Sizes by Type

Layers (average inventory of 20-weeks old or older layers)

	1-49	50-99	100-399	400 - 3,199	3,200-9,999	10,000-19,999	20,000-49,999	50,000-99,999	100,000 +	Total (thousands)
Number of operations	82,693	7,431	3,684	487	672	1,421	1,127	302	498	98.3
Average inventory	17	60	151	1,041	7,517	14,564	28,098	70,981	507,454	334,435
Average lots sold	1.0	1.0	1.0	4.0	5.8	5.6	10.8	27.2	38.9	147.2
Number sold annually	6.3	22.8	57.9	399	2,878	5,575	10,757	27,173	194,267	128,031
Number purchased annually	7.4	26.7	67.8	467	3,370	6,529	12,595	31,819	227,479	149,919

Broilers (annual broilers sold)

	1-1,999	2,000-15,999	16,000-29,999	30,000-59,999	60,000-99,999	100,000-199,999	200,000-299,999	300,000-499,999	500,000-749,000	750,000 +	Total (thousands)
Number of operations	10,869	406	206	444	1,060	3,311	4,653	5,754	3,092	2,211	32.0
Average inventory	16	1,085	3,292	6,819	12,230	23,094	37,513	58,429	91,148	188,977	1,304,158
Average lots sold	6.5	6.5	6.5	6.5	6.5	7.5	12.2	19.0	29.7	61.6	504.0
Number sold annually	105	7,073	21,459	44,443	79,716	150,525	244,502	380,835	594,087	1,231,727	8,500,313
Number purchased annually	114	7,660	23,242	48,137	86,341	163,035	264,823	412,486	643,462	1,334,097	9,206,780

Turkeys (annual turkeys sold)

	1-1,999	2,000-7,999	8,000-15,999	16,000-29,999	30,000-59,999	60,000-99,999	100,000 +	Total (thousands)
Number of operations	5,590	93	126	290	789	748	800	8.4
Average inventory	17	2,000	5,247	9,681	18,657	32,228	100,045	122,611
Average lots sold	2.3	2.3	2.3	2.3	4.3	7.4	23.1	41.5
Number sold annually	38.9	4,619	12,121	22,365	43,100	74,451	231,116	283,248
Number purchased annually	42.6	5,069	13,302	24,544	47,300	81,706	253,639	310,851

7.3 DATA RECORDING, REPORTING AND STORAGE COSTS

BECAUSE THE TECHNOLOGY ASSUMED for the poultry industry is different than the cattle industry, costs of NAIS adoption differ. For example, it was assumed that the cattle industry would use radio frequency identification (RFID) and thus hardware and software for reading RFID tags was included. However, in the poultry industry it was assumed that individual animal identification will not be used and the poultry can be identified with group/lot identification. Thus, electronic readers are not required, but there will still be costs associated with recording, reporting, and storing data. The following is a brief discussion of these components.

7.3.1 DATA ACCUMULATOR AND SOFTWARE

The data accumulator cost represents the average cost of six internet websites prices for laptop computers. This cost was annualized over four years and had a $0 salvage value. Given an initial investment of $692, a 4-year life, and an interest rate of 7.75%, the annual cost is $208. It was assumed that many operations, and especially the larger ones, would already own a computer and thus charging this cost to animal identification would not be appropriate. Data indicating computer usage by type and size of poultry operations could not be found. Thus, it was assumed that computer ownership trends reported for the dairy industry in the NAHMS dairy report (USDA, 2007a) might be similar for poultry operations. Computer ownership rates used by type of operation and operation size are reported in table 7.2 (Ownership adjustment, %). To account for operations that currently own computers, the annual cost of the data accumulator (i.e., computer) was multiplied by one minus the proportion of operations that currently own computers resulting in a weighted-average cost per operation for each size category. Additionally, the calculated annual cost of computers was multiplied by 50% to account for the fact that the entire cost of the computer likely should not be allocated to an animal identification program (i.e., poultry operators would likely use the computer for other management or personal uses).

Many different software packages are available that would satisfy the software requirement of an eID system. The cost of software used here is the suggested retail price of Microsoft Office Professional (Microsoft, 2008). This software package includes Microsoft Office Word, Office Excel, Office PowerPoint, Office Access, and other programs. While most producers would not use some of the programs included in Office Professional, Microsoft Office Word and Microsoft Office Excel or Microsoft Office Access would need to be employed to keep track of group/lots and their movements and to write the necessary documents. Other software packages that also maintain management information likely would be utilized by producers, but the higher cost associated with these software packages are not appropriate to include in an animal ID system as these are providing value beyond that required by NAIS. In other words, producers might choose to spend more for additional management benefits, but this is not something they would need to adopt NAIS procedures. As with data accumulators, annual software costs were adjusted by the percent of operations currently owning computers. That is, it was assumed that if computers were already owned, software for managing the data would also be owned. Additionally, when software was purchased (i.e., those operations not currently owning computers), only 50% of the cost was allocated to the animal ID system.

7.3.2 PRINTING COSTS ASSOCIATED WITH RECORDING / REPORTING DATA

In addition to the hardware and software required for data recording, analysis, and reporting, it was assumed bar codes would be printed that could be sent with lots of poultry as they are marketed, i.e., affixed to bills of lading. That is, when selling group/lots, the seller will need to send papers with the shipment of birds which contain the required information. These preprinted bar codes or labels would contain the group/lot ID required for NAIS. This assumption was made based on the fact that contract growers and processors have high transaction volumes and these entities will require sellers to have bar codes on the identification papers to reduce transaction costs and human error.

This cost was calculated by finding label costs via the internet and multiplying by the cost of printing on a conventional printer. It was assumed that the producer would print two labels per group sold: one for the operator's record and one for the buyer's record. The cost per sheet of paper and labels that could be printed on were obtained from multiple internet sites and averaged $0.24 per lot, assuming two labels were printed per lot. This was then multiplied by the number of groups to be sold to find the total bar code cost.

7.3.3 Other/Fixed Charge

The time needed to submit the group/lot ID numbers to a central database and internet fees were considered here. To determine clerical costs, the time submitting a group/lot ID number and the number of groups submitted needed to be ascertained. The Wisconsin working group for pork found that it took 15 minutes to submit data (Wisconsin Pork Association (WPA), 2006). Thus, it was assumed that each lot would require 15 minutes of time to submit the data. Clerical labor was multiplied by the average secretary wage of $14.60 per hour for the US (US Department of Labor, 2007) to find the total cost associated with recording and reporting a group/lot animal ID number.

In order to be able to achieve a "48 hour trace back system" producers would need to submit group/lot information via an internet access point. An internet charge of $50 per month was assumed for 12 months. However, because some operations already have a computer, it was assumed they likely also had internet access so a weighted cost of internet was used similar to as was done for the cost of data accumulators and software. Also, as with computers and software, the calculated annual cost of internet fees was multiplied by 50% to account for the fact that the entire cost likely should not be allocated to an animal identification program (i.e., poultry operators would likely use the internet for other management or personal uses).

7.3.4 Database Charge

According to the NAIS business plan, "The most efficient, cost-effective approach for advancing the country's traceability infrastructure is to capitalize on existing resources—mainly, animal health programs and personnel, as well as animal disease information databases" (USDA, 2007f, p. 4). As of May 2008, there were 17 approved Animal Tracking Databases or Compliant Animal Tracking Databases meeting the minimum requirements as outlined in the Integration of Animal Tracking Databases that were participating in the NAIS program and have a signed cooperative agreement with USDA Animal Plant Health Inspection Service (USDA, 2008d).

The research team attempted to contact multiple database providers to obtain costs/head (or lot) of their databases so an average cost for data storage could be ascertained. This information was not readily given out, and the information that was expressed was not specific enough for this study. To find a more accurate estimate, Kevin Kirk from Michigan's Department of Agriculture was contacted. Mr. Kirk, who oversees the Michigan State AID database, provided the total data storage cost for Michigan producers (Kirk, 2007). Based on this information, a per-head charge of $0.085 was estimated and this same value was applied to group/lot records. This charge was included for the total number of lots that were sold by an operation as opposed to the number of animals they sold.

7.3.5 Premises Registration costs

Currently premises registration is free and many states are trying to make the process as seamless as possible and NAIS reports that 32.1% of all operations with over $1,000 income have been registered (USDA, 2008d). While the premises registration is a free service, there are potential costs incurred with registering an operation's premises (e.g., time, mileage, paperwork). To capture this cost, it was assumed that a producer would incur a cost of $20 associated with management time, travel, and supplies to register his/her premises. Theoretically, once a premises is registered it will last for the life of the operation as well. However, many producers will need to renew or modify their premises registration on a regular basis as their operations change. Thus, it was assumed that the lifespan of the premises registration would be three years. The cost of renewing the premises every three years was assumed to be $10 per operation. When accounting for the time value of money, the initial premises registration cost of $20 and the renewal every three years of $10 equates to a cost of approximately $4.64 per operation annually in current dollars.

7.3.6 Interest Costs

Investments required for an animal ID system that have useful lives of more than one year (e.g., computers, premises registration) were annualized using an interest rate of 7.75%. Annual operating cost were charged an interest cost at this same rate for the portion of the year a producer's money would be tied up.

7.4 Poultry Industry Summary

Tables 7.2-7.4 report fixed costs related to data recording and reporting that vary by operation size for layers, broilers, and turkeys, respectively. Fixed costs are defined as costs that do not vary based on the number of groups marketed. Because it is assumed that a higher percentage of larger operations own computers, the costs associated with data accumulator (computer), software, and internet are lower per operation for larger operations. Costs associated with premises registration were the same for all operation sizes. Tables 7.5-7.7 report the fixed and variable costs related to data recording, storage, and reporting by operation size for layers, broilers, and turkeys, respectively. Variable costs are defined as costs that increase as the number of groups increase. The variable costs reported in the top portions of the tables are constant on a per lot basis across operation sizes. It can be seen that there are large economies of size in the per lot costs based on these assumptions, however, this is being driven by the investment in computers, software, and internet charges which are very high per lot for the small operations. Thus, in the final analysis, the data-related cost per lot was not allowed to exceed the cost associated with one-half hour of clerical time plus data storage (approximately $7.39). That is, it was assumed that poultry producers would not invest in computers, software, etc. if the costs are significantly higher than what they could do manually. Thus, any of the values in the “Total data cost, $/lot” rows in tables 7.5-7.7 that exceed $7.39 are replaced with $7.39 in the final analysis.

Table 7.8 summarizes the total costs, both as total dollars operation and total cost per bird (layers, broilers, and turkeys) sold by type and size of operation. For all three types of operations there are relatively large economies of size in that the smallest operations have significantly higher costs than the large operations. On average for the industry, costs per bird are $0.0195, $0.0007, and $0.0020 for layers, broilers, and turkeys, respectively. Thus, average industry costs are not particularly high, but for the smallest operations that is not the case. Thus, there would be much less incentive for small operations to adopt an animal (group) identification system due to the diseconomies of size that exist.

Table 7.2. Fixed Costs Related to Data Recording and Reporting for Layer Operations by Size of Operation.

	Layers (average inventory of 20-weeks old or older layers)								
	1-49	50-99	100-399	400-3,199	3,200-9,999	10,000-19,999	20,000-49,999	50,000-99,999	100,000+
Data accumulator (computer)									
Initial investment, $/operation	$692	$692	$692	$692	$692	$692	$692	$692	$692
Ownership adjustment, %	12.0%	30.4%	48.7%	56.0%	63.4%	70.7%	78.0%	85.4%	92.7%
Adjusted investment, $/operation	$609	$482	$355	$304	$254	$203	$152	$101	$51
Annual cost, $/operation	$183	$145	$107	$91	$76	$61	$46	$30	$15
Percent to NAIS	50%	50%	50%	50%	50%	50%	50%	50%	50%
Annual cost, $/operation	$91	$72	$53	$46	$38	$30	$23	$15	$8
Software									
Initial investment, $/operation	$400	$400	$400	$400	$400	$400	$400	$400	$400
Ownership adjustment, %	12.0%	30.4%	48.7%	56.0%	63.4%	70.7%	78.0%	85.4%	92.7%
Adjusted investment, $/operation	$352	$279	$205	$176	$147	$117	$88	$59	$29
Annual cost, $/operation	$106	$84	$62	$53	$44	$35	$26	$18	$9
Percent to NAIS	50%	50%	50%	50%	50%	50%	50%	50%	50%
Annual cost, $/operation	$53	$42	$31	$26	$22	$18	$13	$9	$4
Internet									
Initial investment, $/operation	$600	$600	$600	$600	$600	$600	$600	$600	$600
Ownership adjustment, %	12.0%	30.4%	48.7%	56.0%	63.4%	70.7%	78.0%	85.4%	92.7%
Adjusted investment, $/operation	$569	$450	$332	$284	$237	$189	$142	$95	$47
Annual cost, $/operation	50%	50%	50%	50%	50%	50%	50%	50%	50%
Percent to NAIS	$284	$225	$166	$142	$118	$95	$71	$47	$24
Fixed data cost, $/operation	$429	$339	$250	$214	$178	$143	$107	$71	$36
Premises registration									
Annual cost, $/operation	$5	$5	$5	$5	$5	$5	$5	$5	$5

Table 7.3. Fixed Costs Related to Data Recording and Reporting for Broiler Operations by Size of Operation.

	Broilers (annual broilers sold)									
	1-1,999	2,000-15,999	16,000-29,999	30,000-59,999	60,000-99,999	100,000-199,999	200,000-299,999	300,000-499,999	500,000-749,000	750,000 +
Data accumulator (Computer)										
Initial cost, $	$692	$692	$692	$692	$692	$692	$692	$692	$692	$692
Ownership adjustment, %	12%	30%	49%	71%	74%	78%	82%	85%	89%	93%
Adjusted investment, $/Operation	$609	$482	$355	$203	$177	$152	$127	$101	$76	$51
Annual cost, $/Operation	$183	$145	$107	$61	$53	$46	$38	$30	$23	$15
Percent to NAIS	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
NAIS cost, $/Operation	$91	$72	$53	$30	$27	$23	$19	$15	$11	$8
Software										
Initial cost, $	$400	$400	$400	$400	$400	$400	$400	$400	$400	$400
Ownership adjustment, %	12.0%	30.4%	48.7%	70.7%	74.4%	78.0%	81.7%	85.4%	89.0%	92.7%
Adjusted investment, $/Operation	$352	$279	$205	$117	$103	$88	$73	$59	$44	$29
Annual cost, $/Operation	$106	$84	$62	$35	$31	$26	$22	$18	$13	$9
Percent to NAIS	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
NAIS cost, $/Operation	$53	$42	$31	$18	$15	$13	$11	$9	$7	$4
Internet										
Annual cost	$600	$600	$600	$600	$600	$600	$600	$600	$600	$600
Ownership adjustment	12.0%	30.4%	48.7%	70.7%	74.4%	78.0%	81.7%	85.4%	89.0%	92.7%
Annual cost, total $	$569	$450	$332	$189	$166	$142	$118	$95	$71	$47
Percent to NAIS	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Annual cost, $	$284	$225	$166	$95	$83	$71	$59	$47	$35	$24
Fixed data cost, $/operation	$429	$339	$250	$143	$125	$107	$89	$71	$53	$36
Premises Registration										
Annual cost, $/operation	$5	$5	$5	$5	$5	$5	$5	$5	$5	$5

Table 7.4. Fixed Costs Related to Data Recording and Reporting for Turkey Operations by Size of Operation.

	Turkeys (annual turkeys sold)						
	1-1,999	2,000-7,999	8,000-15,999	16,000-29,999	30,000-59,999	60,000-99,999	100,000+
Data accumulator (Computer)							
Initial cost, $	$692	$692	$692	$692	$692	$692	$692
Ownership adjustment, %	12.0%	49.0%	71.0%	76.5%	82.0%	87.5%	93.0%
Adjusted investment, $/Operation	$609	$353	$201	$163	$125	$87	$48
Annual cost, $/Operation	$183	$106	$60	$49	$37	$26	$15
Percent to NAIS	50%	50%	50%	50%	50%	50%	50%
NAIS cost, $/Operation	$91	$53	$30	$24	$19	$13	$7
Software							
Initial cost, $	$400	$400	$400	$400	$400	$400	$400
Ownership adjustment, %	12.0%	49.0%	71.0%	76.5%	82.0%	87.5%	93.0%
Adjusted investment, $/Operation	$352	$204	$116	$94	$72	$50	$28
Annual cost, $/Operation	$106	$61	$35	$28	$22	$15	$8
Percent to NAIS	50%	50%	50%	50%	50%	50%	50%
NAIS cost, $/Operation	$53	$31	$17	$14	$11	$8	$4
Internet							
Annual cost	$600	$600	$600	$600	$600	$600	$600
Ownership adjustment	12.0%	49.0%	71.0%	76.5%	82.0%	87.5%	93.0%
Annual cost, total $	$569	$330	$187	$152	$116	$81	$45
Percent to NAIS	50%	50%	50%	50%	50%	50%	50%
Annual cost, $	$284	$165	$94	$76	$58	$40	$23
Fixed data cost, $/operation	$429	$248	$141	$114	$88	$61	$34
Premises Registration							
Annual cost, $/operation	$5	$5	$5	$5	$5	$5	$5

Table 7.5. Data Storage and Reporting Costs for Layer Operations by Size of Operation.

	Layers (average inventory of 20-weeks old or older layers)								
	1-49	50-99	100-399	400-3,199	3,200-9,999	10,000-19,999	20,000-49,999	50,000-99,999	100,000+
Cost, $/lot									
Printing cost	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24
Data storage cost	$0.09	$0.09	$0.09	$0.09	$0.09	$0.09	$0.09	$0.09	$0.09
Clerical labor	$3.93	$3.93	$3.93	$3.93	$3.93	$3.93	$3.93	$3.93	$3.93
Total variable data cost, $/lot	$4.26	$4.26	$4.26	$4.26	$4.26	$4.26	$4.26	$4.26	$4.26
Software									
Number of lots sold per year	1.0	1.0	1.0	4.0	5.8	5.6	10.8	27.2	38.9
Variable data cost, $/operation	$4	$4	$4	$17	$25	$24	$46	$116	$166
Fixed data cost, $/operation	$429	$339	$250	$214	$178	$143	$107	$71	$36
Total data cost, $/operation	$433	$344	$254	$231	$203	$167	$153	$187	$201
Total data cost, $/lot*	$433.00	$343.60	$254.20	$58.01	$35.27	$29.87	$14.21	$6.89	$5.18

* If this cost exceeds $7.39, it was assumed data recording/reporting would be done manually at a cost of $7.39/lot.

Table 7.6. Data Storage and Reporting Costs for Broiler Operations by Size of Operation.

	Broilers (annual broilers sold)									
	1-1,999	2,000-15,999	16,000-29,999	30,000-59,999	60,000-99,999	100,000-199,999	200,000-299,999	300,000-499,999	500,000-749,000	750,000+
Cost, $/lot										
Printing cost	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24
Data storage cost	$0.09	$0.09	$0.09	$0.09	$0.09	$0.09	$0.09	$0.09	$0.09	$0.09
Clerical labor	$3.93	$3.93	$3.93	$3.93	$3.93	$3.93	$3.93	$3.93	$3.93	$3.93
Total variable data cost, $/lot	$4.26	$4.26	$4.26	$4.26	$4.26	$4.26	$4.26	$4.26	$4.26	$4.26
Software										
Number of lots sold per year	6.5	6.5	6.5	6.5	6.5	7.5	12.2	19.0	29.7	61.6
Variable data cost, $/operation	$28	$28	$28	$28	$28	$32	$52	$81	$127	$262
Fixed data cost, $/operation	$429	$339	$250	$143	$125	$107	$89	$71	$53	$36
Total data cost, $/operation	$457	$367	$278	$171	$153	$139	$141	$152	$180	$298
Total data cost, $/lot*	$70.04	$56.32	$42.61	$26.16	$23.42	$18.48	$11.55	$8.01	$6.06	$4.84

* If this cost exceeds $7.39, it was assumed data recording/reporting would be done manually at a cost of $7.39/lot.

Table 7.7. Data Storage and Reporting Costs for Turkey Operations by Size of Operation.

	Turkeys (annual turkeys sold)						
	1-1,999	2,000-7,999	8,000-15,999	16,000-29,999	30,000-59,999	60,000-99,999	100,000+
Cost, $/lot							
Printing cost	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24
Data storage cost	$0.09	$0.09	$0.09	$0.09	$0.09	$0.09	$0.09
Clerical labor	$3.93	$3.93	$3.93	$3.93	$3.93	$3.93	$3.93
Total variable data cost, $/lot	$4.26	$4.26	$4.26	$4.26	$4.26	$4.26	$4.26
Software							
Number of lots sold per year	2.3	2.3	2.3	2.3	4.3	7.4	23.1
Variable data cost, $/operation	$10	$10	$10	$10	$18	$32	$98
Fixed data cost, $/operation	$429	$248	$141	$114	$88	$61	$34
Total data cost, $/operation	$439	$258	$151	$124	$106	$93	$133
Total data cost, $/lot*	$189.85	$111.82	$65.42	$53.82	$24.61	$12.44	$5.74

* If this cost exceeds $7.39, it was assumed data recording/reporting would be done manually at a cost of $7.39/lot.

Table 7.8. Summary of ID Costs for Poultry Operations by Type and Size of Operation

	Layers (average inventory of 20-weeks old or older layers)										
	1-49	50-99	100-399	400-3,199	3,200-9,999	10,000-19,999	20,000-49,999	50,000-99,999	100,000+		Total/Avg
Number of lots sold per year	1.0	1.0	1.0	4.0	5.8	5.6	10.8	27.2	38.9		147,217
Number of layers sold per year	6.3	22.8	57.9	399	2,878	5,575	10,757	27,173	194,267		128,031,003
Data-related costs*	$7.39	$7.39	$7.39	$29.46	$42.54	$41.21	$79.50	$187.10	$201.15		$2,036,425
Premises registration costs	$4.64	$4.64	$4.64	$4.64	$4.64	$4.64	$4.64	$4.64	$4.64		$456,043
Total costs, $/operation	$12.03	$12.03	$12.03	$34.10	$47.18	$45.85	$84.14	$191.74	$205.79		$2,492,469
Total costs, $/layer	$1.9014	$0.5270	$0.2077	$0.0855	$0.0164	$0.0082	$0.0078	$0.0071	$0.0011		$0.0195

	Broilers (annual broilers sold)										
	1-1,999	2,000-15,999	16,000-29,999	30,000-59,999	60,000-99,999	100,000-199,999	200,000-299,999	300,000-499,999	500,000-749,000	750,000 +	Total/Avg
Number of lots sold per year	6.5	6.5	6.5	6.5	6.5	7.5	12.2	19.0	29.7	61.6	504,017
Number of broilers sold per year	105	7,073	21,459	44,443	79,716	150,525	244,502	380,835	594,087	1,231,727	8,500,313,357
Data-related costs*	$48.17	$48.17	$48.17	$48.17	$48.17	$55.63	$90.36	$140.74	$180.02	$298.03	$5,911,451
Premises registration costs	$4.64	$4.64	$4.64	$4.64	$4.64	$4.64	$4.64	$4.64	$4.64	$4.64	$148,463
Total costs, $/operation	$52.81	$52.81	$52.81	$52.81	$52.81	$60.27	$95.00	$145.38	$184.66	$302.67	$6,059,914
Total costs, $/broiler	$0.5008	$0.0075	$0.0025	$0.0012	$0.0007	$0.0004	$0.0004	$0.0004	$0.0003	$0.0002	$0.0007

	Turkeys (annual turkeys sold)							
	1-1,999	2,000-7,999	8,000-15,999	16,000-29,999	30,000-59,999	60,000-99,999	100,000+	Total/Avg
Number of lots sold per year	2.3	2.3	2.3	2.3	4.3	7.4	23.1	41,548
Number of turkeys sold per year	38.9	4,619	12,121	22,365	43,100	74,451	231,116	283,247,649
Data-related costs*	$17.07	$17.07	$17.07	$17.07	$31.86	$55.03	$132.60	$521,342
Premises registration costs	$4.64	$4.64	$4.64	$4.64	$4.64	$4.64	$4.64	$39,131
Total costs, $/operation	$21.71	$21.71	$21.71	$21.71	$36.49	$59.67	$137.24	$560,473
Total costs, $/turkey	$0.5589	$0.0047	$0.0018	$0.0010	$0.0008	$0.0008	$0.0006	$0.0020

* Based on minimum of $15/lot or Total data cost reported in tables 7.5-7.7 times the number of lots sold per year.

Table 7.9 reports the total costs to the poultry industry by sector under two of the three different scenarios: 1) premises registration only and 3) full traceability ID system for various adoption rates. Scenario #2 (bookend only) is not reported here as it would be the same as the full traceability scenario (#3) given the integration assumption (i.e., processors also are producers). The costs are reported for both a uniform adoption rate and a lowest-cost-first adoption rate. Given that animal identification is a voluntary program, the lowest-cost-first adoption rate likely better reflects what costs would be to the industry with something less than 100% adoption. Note that at 100% adoption the two methods have equal costs.

The premises registration scenario (#1) reflects only costs associated with registering premises (see Section 7.3.5 for a discussion about how premises registration costs were estimated), which is significantly below Scenario #3. However, it is also important to recognize that this represents no animal or group/lot identification and no ability to trace animal movements. Scenario #3 is the full traceability system costs given different adoption rates.

Table 7.9. Total Poultry Industry Cost versus Adoption Rate Under Alternative Scenarios.

Scenario #1 -- Premises Registration Only

Industry Segment	Premises Registration	Adoption rate	Uniformly adopted	Lowest cost adopted first
Layers	$456,043	10%	$64,364	$6,388
Broilers	$148,463	20%	$128,728	$13,785
Turkeys	$39,131	30%	$193,091	$27,677
TOTAL COST	$643,638	40%	$257,455	$70,125
		50%	$321,819	$150,181
		60%	$386,183	$233,730
		70%	$450,546	$322,351
		80%	$514,910	$420,178
		90%	$579,274	$531,137
		100%	$643,638	$643,638

Scenario #3 -- Full Traceability Animal ID System

Industry Segment	Traceability Cost	Adoption rate	Uniformly adopted	Lowest cost adopted first
Layers	$2,492,469	10%	$911,286	$629,118
Broilers	$6,059,914	20%	$1,822,571	$1,283,803
Turkeys	$560,473	30%	$2,733,857	$2,020,954
TOTAL COST	$9,112,856	40%	$3,645,143	$2,829,849
		50%	$4,556,428	$3,734,503
		60%	$5,467,714	$4,703,411
		70%	$6,378,999	$5,719,316
		80%	$7,290,285	$6,841,228
		90%	$8,201,571	$7,976,271
		100%	$9,112,856	$9,112,856

8. Government Cost Estimates

8.1 Executive Summary/Chapter Overview

THE PURPOSE OF THIS CHAPTER was to examine governmental benefits and costs of NAIS. The chapter lays out findings regarding past and future federal NAIS budgets and summarizes findings from evaluations of select states. The data necessary to complete a robust empirical analysis were not always available. With that constraint in mind, this chapter provides: a) budgetary information on how NAIS funds have been allocated and utilized, b) a summary of experienced and potential governmental cost savings that may result from use of NAIS resources in animal disease response and surveillance efforts, and c) viewpoints and implications from animal ID coordinators in several key US states regarding NAIS issues and associated costs. The NAIS program is estimated to cost the federal governmental around $23.8 million to $33.0 million and combined state governmental costs total $2.1 to $3.4 million annually. The NAIS program is also estimated to possibly reduce bovine tuberculosis response costs of government animal health agencies by approximately $300,000 annually. In addition to sample estimated "direct cost savings," NAIS is identified to provide the government with an array of other "indirect benefits" that are difficult to empirically value.

8.2 Federal Government Analysis

8.2.1 Historical USDA NAIS Budgets

Our analysis of federal governmental expenditures on NAIS begins with a tabulation of historical governmental expenditures directly appropriated to the NAIS program. We obtained NAIS expenditure information from three data sources: 1) USDA NAIS Business Plan (USDA, 2007e), 2) an updated version (June 2008) of the USDA business plan provided by Mr. Neil Hammerschmidt (USDA, 2008g), 3) and the US Government Accountability Office report on NAIS (GAO, 2007). Collectively, these sources identify the total amount of funds available to NAIS and the NAIS expenditures planned for fiscal years (FY) 2004 through 2009. Furthermore, the actual expenditures incurred for fiscal years 2004 through 2007 were collected. This information is summarized in tables 8.1-8.3.

Over the time period of FY 2004 to FY 2008, approximately $127.7 million was made available to USDA to implement NAIS (table 8.1). These funds are typically sub-allocated in NAIS budgets across four primary activities: 1) Information Technology, 2) Cooperative Agreements, 3) Communications and Outreach, and 4) Program Administration (USDA, 2008g). These four primary activities accounted for 14.4%, 51.2%, 9.9%, and 24.5%, respectively, of the actual NAIS obligations between FY 2004 and FY 2007 (table 8.2). These actual obligation allocations closely reflect the planned allocations of 18.1%, 50.5%, 7.7%, and 23.6%, respectively, made for the FY 2004 – FY 2008 period (table 8.3). Actual expenditures were less than planned expenditures over the FY 2004 – FY 2006 time period. Any unobligated funds were carried over, per Congress stipulation, and remained available to cover future NAIS expenditures (USDA, 2008g). This is why actual expenditures in FY 2007 were able to exceed planned expenditures by approximately $10.7 million. Furthermore, Congressional permission to carry over unobligated funds underlies USDA's ability to have planned obligations in 2008 (totaling $24.7 million) to exceed FY 2008 appropriations of $9.7 million (table 8.1).

Table 8.1. Appropriated Funds Available to Implement NAIS.

Dollars in Thousands

	Fiscal Year					
	2004 (CCC Funds)[a]	2005	2006	2007	2008	Total
Total Funds Available	$18,793	$33,197	$33,007	$33,053	$9,683	$127,732

* Sources: USDA, 2008g

[a]CCC denotes Commodity Credit Corporation

Table 8.2. Actual NAIS Obligations.

Dollars in Thousands

	Fiscal Year					
	2004	2005	2006	2007[a]	Total	% of Total
Actual Obligations						
Information Technology	$1,829	$4,140	$2,466	$6,260	$14,695	14.4%
Cooperative Agreements	$13,666	$12,936	$5,231	$20,311	$52,144	51.2%
Communications and Outreach	$2,134	$2,557	$2,422	$2,951	$10,064	9.9%
Program Administration	$357	$3,948	$6,424	$14,264	$24,993	24.5%
Total	$17,986	$23,581	$16,543	$43,786	$101,896	

* Sources: USDA, 2008g.

[a] FY 2007 actual obligations are as of September 2007 (USDA, 2008g).

Table 8.3. Planned NAIS Obligations.

Dollars in Thousands

	Fiscal Year								
	2004	2005	2006	2007	2008 Approp.	Total Approp.	% of Total Appropriated Funds	2008 Carry Over[a]	2008 Total[b]
Planned Obligations[a]									
Information Technology	$2,009	$6,858	$7,733	$5,224	$1,311	$23,135	18.1%	$2,753	$4,064
Cooperative Agreements	$14,357	$17,050	$13,882	$15,067	$4,182	$64,538	50.5%	$8,787	$12,969
Communications and Outreach	$2,137	$3,474	$1,940	$1,940	$392	$9,883	7.7%	$825	$1,217
Program Administration	$290	$5,815	$9,452	$10,822	$3,797	$30,176	23.6%	$2,635	$6,432
Total	$18,793	$33,197	$33,007	$33,053	$9,682	$127,732		$15,000	$24,682

* Sources: USDA, 2008g

[a] *2008 Carry-Over Funds* are planned expenditures using $15 million in unobligated funds from prior fiscal years (USDA, 2008c).

[b] *2008 Total* planned obligations include both Appropriated Funds ($9.7 million) and carry over funds ($15 million) (USDA, 2008c).

8.2.2 Future USDA NAIS Budgets

Table 8.4 shows three alternative future NAIS budgets. The first budget (columns 2 & 3) presents USDA's current budget plan for fiscal year 2009 (USDA, 2008g). This budget forecasts total expenditures of $24.1 million will be available. Allocations across the four primary budget activity categories are similar to actual expenditures over the FY 2004 – FY 2007 period, with small reductions (increases) in relative funding of cooperative agreements (program management).

As shown in table 8.1, the NAIS program was provided approximately $33 million in FY 2005 – 2007. As a comparison to the current forecast provided by USDA, which assumes a $24.1 million budget, table 8.4 (columns 4 & 5) also presents a budget assuming $33 million are available with allocations made consistent with actual expenditures incurred during the FY 2004 – FY 2007 time period (table 8.2).

As a final budget forecast, table 8.4 (columns 6 & 7) also provides a budget reflective of USDA plans to have NAIS information infrastructure (IT) in a "maintenance phase" by FY 2010 (USDA, 2008g). This will reduce expected IT expenditures to approximately $2 million per year (USDA, 2008g). Given these IT savings, table 8.4 presents a potential future budget of $23.8 million. Allocations to the three other core programs (Cooperative Agreement, Communications and Outreach, and Program Administration) reflect the average expenditures incurred during FY 2004 – 2007 (table 8.2).

It would be advantageous to forecast future federal NAIS budgets for alternative levels of NAIS adoption and goals. For instance, it would be useful to develop and compare NAIS budgets conditional on achieving 30%, 70%, or 90% registration of the nation's premises. However, sufficient budgetary information necessary to accurately generate these differential forecasts is simply not available at this time. Accordingly, we note that this is a subject that should be addressed in future research as a valuable area of focus given ongoing modification of NAIS goals and areas of focus.

Table 8.4. USDA NAIS Future Fiscal Year Planned and Forecasted Expenditures.

Dollars in Thousands

Planned Program Expenditures	FY 2009[a]	% of Total	$33 million budget [b]	% of Total	$23.8 million budget [c]	% of Total
Information Technology	$3,500	14.5%	$4,759	14.4%	$2,000	8.4%
Cooperative Agreements	$10,575	43.8%	$16,887	51.2%	$13,036	54.8%
Communications and Outreach	$800	3.3%	$3,259	9.9%	$2,516	10.6%
Program Administration	$9,269	38.4%	$8,094	24.5%	$6,248	26.3%
Total	$24,144		$33,000		$23,800	

[a] FY 2009 planned expenditures were obtained from USDA (USDA, 2008g).

[b] Forecasted budget of $33 million reflects USDA's forecasts as of December 2007 (USDA, 2007e).

[c] Forecasted budget of $23.8 million reflects potential reduction in *Information Technology* expenditures (USDA, 2008g and author calculations).

8.2.3 Governmental Costs of Disease Response and Surveillance

Careful examination of the costs incurred by governmental agencies in responding to animal disease events is critical in assessing the potential cost savings that NAIS may provide. That is, resources available through implementation of NAIS may be useful in governmental response or surveillance of animal diseases. Since associated response and surveillance are not a component of NAIS budgets (and hence do not fit into the preceding discussions), a separate analysis is warranted.

This animal disease response and surveillance costs section of our analysis is comprised of three main components. The first briefly highlights the magnitudes of select past animal disease events to provide some scope to the governmental costs at discussion. Subsequently, we overview the potential cost savings that may be experienced by leveraging NAIS resources with a new software application developed by APHIS for on-farm disease testing and reporting. Finally, we summarize how differences in governmental costs incurred following a range of hypothetical, simulated animal disease events characterized by varied levels of traceability capabilities should be evaluated in future research and why this was not conducted in our analysis.

8.2.3.1 Scope of Costs

It has been well documented that federal government expenditures can be substantial when responding to domestic animal disease events. While multiple events are provided by the literature, a select sample is highlighted in table 8.5. Table 8.5 documents the diversity in magnitude, duration, geographical location, and disease type that likely require governmental animal health agency responses.

Bovine tuberculosis (TB) is one endemic disease that has had ongoing concerns in the United States. Since 2002, detections of bovine TB in six different states (Arizona, California, Michigan, Minnesota, New Mexico, and Texas) have required the destruction of over 25,000 cattle and corresponding USDA owner indemnification and control expenses of over \$130 million (USDA, 2007i). Moreover, since 2004 USDA has tested over 787,000 animals for bovine TB (USDA, 2007i). As evidence of state governmental cost magnitudes; in addition to federal expenditures, the state of Minnesota has spent approximately $1.4 million on TB control and eradication efforts since 2006 (Radintz, 2008).

In addition to bovine TB, USDA-APHIS conducts an ongoing bovine brucellosis eradication program. While the national herd prevalence rate is rather low (0.0001% in fiscal year 2007), APHIS routinely tests a significant number of animals. For instance, in 2007, APHIS tested 835,200 head on farms or ranches, in addition to an estimated 7.995 million head tested as part of the Market Cattle Identification (MCI) program (USDA, 2007j). While some select aggregated cost estimates are available (i.e., $138.9 million in Federal eradication efforts corresponding to the noted Exotic Newcastle event in table 8.5), information at a more allocated (e.g., salary, travel, and indemnification allocations) level of detail is difficult, if not impossible to find. Moreover, multiple USDA-APHIS reports (USDA 2004, 2006c, 2007e, 2008k) have documented the mixed success in the ability to quickly (if at all) identify critical animals and herds in responding to disease events. For instance, despite a 48-day investigation, APHIS was not able to identify the herd of origin in the 2006 BSE response in Alabama (USDA 2006b, 2008g). This is particularly important for our assessment of NAIS costs and benefits as one significant *potential* benefit that NAIS may provide is: a) an increase in the likelihood of identifying critical animals/herds and b) a reduction in governmental costs in responding to animal diseases. To thoroughly appraise these potential cost savings, solid estimates are needed of incurred governmental expenditures over a range of disease types and scopes that are further characterized by inherent differences in the traceability capabilities available in each response. Unfortunately, this detailed historical information simply was not available for this analysis.

Detailed government animal health emergency response cost information is generally not available for two primary reasons. First, traditionally the core priority of governmental responses to animal diseases is containment and eradication, not detailed record-keeping of associated resources used to arrest the disease. While this makes sense, there is certainly value as well in more thorough record-keeping of expenditures and corresponding results during a disease investigation. Second, there is not sufficient historical frequency, nor diversity of events, to facilitate a "detailed, real-world evaluation" of how even aggregate-level governmental expenditures vary when different levels of traceability capabilities are present and utilized.

8.2.3.2 Mobile Information Management (MIM) Cost Savings

A benefit offered by NAIS is a reduction in governmental expenditures associated with animal disease eradication as well as surveillance and testing. We evaluated the potential governmental costs savings at the individual herd level in on-going animal health surveillance programs. Namely, we examined the relative cost differences of conducting animal surveillance activities using technology making use of NAIS resources with surveillance activities not utilizing technology that leverages NAIS resources. One such technology is the Mobile Information Management (MIM) system supported by APHIS. MIM was originally developed by the Michigan Department of Agriculture (under the name of RegTest) to assist with the state's bovine TB surveillance and eradication efforts (Munger, 2008a). While additional details and visual depictions on the MIM system and its operations are available in Munger (2008a) and Baca (2007), we succinctly note here that MIM is a PDA (personal digital assistant) based application that utilizes RFID (radio frequency identification) or barcode technologies to increase the efficiency and accuracy of bovine TB testing.

Table 8.5. History of Select Government Animal Disease Responses.

Species	*Event*	*Initiation Year*	*Notes**	*Source*
Cattle	BSE – Alabama	2006	Investigation of 37 farms took 48 days.	USDA, 2008g
Cattle	BSE – Texas	2005	Investigation of 1,919 animals (8 herds) lasted 61 days.	USDA, 2008g
Cattle	BSE - Washington	2003	255 animals from 10 premises were destroyed; investigation of over 75,000 animals (189 herds) took 46 days	USDA, 2008g
Cattle	TB – California	2008	Tested over 150,000 animals (105 herds)	Bennett et al. (2008)
Cattle	TB - New Mexico	2007	Tested 20,150 animals (16 herds); 14 State & Federal personnel; $35 million in Federal funds allocated for indemnification	USDA, 2008g
Cattle	TB – Minnesota	2005	Over 3,500 animals have been depopulated; USDA has incurred over $5 million costs ($3.9 million in indemnities)	USDA, 2008g
Cattle	TB – California	2002	875,616 animals (687 herds) tested; 13,000 animals depopulated	USDA, 2008g
Poultry	Exotic New Castle - California, Nevada, Arizona, Texas, New Mexico	2002	2,700 infected premises; nearly 4.5 million birds were euthanized; peak eradication response consisted of 1,600 personnel; total investigation period of 350 days; Federal eradication effort expenses of $138.9 million	CNA Corporation (2004) USDA, 2008g

* Amounts noted are projections/estimates directly obtained from the sources indicated.

Use of the MIM system requires a PDA, RFID wand for animal scanning, and Bluetooth capabilities (Munger, 2008b). Combined, this system allows for disease surveillance to be conducted in an electronic manner. Munger indicates that MIM results in fewer testing errors as the software replaces the need for manually reading and recording data. Moreover, Munger advocates that, while economies of scale may exist in the direct cost saving justification for using MIM, data quality resulting from use of MIM is enhanced regardless of the evaluated herd size. Since the MIM system is currently in use for bovine TB testing in several states including Michigan, Minnesota, and New Mexico, we attempted to obtain additional feedback on the benefits MIM provides from practitioners in these states. Feedback was obtained from three different sources: 1) a weekly status report from Ray Scheierl (State of Minnesota), 2) a direct cost analysis of MIM from Diana Darnell (USDA-APHIS), and 3) email correspondence between Diana Darnell (USDA-APHIS) and three MIM users in Michigan.

On July 24, 2008, Ray Scheierl (State of Minnesota) submitted a report to APHIS following the state of Minnesota's first week of using the MIM system in its TB surveillance efforts. The report estimates the start-up cost of each MIM system to be $3,500 ($850 for a RFID wand reader, $2,500 for a PDA, and $0 for the MIM software provided by APHIS). According to Scheierl's calculations, use of MIM pays for itself in the form of TB test cost savings after use on 1,800 animals. The cost savings underlying MIM's use originate from observed reductions in both veterinarian time (valued at $70/hour) and data entry personnel time (valued at $30/hour) required in test reporting as data entry and results reporting are automated by MIM (Scheierl, 2008). Scheierl also notes that in addition to cost savings of labor reductions, MIM provides indirect value in a reduction in data errors (electronic vs. manual entry) and duration of production interruption imposed on producers of herds being tested.

More specifically, Scheierl estimates that the time of testing on day 2 of a herd's evaluation is reduced by 10-20% relative to TB testing without the MIM system.[12] While these "indirect benefits" of data quality and on-farm production interruption are difficult to empirically estimate, they certainly are noteworthy. As additional evidence that the MIM system provides net benefits to those with MIM experience, Scheierl noted that the state of Minnesota is equipping 10 state veterinarians with the PDA/RFID wand/MIM software systems to conduct the 40,000 TB tests anticipated to be necessary by December 2008.

In addition to the analysis by Ray Scheierl, we obtained an analysis from Diana Darnell (USDA-APHIS). Darnell's analysis was based upon a herd of 3,692 animals that was tested in Michigan in July of 2008 (Darnell, 2008). The National TB MIMS software was used in conducting the TB tests. Comparable manual time of testing calculations was obtained by a survey Darnell conducted of animal health technicians and field veterinarians. Using the assumptions proposed by Darnell (2008), table 8.6 suggests using the MIMS software in a TB test of approximately 3,700 animals results in cost savings of approximately $9,000 (or approximately $2.44/head).[13]

Finally, we supplement the information provided by Scheierl and Darnell by correspondence Darnell has had with Michigan TB test practitioners. Commentary by both Dr. Tom Flynn (USDA-APHIS) and Dr. Dan Robb (Michigan Department of Agriculture) suggests that there is economies of size to the TB cost savings provided by MIM. In particular, Flynn indicates no time savings in creation of TB test charts in herds with less than 20 head while use of MIM on a 100-head herd may reduce test chart creation time from 1 hour (manual) to 15 minutes (MIM). Robb suggests that test charts for 50- and 100-head herds may be conducted 1 and 2.5 hours quicker, respectively, by using MIM. This suggests that not only is there economies of size to MIM's cost savings, but that these cost savings occur at an increasing rate. This corresponds with Robb's proposition

[12] It is worth briefly noting that TB tests typically involve injecting each individual animal initially (day 1) and returning to the herd in question three days later to evaluate and diagnose each individual animal. As such, electronic entry of information on day one may provide benefits in the return visit three days later.

[13] The actual amounts deviate slightly from Darnell's original calculations due to rounding differences.

that test chart creation with MIM takes about 15 minutes regardless of herd size, while manual test chart creation is directly a function of herd size. In addition to the suggested test chart creation time savings, both Flynn and Robb confirmed Scheierl and Munger's points regarding additional benefits provided by MIM in the form of notable data entry error reduction. For instance, Flynn noted that MIM prevents occurrences of a specific experience he had where in evaluating the test chart of a 1,000 head herd, he spent over 1 week correcting mistakes from manual data entry. Regarding accuracy, Robb suggests that using eID tags has increased accuracy of testing from an error rate of 5-10% in reading metal tags to an error rate of about 1% in using eID tags. Moreover, Robb noted that the level of specificity required in federal paperwork accompanying the depopulation is better met and with more confidence when using the MIM system.

Also note that MIM may further reduce cost of testing in situations where the same herd is repeatedly tested as the information from prior tests is available and the herd is already partially (net of reasonable tag loss and herd turnover rates) tagged with RFID ear tags. An example situation is the annual whole herd testing of all animals 12 months of age or older conducted of Michigan producers operating in the MA (Modified Accredited) Zone (MDA, 2006). Discussions with Munger and Scheierl suggest that MIM may provide additional cost savings in these scenarios. That is, the above discussion primarily stems from cost savings gained on the second day of TB testing. In cases of repeated testing of a same herd, additional cost savings on both test days may be experienced. Moreover, Scheierl notes that having a test chart electronically created based upon prior testing of a given herd not only reduced the time of testing a herd, it also enhances the testing procedure quality as specific animals now have to be accounted for.

Our analysis was unable to identify any comprehensive efforts to assess the benefits that MIM may provide at a more aggregated level. The above information obtained from Scheierl, Darnell, Flynn, and Robb is certainly a useful first-step that supports the use of MIM. However, in the future we encourage a more through attempt by animal health officials to conduct analysis similar to that of Darnell's study of one 3,692 head dairy that would better enable a rigorous examination of cost savings experienced for herds of different sizes. This seems particularly relevant as APHIS is considering development of equivalent MIM software packages for other surveillance activities including Pseudorabies, Avian Influenza, and Johne's disease (Baca, 2007).

Nonetheless, for purposes of developing an estimate based upon the current state of knowledge noted above, we believe that use of an automated system like MIM may save the government approximately $1.50 for each TB tested animal. Coupling this estimate with the fact that in recent years approximately 200,000 animals have been TB tested annually (USDA, 2007i), produces a total, annual cost savings estimate of $300,000. Given that MIM appears to work most efficiently with NAIS resources already in place, this can be used as an approximation of the reduction in annual TB testing expenditures afforded by NAIS.

This procedure likely underestimates the cost savings provided by NAIS. For instance, APHIS is considering expansion of MIM to other surveillance programs. As MIM is expanded, the cost savings noted above will be enhanced. Moreover, while not a "direct governmental costs," NAIS and associated use of programs like MIM may provide "indirect benefits" in the form of more content and compliant producers as testing procedures are shorter in duration and likely more tolerable to producers.

8.2.3.3 Simulated Animal Disease Events

In addition to the cost savings of surveillance efforts, NAIS may provide a reduction in governmental expenditures associated with animal disease control and eradication. When this project was initiated, we anticipated using an epidemiological disease spread model to provide associated insights on the cost savings of alternative traceability capabilities. Unfortunately, models available to use were parameterized only for small geographical regions and a limited number of diseases. Accordingly, we were not able to obtain national estimates of government costs associated with mitigating a contagious disease outbreak with or without the impact of animal ID and tracing on such government costs. As such, we strongly encourage future research to use epidemiological disease spread models once data for animal populations and densities are adequately specified for broader, more national consideration of potential animal disease events.

While these limitations unfortunately prohibit current empirical estimation of the benefits NAIS provides in reducing government costs following different animal disease events, a couple points are worthwhile. Namely, by definition, any system that provides additional information on the location of farms (e.g., premises registration) and the movement of animals (e.g., animal tracking) will enhance governmental disease response. That is, NAIS provides benefits in this manner and we leave it to future research, enabled by better data and model capabilities; to empirically estimate these benefits for potential animal disease events. As such, our analysis under-estimates the government benefits, in the form of cost savings, provided by NAIS.

Table 8.6. TB Test Costs Comparisons: MIM vs. Manual*

	MIMS TB Testing		*Manual TB Testing*	
	Costs	Notes	Costs	Notes
Animal ID & Data Collection				
On Injection Day	$1,429	(7.5 hours for 6 AHTs)	$4,572	(12 hours for 12 AHTs)
On Read Day	$1,048	(5.5 hours for 6 AHTs) -- 3 teams of 2 people (1 runs PDA, 1 scan and read tags)	$4,572	(12 hours for 12 AHTs) -- 6 teams of 2 people (1 writes down data, 1 manually reads tags)
Test Chart Creation				
	$16	(0.5 hour for 1 AHT to download herd inventory on injection day)	$2,096	(66 hours for 1 AHT)
	$32	(1 hour for 1 AHT to reload PDA with data prior to re-read day)	$100	(2 hours for 1 V for error checking/signing)
	$50	(1 hour for V to check errors, sign chart)		
	$48	(1.5 hours for AHT to merge PDA data, error check, print charts)		
Data Entry into FAIR	$3	(5 minutes for 1 AHT)	$288	(21 hours for 1 DE)
Total Costs:	$2,624		$11,627	
Cost Savings of MIM**:	$9,003			

Source: Darnell (2008)

* Assumptions: Veterinarian (V), Animal Health Technician (AHT), and Data Entry (DE) wages are $50/hr, $31.75/hr, and $13.75/hr, respectively.
Manual test chart writing takes 1.5 hours per 100 animals, error-checking and correction of 3,700 animal test chart takes 10 hours,
and Data Entry clerk manually enters animals at a rate of 180/hour.

** Values slightly differ due to rounding in Darnell (2008).

8.3 State Government Analysis

8.3.1 Michigan's Experience

Given the state of Michigan's status as the only US state with a mandatory individual animal identification program in operation, Michigan provides a good model to initially evaluate in developing estimates of state expenditures associated with NAIS adoption. Furthermore, between January 1, 2000 and June 1, 2006 over 18,000 herds and 1,191,063 animals (average tested herd size of approximately 66 head) were TB tested in Michigan (MDA, 2006). Accordingly, in October 2007 members of our research team visited with personnel at the Michigan Department of Agriculture (MDA) as well as producers and auction market managers throughout Michigan. The Animal Industry Division of MDA is responsible for the state's animal identification program. The research team held discussions with key MDA personnel including Kevin Kirk (MDA Director's Special Assistant) and Roberta Bailey (MDA accountant) to obtain detailed information regarding expenditures the state has incurred in administering its animal identification program. Bailey provided the research team with detailed summaries of the Michigan Department of Agriculture Animal Identification Program expenditures for fiscal years 2006 and 2007.

These expenditures are shown in table 8.7 and segmented into five categories. Consistent with their name, the *Payroll*, *Travel*, and *Materials, Brochures, and Supplies* categories encompass all salary and benefit; travel; and materials, brochures, and supplies expenditures, respectively. The *Equipment* category includes expenditures incurred in purchasing RFID reading equipment for locations of public animal transactions including auction markets and slaughterhouses. These expenses were incurred in implementing the state-wide program, as Michigan subsidized building the state's infrastructure to expedite the implementation process. The *Grants* category is directly associated with bills the state has received from Holstein Association USA, Inc. (HAUI). The state of Michigan currently uses HAUI to process all RFID transaction reads, to obtain RFID tags (Michigan provided 100% of the tags needed in the state's tuberculosis zone (north-east region) free-of-charge, but required producers outside of this zone to purchase their own tags), and