The National Ag Safety Database: Factors Influencing Adoption

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Abstract

The National Ag Safety Database (NASD) is a NIOSH-funded project intended to provide an extensive compendium of educational and information resources targeted primarily to support delivery of programs in county Cooperative Extension Service (CES) offices. The first edition of the PC-based CDROM, NASD'95, was released to the public at the 1995 National Institute for Farm Safety Summer Meeting in Saratoga, New York, following extensive testing of two prototype (beta) versions of the database.

To improve the likelihood of adoption of NASD by agricultural safety and health specialists, a series of evaluation studies were conducted using mail questionnaires, phone surveys, focus group interviews, direct scientific observation and face-to-face interviews. Data were analyzed to determine whether NASD materials are significant to the programming needs of agricultural safety and health specialists, whether specialists will adopt electronic database technology, and whether there is a difference in adoption rate as a result of familiarity with the technology.

Evaluation results indicated that materials on NASD were perceived to be significant to the programming needs of agricultural safety and health specialists, but are not yet sufficiently comprehensive to replace traditional means of obtaining safety programming materials. Agricultural safety specialists will adopt electronic database technology as long as they understand how to effectively utilize the system's available functions. A slight correlation between familiarity with technology and adoption rate was found.

Keywords. **Safety, Agriculture, Database, Acceptance.**

The agricultural work force in the United States totals approximately 3.1 million, 2.6% of the nation's total work force. Within this group, there are nearly 1,100 deaths and 130,000 disabling injuries annually, or 12.1% of all workplace deaths and 4.2% of all disabling injuries (National Safety Council, 1994). In America, the annual death rate in agriculture is 35 deaths per 100,000 workers, making agriculture more dangerous than any other economic sector. The number of deaths and injuries is even higher when one factors in accidents involving children

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and non-employed individuals who are killed or injured in agricultural settings. Farms as a location are rated the third most dangerous place following only industrial locations and streets or highways (National Safety Council, 1995).

The industry of agriculture as well as the United States government has realized the need for increasing safety awareness throughout agribusiness – field workers, packinghouse workers, line supervisors, middle management, and even chief executive officers. Since 1976, the United States Department of Agriculture (USDA) has provided $20,000 annual stipends to 47 Land Grant Universities across the nation to support agricultural safety education efforts. In the majority of states, this funding is used to support state Cooperative Extension Service (CES) agricultural safety specialist positions (White, 1994; Young, 1995). Their function is to disseminate agricultural safety and health information in their respective states through the implementation of comprehensive farm safety programs. Beginning in 1990, the National Institute for Occupational Safety and Health (NIOSH) funded research and extension program development in the area of agricultural accident, injury, and illness prevention; made recommendations concerning the use of agricultural equipment and chemicals; and held several agricultural safety and health conferences (Freund, 1991).

There are several fundamental problems impeding such a nationwide commitment to agricultural accident, injury, and illness prevention:

1. It is difficult (practically and financially) to inspect or educate such a geographically widespread industry group (farming operations are not concentrated in "centers" like other industries).
2. As a result of the wide variety of activities occurring on farms, there is a large amount of information to be disseminated to farm operators in order for them to be knowledgeable about how to keep their employees safe.
3. Since most farms either hire fewer than 11 workers or employ only family members, the federal government does not regulate this group, instead the CES is expected to provide pertinent information to small farm operators on a voluntary basis.

NIOSH recognized the need to use the CES system for accident, injury, and illness prevention and intervention programming. In 1990, NIOSH initiated a four-year funding program for Agricultural Health Promotion System projects through cooperative agreements with 18 Land Grant Universities including the University of Florida (Hard, 1993). Following the AHPS program, NIOSH continued its commitment to CES programming and funded six Agricultural Safety Promotion System (ASPS) projects through similar agreements in September 1994. To promote the efficient sharing of safety programming materials which are developed independently in each state and to better catalog interstate safety resources, NIOSH provided supplemental funding through the AHPS program at the University of Florida to produce a National Ag Safety Database (NASD) (Jones et al., 1995). The project's goal was to develop a national repository of agricultural safety, health, and injury prevention extension programming resources to be delivered on CDROM for use with personal computers.

Unfortunately, it is not sufficient simply to produce such a database especially if it is delivered using new technology with which the target audience is unfamiliar. According to Loucks and Hall (1977), as new technology is introduced to a population, each individual exposed to the technology will progress through the "Seven Stages of Concern About an Innovation". Adoption will not occur until all seven stages have been experienced. The seven stages are:

Awareness — The subject shows little concern about or involvement with the innovation.

Informational — The subject displays a general awareness of the innovation and desires to learn more about it.

Personal — The subject is uncertain about the demands of the innovation and their ability to meet those demands.

Management — The subject focuses their attention on the actual use of the innovation.

Consequence — The subject is concerned about the impact of the innovation on clients.

Collaborating — The subject focuses on using the innovation in cooperation with others.

Refocusing — The subject explores other innovations that may more effectively achieve the same goal.

The overall goal of this study was to determine whether acceptance of the technology could be predicted by studying potential users' progression through the seven stages and what improvements to the product needed to be made in order to facilitate adoption. Specific objectives included:

1. Determination of whether materials on NASD are significantly comprehensive and of high enough quality for the programming needs of agricultural safety specialists;
2. Determination of whether agricultural safety specialists will adopt electronic database technology as a replacement or supplement to current methods of gathering and disseminating safety programming information; and
3. Determination of whether there is a difference in adoption rate as a result of previous experience with such technology.

Methodology

The National Ag Safety Database was described and evaluation methods to determine its potential usefulness to agricultural safety specialists were suggested by Jones et al. (1995). During its development, five evaluation methods were used including direct scientific observation of behavior (Summerhill and Taylor, 1992a), telephone interviews (Summerhill and Taylor, 1992b), face-to-face interviews (Summerhill and Taylor, 1992a), focus group interviews (Israel, 1994), and mail questionnaires (Taylor and Summerhill, 1992a, b, c, d) to refine the database and its retrieval software.

In September 1993, the concept of a large electronic database of national agricultural safety and health programming materials was demonstrated to a cross-section of the agricultural safety community in two hands-on sessions during an agricultural safety and health conference, *"Harvesting" Health and Safety in the Southeast* (Derthick and McLymore, 1994). This conference provided a forum in which preliminary attitudes about the concept of such a database were compiled via direct scientific observation (Summerhill and Taylor, 1992a).

Between September 1993 and June 1995, many suggestions were made by potential authors and users of NASD as to what materials they wanted to find on such an electronic database. Recommendations were made during demonstrations, one-on-one interviews, and telephone interviews which were scheduled specifically to collect this type of information (Summerhill and Taylor, 1992b).

In August 1994, individual face-to-face interviews with a group of 30 agricultural safety and health specialists were used to introduce and observe reactions to a prototype NASD. After the one-on-one explicitly scripted demonstrations of the prototype NASD at the *Agricultural Safety and Health: Detection, Prevention and Intervention* (Bean, 1994) conference, the 30 participants were given the opportunity to interact with the demonstrators. All of the participants were given a questionnaire to enable them to relay their preliminary opinions, attitudes, and behaviors (Summerhill and Taylor, 1992c).

Participants in the face-to-face interviews were asked to return a questionnaire and a beta tester information sheet. The information sheet asked for type of computing platform, video capability, amount of Random Access Memory (RAM), CDROM drive make and model, printer make and model, and operating system version available to the potential beta testers. Beta testers who did not return an information sheet were queried via phone seven days after being mailed a NASD disc.

Between August 1994 and February 1995, a total of 133 beta testers were identified through NIOSH-sponsored conferences and referrals from other beta testers. The beta testers were asked to evaluate the ***NASD Beta 1*** disc. Upon receiving reports from beta testers of many retrieval software-related difficulties, the NASD development group released a second Beta disc, ***NASD Beta 2***. The final evaluations were based upon experiences with ***NASD Beta 2***.

An evaluation workshop was conducted in Gainesville, Florida, from 30 March through 1 April 1995. Participants were invited from among the 133 evaluators of the two NASD prototype CDROMs; 23 agricultural safety and health specialists attended the workshop. During the afternoon and evening of 30 March and prior to the beginning of the group meetings, "skills checks" were conducted with 21 of the workshop attendees in a series of one-on-one explicitly scripted interviews. Each of the attendees was expected to have considerable experience using the database before arriving for the workshop. To measure the base-level of competence, each participant was asked to demonstrate proficiency in nine common NASD functions. Some skills measured were absolutely essential to navigation around and utilization of NASD. Others were non-essential to actual navigation, however if mastered facilitated navigation. The "skills checks" were intended to quantify the attendees' mastery of the system's essential and non-essential functions.

On 31 March and 1 April 1995, the *NASD Evaluation Workshop* facilitated a series of topical focus group meetings. Topics covered were the content of materials currently stored on NASD, the applicability of the information system as a resource tool, the scope of potential problems in managing the database, and the potential for sustaining the system (Jones, Niemeier, and Pirozzoli, 1995). All of the attendees were familiar with NASD as a result of two months of beta testing and completion of the "skills checks" and tutoring. As a result, they were able to discuss and offer informed opinions about the database. The sessions were organized as focus group interviews. Eleven attendees were contacted in advance and asked to present their opinions on the various session topics. Following each group of opinion presentations, the topic was opened up for general discussion. Two individuals recorded the discussions which were transcribed immediately following the workshop (Jones et al., 1995).

A mail questionnaire was distributed to 133 NASD beta testers in February 1995 to provide an evaluation of NASD that could be statistically analyzed (Taylor and Summerhill, 1992a, b, c, d). The questionnaire contained eight alphabetical sections as follows:

A. Ease of Use/Interface
B. Content of Materials on NASD
C. Future Disc Content and Features
D. Computer Experience
E. Ranking of Importance of NASD Categories
F. Ranking of Importance of NASD Contents
G. Personal
H. Short Answer

Ninety-five percent confidence intervals were constructed for questions in sections A through D. All conclusions regarding questions in those sections are stated with 95% confidence. The responses to sections E and F were analyzed using the following scoring system. Three points were given for items ranked as most important, two points to the second most important item and one point to the third most important item. The non-ranked items received zero points. To draw conclusions, the averages across all of the participants were compared. Section G was meant to gather demographic data. Section H gave respondents the opportunity to voice their opinions about the database via open-ended questions (Taylor and Summerhill, 1992d). In order to compare responses among groups, a chi square test was recommended for equal sample sizes. If the sample sizes were significantly disproportionate, a box-and-whiskers plot was recommended for analysis (Harrison, personal communication, 1995; Ott, 1988).

Results and Discussion

Beta testers' hardware capabilities were determined via telephone surveys. Some of the more significant findings are given in table 1.

The survey revealed that many beta testers were unable to identify their computer hardware which indicated a lack of familiarity with computing technology. This is consistent with subjects experiencing the ***awareness*** and ***informational*** stages defined by Loucks and Hall (1977). A subject in the ***awareness*** stage shows little concern about or involvement with the innovation.

Table 1. Beta testers' computer hardware survey results

Computing Platforms
At least 59% had access to a 386, 486 or Pentium™ PC At least 7% worked in Apple™ environments and could not use the NASD disc
Random Access Memory
At least 48% had at least 4MB of RAM At least 34% had at least 8MB of RAM 10% had less than 4MB of RAM or worked in Apple™ environments 42% were either unable to identify their RAM capability or did not respond
Printers
At least 44% used Hewlett-Packard™-compatible printers 41% were not aware of what type of printer they used or did not respond
CDROM Drives
At least 86% had CDROM drives connected directly to their computers 14% did not have CDROM drives or did not respond

This reinforced earlier direct scientific observation of participants at the hands-on demonstrations at the *"Harvesting" Safety and Health in the Southeast* conference in September 1993. Observation clearly indicated that participants fell into two groups: those familiar with personal computers and the mouse as a pointing device, and those unfamiliar with personal computers and the mouse as a pointing device.

Participants familiar with personal computers and the mouse as a pointing device readily followed and understood the concepts suggested by the presenter. They were able to easily navigate through the safety materials on the database being demonstrated. There were many participants in group one who not only easily followed along, but successfully found information they were interested in that was unrelated to the speaker's discussions. These participants were very vocal and inquisitive about the database. In several specific instances, members of this group stayed after the presentation to explore the database further. Finally, several of these individuals left contact information in order to receive additional material regarding a possible future electronic database of agricultural safety programming tools. Participants in this group were experiencing the second and fourth of the seven stages, ***informational*** and ***management***. A subject in the ***informational*** stage displays a general awareness of the innovation and desires to learn more about it. The ***management*** stage is characterized by the focusing of attention on the actual use of the innovation.

Participants unfamiliar with personal computers and the mouse as a pointing device were observed to have difficulty following along with the presenter. They showed no apparent interest in navigating through the database beyond what the speaker prompted. Oftentimes the aides were required to assist them in "catching up" with the presenter so they would not miss the remainder of the demonstration. Their questions were centered around the "how-to" of navigating rather than the concept of a large electronic database. They did not try to obtain more information than the speaker presented. Generally, members of this group did not leave contact information with the presenter. Participants in this group were experiencing the ***awareness*** and ***personal*** stages, or first and third of the seven stages. In the ***personal*** stage, the subject is uncertain about the demands of the innovation and their ability to meet those demands.

Further evidence of differing phases of familiarity was found during telephone interviews (August 1994), demonstrations, contact with NIOSH Agricultural Health Promotion Systems grant recipients (November 1994 to March 1995), and the face to face interviews at the *Agricultural Safety and Health: Detection, Prevention and Intervention*, a NIOSH-sponsored conference. During these interactions, many suggestions were made by potential authors and users of NASD as to what materials they would prefer to find on such an electronic database. These individuals also fell into two groups: those who had seen demonstrations of NASD, and those who had not seen demonstrations of NASD.

Members of the first group were familiar with the concept of a large electronic database of agricultural safety and health programming materials. Generally, they had seen presentations in which the capability of displaying graphics as well as text was demonstrated. Members of this group had the ability to envision public service announcement scripts, sample newspaper articles, slide shows, coloring books, video and sound, and contact information for safety and health professionals appearing on the database. They also conceived the possibility of including other agricultural safety and health training software. Not all of their suggestions were feasible or practical, but their foresight seemed to result directly from their familiarity with new [illegible]. Potential authors in this group progressed to the ***management*** (fourth) and ***consequence*** (fifth) stages. In the ***consequence*** stage the subject is concerned about the impact of the innovation on customers or clients.

Members of the second group were unacquainted with the concept of a database capable of displaying images as well as text. Their suggestions were more narrow in scope than those in the group who had seen demonstrations. The majority of the members of the group that had not seen demonstrations saw traditional extension publications (primarily text-only documents) as the primary type of materials to be included in the database. Potential authors in this group were experiencing one of the first three of the seven stages: ***awareness***, ***informational*** or ***personal***.

The progression through the seven stages was further illustrated during the "skills checks" conducted at the *NASD Evaluation Workshop*. Table 2 summarizes the results of the "skills checks". The skills were broken down into three categories. The majority (11 or more) of the participants could successfully demonstrate how to find a document using the menus, and could successfully perform a search using the Boolean operators "and" and "or". Mastery of these essential skills demonstrated a degree of familiarity with the technology. Less than 11 of the participants could successfully demonstrate two ways to exit a slide show, the use of the "expand" buttons on the search results screen, three ways to close a window, printing a document from the search results screen, and locating and copying an electronic file from the CDROM drive to the hard drive of the computer. No one participant successfully demonstrated all nine skills. These skills are a combination of essential, non-essential, and variable skills. This indicated a lack of familiarity with certain aspects of the technology combined with a failure to provide effective documentation.

Table 2. Skills check results (n = 21)

Skill		No.
Locate a specific document using the menus (essential).		
	Yes	17
	No	4
Demonstrate two ways to exit a slide show (non-essential).		
	Yes	8
	No	13
Perform an "and" search (essential).		
	Yes	12
	No	9
Perform an "or" search (essential).		
	Yes	14
	No	7
Use the expand buttons on the search results screen (essential).		
	Yes	6
	No	15
Demonstrate three ways to close a window (non-essential).		
	Yes	7
	No	14
Print a document from the search results screen (essential).		
	Yes	8
	No	13
Determine where the electronic file is located on the CDROM (variable).		
	Yes	10
	No	11
Copy a file from the CDROM to the hard drive (variable).		
	Yes	10
	No	11

Immediately after each participant's "skills check" was completed, the results were explained after which questions were answered and the participant's suggestions and comments noted. The beta testers themselves believed the primary reason for their inability to perform these tasks was the lack of comprehensive documentation. Those who read the documentation which accompanied the *NASD Beta 2* disc stated that it was confusing and ineffective. Many of the respondents stated they did not know documentation existed, and if so how to access it. Two of the participants stated they had never used the NASD disc and therefore could not demonstrate proficiency in the required NASD functions. Lack of familiarity with the technology prevented many of the participants from completely progressing through the seven stages (Loucks and Hall, 1977). As a result, they were unable to adopt the technology at that time.

After the results were explained to the participants, they were tutored in their weak areas. Participants displayed serious interest in learning how to perform the functions they missed. It was clear to the participants that they would be able to access information more effectively if they learned how to correctly execute these tasks. This display of interest demonstrated a high likelihood of adoption once users understood how to use all of the functions of the system effectively. Once the participants fully understood the capabilities inherent in the electronic delivery of information, as opposed to traditional methods, they were able to progress through the sixth of the seven stages, ***collaborating***. At this time, participants were capable of using the innovation in cooperation with others.

In the focus group sessions at the *NASD Evaluation Workshop* following the "skills checks", participants had a series of discussions concerning broad topics: database content, NASD as an information system, target audiences, and sustainability of the database. The sessions benefited from the "skills checks" process that brought everyone up to a similar level of awareness and resulted in generally lively and well informed discussions. Some of the major points discussed included expanding the collection of Spanish (and other) language documents and sets of materials related to the Worker Protection Standard. NASD was recognized by the participants as an information system that exceeded any other source of information at a "local" level. A wide range of target audiences in three primary sectors were identified: agricultural; government; and services. The participants recognized the importance of targeting specific audiences by materials selection, menu structure, and vocabulary. Participants agreed that all materials on the database should be reviewed and that the database should be sustained with some government involvement (Jones et al., 1995).

Participants identified several areas of concern regarding delivering safety programs via large electronic databases:

1. Continued funding
2. Regulating database content
3. Software limitations
4. Hardware requirements and limitations
5. Acceptance by the target audience

The participants' discussions about continued funding, regulating database content, and acceptance by the target audience offered many plausible solutions including securing long-term government funding, privatizing the project, appointing an editorial review board, and customizing hierarchical menus to appeal to various target audiences. These suggestions demonstrate progression to ***collaboration***, the sixth of the seven stages. ***Collaboration*** refers to focusing on using the innovation in cooperation with others. Discussions centering around hardware and software limitations resulted in suggestions such as exploring commercial software, creating a home page on the World Wide Web and addressing their computing platforms such as the Apple Macintosh™. This indicates the advancement to ***refocusing***, the seventh stage. ***Refocusing*** involves exploration of other innovations that may more effectively achieve the same goal. The participants were then able to become adopters of NASD and electronic database technology (Loucks and Hall, 1977).

A formal evaluation of the database was completed using a mail questionnaire. Of the 133 beta testers, 81 (60%) successfully installed and ran NASD. Assuming no one returned a questionnaire who did not install and use NASD, 71 of the 81 who successfully installed NASD (87%) returned their questionnaires. The respondents' demographics are presented in table 3.

Statistical analysis of the questionnaire revealed that most safety specialists use their personal computers daily, have used other electronic databases, and have found other electronic databases to be useful. The interface, including the hierarchical menus and the search engine, are useful. The categories of personal protective equipment, accident causes and prevention, machinery safety, chemicals and pesticides were ranked the most important to safety programming activities. Respondents felt less likely that they would use the information regarding sanitation/hygiene, workers' compensation, ergonomics, and lightning. Respondents ranked extension publications, government fact sheets, the video database, and abstracts of standards as most important to their safety programming activities. They felt less likely that they would use alternate language documents, public service announcement scripts, and complete government standards. Respondents agreed that NASD should be distributed to all county CES offices in each state

Table 3. Respondents' demographics

Characteristic	No.
Average Age (yrs.)	43.9
Gender	
Male	58
Female	12
Red-Green Colorblindness (males)	
Yes	4
No	54
Industry Type	
Florida CES agents	10
Other CES staff	30
Private industry	9
Centers for ag safety and health	3
Other government agency staff	11
Other	8
Education Level	
Graduate degree	62
Two- or four-year degree	16
Computer Experience	
Self teaching	69
Received formal training	16
Never received training	2

without review by state CES specialists. The information on NASD is accurate and current, however some subject areas are not adequately covered. Though NASD has not reached critical mass, safety specialists will use NASD in their safety programming activities because there is no other comprehensive collection of safety programming materials accessible to them at this time. Evaluation of data plotted as a box-and-whiskers plot indicated a slight correlation between familiarity with technology and adoption rate (Pirozzoli, 1995).

Conclusions

In general, agricultural safety and health specialists have a favorable opinion of the NASD effort and want the system to continue to grow and expand. Evaluation of accumulated data revealed that the extent of the materials appearing on the database is adequate for safety specialists to adopt NASD as a supplementary method of accessing programming resources. At this point in time, NASD is not capable of totally replacing hard copy distribution and storage of safety information. However, materials appearing on the database are considered to be accurate, current, and complete. The safety specialists polled would not hesitate to use the database for fear the information is of poor quality. Further, it was found that agricultural safety specialists want access to information which will directly assist them in safety programming in areas such as conditions which have a high fatality or injury rate or those spotlighted in current legislation.

Agricultural safety specialists foresee a product such as NASD as capable of becoming a local, regional, and national information system. However, because of the sensitivity of safety and health practices and legislation, it is important to safety specialists that all documents considered for inclusion on NASD be reviewed at some level. Further, specialists prefer the "seal of approval" of a federal agency. Finally, agricultural safety specialists who had past experiences with similar electronic databases were more likely to strongly believe electronic database technology is useful to them in their safety programming activities. Those who were not familiar with similar electronic databases also agreed with this statement, but to a lesser degree.

Agricultural safety specialists will progress through the Seven Stages of Concern About an Innovation and be able to adopt electronic database technology if the following conditions are met:

1. Users must be familiar with personal computing systems and pointing devices.
2. Users must be familiar with the concept of electronic database technology.
3. Users must have access to the hardware required to utilize large electronic databases.
4. Useful documentation must be supplied to the users.
5. Industry specific jargon must be addressed in the phraseology of the hierarchical menu structure.

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