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An evaluation of the safety content in the National Association of Industrial Technology certification exam

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An evaluation of the safety content in the National Association of Industrial Technology certification exam

by

Chandra Wynette Hill

A thesis submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of
MASTER OF SCIENCE

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Program of Study Committee:
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2006

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This is to certify that the master’s thesis of

Chandra Wynette Hill

has met the thesis requirements of Iowa State University

Signatures have been redacted for privacy
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ABSTRACT

This study addresses the safety portion of the National Association of Industrial Technology (NAIT) Certification exam. NAIT promotes the field of industrial technology in education, business, and industry. Certification is the recognition of voluntarily achieved standards by the profession that created the proposed standards. Certification programs are used to define a required body of knowledge and skills, and establish common performance standards. The NAIT certification exam began its initial development in the early to mid-1990s. As technology continues to change new safety hazards are introduced. Since its development the safety portion of the certification exam has not been reevaluated critically. A Delphi study was used to determine if safety content topics had changed over time. Each survey is distributed to the panel for feedback. The feedback is then collected and analyzed. The data collected from the survey is then used to develop the second survey and the process repeats itself until consensus of opinion is obtained by the panel. This study concluded that while terminology may have changed slightly, the safety topics covered on the NAIT certification exam are still relevant and current.
CHAPTER 1. INTRODUCTION

This study will address the safety portion of National Association of Industrial Technology (NAIT) certification exam. NAIT was established in 1967 and became the first formal association to represent the profession of industrial technology (Strong, Kassapoglou, Dugger, & Rudisill, 1999). NAIT is dedicated to the establishment and maintenance of professional standards for industrial technologists, and the certification program was established to acknowledge an individual’s knowledge, skills, and professional development in the field of industrial technology (Field & Rowe, 2001).

What is Certification?

Certification is the recognition of voluntarily achieved standards by the profession that created the proposed standards (Schoon & Smith, 2000). Certification programs are used to define a required body of knowledge and skills, and establish common performance standards (Hale, 2000). The performance standards and guidelines for certification are developed by certification associations such as the National Certification Commission (NCA), the National Organization for Competency Assurance (NOCA), and the National Commission for Certification Agencies (NCCA) (Field & Rowe, 2001).

Certification programs are developed to assure compliance with standards to protect the public, increase the credibility of a profession, and assist employers (Barnhardt, 1997; Hale, 2000; Hamm, 1996). Certification programs add value to employees and their professions, provide the public with more confidence in the individual’s quality of work, and provide employers with a better understanding of the individual’s skills and abilities (Barnhardt, 1997; Field & Rowe, 2001; Peluso, 2000).
Certification by examination has become a tool used in most programs before the actual certification is awarded. The examination is often objective-based, multiple-choice, and developed by a professional testing company or university (Barnhardt, 1997). Standards for the test development of certification examinations are made available to associations by organizations such as the American Psychological Association (APA), the American Educational Research Association (AERA), and the National Council on Measurement in Education (NCME) (Field & Rowe, 2001).

**NAIT Certification**

The NAIT certification exam began its initial development in the early to mid-1990s. The first step in the development of the NAIT certification exam was the use of the Delphi method to determine the appropriate content for the exam. The Delphi method was used to collect data from the various academic institutions across the United States that had industrial technology programs, without bringing them to one central location.

In the early development stages of the NAIT certification exam, the Delphi method identified eight content areas as important topics to be addressed. These eight content areas were reduced to six, and then to the four content areas that are represented currently on the certification exam: (1) Production Planning and Control, (2) Quality Control, (3) Safety, and (4) Supervision/Administration.

NAIT is the only organization responsible for the advancement of Industrial Technology in business, academia, and industry. NAIT established the exam to provide certification to professionals and to add value to baccalaureate-level programs wanting to assess the technical management portion of their programs (Field & Rowe, 2001).
Problem of the Study

Since the NAIT certification exam’s initial development, the safety portion has not been evaluated. Advancements in technological and industrial processes have changed the way business and industry operates (Goetsch, 2005). Thus the safety portion of the certification exam should be evaluated.

Purpose of the Study

The purpose of this study is twofold:

1. To determine if the safety portion of the NAIT certification exam is addressing the appropriate safety topics.
2. To make recommendations based on the findings of this study to the NAIT Board of Certification.

Need for the Study

The current version of the NAIT certification exam has undergone policy changes since its initial development. NAIT is now developing the second generation certification exam by implementing the following changes to the initial certification exam (Monforton, 2005c):

1. changing the certification requirements,
2. changing the criteria for passing the NAIT certification exam,
3. replacing questions on the certification exam, and
4. setting goals for the second generation exam.

Studies have been conducted on the NAIT certification exam to identify a need to change or develop the current version. McCue (2003) designed a study to determine if there was a need to change the Quality Control subsection of the NAIT certification exam and
made recommendations. His research provided a starting point for certification evaluation and a general direction for modifying the development of the exam. Rowe (2001) developed a test blueprint to identify core content, subject areas, and competencies needed to update the exam. She identified eight core content areas and concluded there was a greater need to expand the evaluation component regarding written and verbal skills in technical communication. She also stated that industrial technologists are at the forefront of a growing informational society characterized by rapid advances in technology, and that institutions of higher education should continually align their curricula with the needs of business and industry.

The NAIT Board of Certification recognizes the need to develop a second generation exam and currently is seeking volunteers to develop exam blueprints and new exam questions for the content areas of the certification exam (Monforton, 2006). The chair of the NAIT Certification Board, Dr. Field, presented the impetus to conduct this study to determine if any changes in the safety discipline have occurred over time, and the need for those potential changes to be reflected on the safety portion of the NAIT certification exam.

**Assumptions of the Study**

The study was based on the following assumptions:

1. The safety portion of the NAIT certification exam is important to professionals in the field of industrial technology.
2. Current and relevant safety topics for the NAIT certification exam can be identified by the professionals in the Safety Division of NAIT.
3. The participants in this study are experts and have an extensive knowledge base of the safety concerns in education and industry.
Delimitations of the Study

The delimitation of the study is that the opinions represented in this study are those of the NAIT Safety Division, not all professionals in safety and/or technology.

Limitations of the Study

The limitations of the study are:

1. The opinions of experts who are considered experts in their field are based on years of experience, professional achievement, and professional interest as members of the NAIT Safety Division.

2. The findings in the study are applicable only to the NAIT certification exam.

Procedure of the Study

This study used the Delphi method, which allows the collection of data based on group consensus without face-to-face interaction (Fischer, 1978; Linstone & Turoff, 1975). In the first round, participants were asked to respond to open-ended questions about the safety topics important to all technology students. Participants also were asked to list the safety courses required of all the technology students in their programs. In the second round of the study, participants were asked to rank the data from the first round in numerical order based on importance and add any safety topics they believe should be included but were not represented. The third round of the study would have an explanation of items added or deleted in round two. Additional rounds would have repeated this process until participants came to consensus on the safety topics that should be included on the NAIT certification exam.

The participants in this study are all current member of the Safety Division of NAIT and are professionals currently working in academia and industry. Their responses were
analyzed and placed into a Microsoft Excel file, to obtain the means of each category’s response. Based on the mean of the responses, each safety topic was placed in numerical order. The numerical rankings of each safety topic indicated the perceived importance of the safety topic to all technology students, by the participants.

**Definitions of Terms**

*Certification:* recognition by the private sector of voluntarily achieved standards, bestowed by private sector, nonprofit, professional association, or an independent board of members who have achieved specified standards (Schoon & Smith, 2000).

*Delphi Method:* is a method of gathering and refining the opinions of experts to obtain consensus about some aspect of the future (Fischer, 1978).

*The National Association of Industrial Technology (NAIT):* the first professional association responsible for promoting industrial technology in business, industry, education, and government; the accreditation of industrial technology programs in colleges, universities, and technical institutes; and certification of industrial technologists and recognition of their continued professional development (NAIT, 2006d).

*Industrial technology:* field of study designed to prepare technical and/or management-oriented professionals for employment in business, industry, education, and government (NAIT, 2006d).

*Round:* refers to a survey or questionnaire used in the study to obtain information from participants.
CHAPTER 2. LITERATURE REVIEW

Certification

Changes in traditional hiring practices, an increase in specialized workplaces, and the rise of new job positions has challenged companies to change the way they recruit and assess training. These changes have led to employment seekers steering away from traditional educational resources to advance their job skills. Corporations and individuals have begun to look to professional organizations to help them in this transition. Certification and/or certification programs have become one tool that companies and individuals have used to adapt to the constant changes in the workforce (Barnhardt, 1997; Hamm, 1996).

Certification is defined by the National Organization for Competence Assurance (NOCA) as a process by which a nongovernmental agency or association grants recognition of competence to an individual who has met predetermined qualifications specified by that agency or association (Hamm, 1996). In short, certification is a credential awarded by an employer, vendor, association, or independent agency (Hale, 2000).

Certification vs. Other Associated Terms

One cannot address certification without also addressing the following terms: credential, accreditation, license, and licensure. These terms should not be used interchangeably, and often confuse the public as well as employers (Hamm, 1996). Hale (2000) defines a credential as a designation, mark, or stamp given to a person, organization, or program that has satisfied a set of standards. Accreditations regulate academic programs and specialized education, and training by universities, colleges, trade schools, and vendors (Hale, 2000). A license is the individual’s right backed by laws of the state it is granted in.
Licensure is the granting of license to practice a profession by a governmental body (Schoon & Smith, 2000).

Educational degrees, certifications, accreditations, or licenses are examples of credentials (Hale, 2000). Educational degrees are awarded by academic institutions and a license is awarded by state government. Certifications are awarded by an employer, association or independent agency, and an accreditation is awarded by a nongovernmental association (Hale, 2000). Certifications promote the business interests of professions that indirectly benefit the public (Schoon & Smith, 2000). Accreditations are measurements of a program’s or organization’s performance, while certifications refer to an evaluation of an individual’s competence (Hamm, 1996).

**Importance of Certification**

There are over 1,500 certification programs in existence in the United States, representing approximately 20 professions and/or industries (Barnhardt, 1997). When the need for a defined standard or practice is noticed in a discipline, certification programs are developed by national associations and/or businesses and industries (Hamm, 1996). These programs serve as a basis to (Field & Rowe, 2001; Hamm, 1996):

1. let the public evaluate a service provider,
2. allow employees the opportunity to advance their knowledge in a profession and set themselves apart from others,
3. give employers the ability to judge the skills of potential or existing employees,
4. allow colleges and universities the opportunity to assess their programs and curricula,
5. assure compliance with standards to protect the public interest; and
6. increase the credibility of the discipline.

Barnhardt (1997) says certification programs are important to the organizations, businesses, and individuals involved because university degrees no longer represent an individual’s job-related knowledge and capability. He goes on to say changes in business practices have forced professionals to take ownership of their careers and the business environment requires constant professional involvement, development, and job training beyond one’s job title.

Schrage (2000) states that university degrees are not the ultimate measure of professional knowledge and capability. He argues that university and/or college degrees do not give insight to a person’s ability to perform a task by stating that two identical degrees from different educational institutions do not give one person advantage over the other. He goes on to say that university degrees become outdated in job markets where knowledge is being updated constantly and college degrees and job training now are considered more basic entry-level prerequisites. Certification programs help fill this void because they measure job-related experience and portray an individual’s ability to perform tasks (Barnhardt, 1997).

With professionals facing the effects of corporate downsizing, coupled with teaming, outsourcing, and the use of temporary workers, there is a need for them to control their careers independent of the employers (Barnhardt, 1997). Certification allows professionals the opportunity to distinguish themselves from their competition, and to show an advanced level of skill, experience, and understanding in an increasingly competitive workplace (Phillips, 2004). The growth of certification programs can be accredited to a reaction in the changing job market. Certification allows its participants the opportunity to define their
profession, establish recognized benchmarks of performance and knowledge for the profession and industry, and create a standard of quality for others in the profession (Barnhardt, 1997; Hamm & Early, 1994).

Trade associations and professional organizations develop certification programs to recognize competency in a profession (Hamm & Early, 1994). These programs try to create standards for their profession and determine if the education, experience, and professional knowledge to meet these standards exist within the individuals in that profession. By creating standards for a profession, they define themselves independent of company job descriptions and academic degrees. Certifications are versatile, not subject to one job position or set of job requirements, and can travel to any corporation within a profession (Barnhardt, 1997).

Certification has become a risk management tool for companies (Schrage, 2000). Many certification programs take the guesswork away from companies looking to hire an individual. Companies and organizations request certifications because they want to validate that the workforce is qualified for the job or position (Mulkey & Naughton, 2005). Certifications help transform years of experience and continued education into a credential accepted by industry and sometimes is accepted in lieu of an academic degree (Frost, 1998).

Most certifications require individuals to maintain an ongoing commitment to their profession through continuing education, involvement in professional organizations, and attending conferences and other formal professional meetings (Barnhardt, 1997; Mulkey & Naughton, 2005). Their involvement in the profession keeps them prepared for changes in their environment (Barnhardt, 1997). Individuals become certified because it adds to
credibility as a professional, provide a greater opportunity for employment and promotion, and may be required for a job (Mulkey & Naughton, 2005).

Although certification does not guarantee an individual can perform the job, it is a good indicator of the quality of the person and his or her capabilities. Certification demonstrates job knowledge, experience, background, and commitment to the profession. Professional certification shapes the way professions educate, promote, and develop themselves. The certification of professionals' sets new standards in expertise and the organizational contributions it makes to their profession (Barnhardt, 1997).

**Elements of a Certification Program**

A well-developed certification program is one of the most important services that an association can provide to the public because it establishes an organization as an important standard-setting body that has defined competence in a particular field, and provides an opportunity to members for recognition and professional development (Hamm & Early, 1994). Being better informed about certification programs can help employers and the public identify programs that will benefit the company and the public, respectively (Hamm, 1996). Hundreds of certification programs are available in different professions, and finding a quality program can be difficult. Barnhardt (1997) lists the nine basic components of certification programs used to identify the type of certification:

1. **Title/designations.** The official title or designation is the certification’s name and in many programs is marked by a symbol. For example, the symbol for a Certified Safety Professional is CSP, the symbol for a Professional Engineer is PE, and the symbol for a Certified Engineering Manager is CME.
2. **Sponsors.** The sponsors of certification programs, which can be associations, independent boards, or a group of organizations, are responsible for setting the criteria for certification, assessing candidates, and awarding certification.

3. **Ethics and conduct.** Certification programs should recognize, define, and promote professional ethics and conduct. Some certifications require adherence to a set of professional ethics standards and can be revoked if these standards are violated (Barnhardt, 1997). The acceptance of a code of conduct is normally handled by corporate policy and local laws (Hale, 2000).

4. **Eligibility for certification.** Candidates often will have to meet certain eligibility requirements before acceptance to a certification program. These requirements include but are not limited to the candidates’ level of education, years of experience, and/or association memberships. A point system is used by some certification programs to assess, education, experience, and professional involvement (Barnhardt, 1997). Earning a degree or completing a development program is an accepted requirement for certification (Hale, 2000).

5. **Professional education courses.** Professional education, through workshops, seminars, conventions, and personal study, is important in maintaining competence and staying current in a profession. Professional education courses, given by sponsoring organizations, often are provided because they cover core information necessary for competence within a field (Barnhardt, 1997).

6. **Special requirements.** Other certification programs may have special requirements, such as research papers, portfolios, and performance exercises (Barnhardt, 1997). Professional experience often is needed to qualify for
certifications. Professional experience can be determined by job position, through employer verification, work samples, work or personal records, and endorsements. These methods are used to corroborate experience as a professional, prove active status in a field, and assess skills (Barnhardt, 1997; Hale, 2000).

7. Examinations. The last step to be completed in most programs before certification is the examination portion of the program. Examinations typically are objective-based or fact-based and multiple-choice (Barnhardt, 1997). These are designed to help judge an individual's knowledge, skills, and/or abilities (Hale, 2000). Occasionally short answer and essay format is used. Many exams are developed by professional testing companies or universities and are proctored (Barnhardt, 1997). Hamm (1996) states good certification exams always should come from an objective analysis. He goes on to say that the quality of the examination instrument is one of the most important aspects of the evaluation of a certification.

8. Fees. The cost of certification varies. It includes, but is not limited to, examinations fees, professional education, testing fees, and study materials (Barnhardt, 1997).

9. Recertification. Another aspect of certification programs is the ability for a currently certified individual to stay current within a profession through recertification. Recertification can include continued education and employment in a field, payment of recurring fees, the accumulation of continuing education hours, and/or retesting (Barnhardt, 1997). Recertification can require an
individual to hold active membership within a professional organization through repayment of membership fees, meeting professional development criteria, and retaking and passing the profession’s certification exam. A time limit is placed on certain certifications and it is understood that not honoring the commitment to recertify will result in expiration or loss of the certification (Hale, 2000).

**Development of Certification Programs**

According to Hale (2000), the main purpose behind the development or adoption of certification exams by organizations is to protect the safety, health, and welfare of workers or the public. She also states that other reasons to adopt or develop certification programs are to enhance stature of a role or position, promote continuous improvement, increase productivity, and maintain employee skills and knowledge. To develop a quality certification program, an organization or association must study and learn as much as possible about the certification development process. One oversight could damage the reputation of the profession, put the livelihood of all involved at stake, and the organization could have legal action taken against it (Hamm, 1996). Peluso (2000) suggests that when creating and maintaining a professional certification program you must have the proper plan, understand the different parts of the certification process, know the types of certification, and take into account all the costs of developing and marketing the program. When planning a professional certification exam the program’s potential benefits should be evaluated.

**Occupational Safety**

The discipline of safety and health is not fixed; it evolves with advancement of industrial technology and as an area of public policy, it changes with each new presidential administration and each shift in congressional priorities (Blosser, 1992). These changes are
observed better when addressing the history of health and safety and its effects on society. Occupational safety and health has an extensive history in the U.S., and the following section gives only a brief synopsis.

A Brief History

During the late 1800s modern transportation and communication made it possible to coordinate the production and selling of mass quantities of goods. These mechanized production processes enabled producers to take advantage of expanding markets and the potential for volume production (Ashford & Caldart, 1996). The first safety and health laws in the U.S. were enacted at the state level in the late 1800s. These laws addressed only a small number of workers in the most heavily industrialized states and only in special occupations, i.e., mining and railroading (Blosser, 1992). However, in 1904 worker fatalities on U.S. railroads reached an all-time high, with a rate of 28 per 10,000 employees, while the injury rate reached a high of 1 in 10 employees in 1916 (Gersuny, 1981). Railroading was safe compared to coal mining, whose mortality rate for workers’ was 48.1 per 10,000 workers in 1906 (Gersuny, 1981).

Muntz (1932) states that the achievements of modern industry unfortunately are marred by a startling casualty list. He goes on to say that one of the immediate effects of the industrial revolution, with its mechanization of industry, was a tremendous increase in the number of health and safety hazards faced by the worker. The Industrial Revolution changed the method of producing goods. During this period workers were replaced by machines and new methods for converting raw materials, and the organization of specialized work resulted in a division of labor (Goestch, 2005).
The first half of the century, from 1900-1945, was the period of formation for the U.S. industrial system. Many large corporations were created through a system of mergers and consolidations. Mass production methods were adopted, which in turn led to an increase in floor operators (Ashford & Caldart, 1996). The more the U.S. industrial sector grew, the more hazardous conditions became commonplace (Goestch, 2005). The increase in the mechanization of the workplace contributed to the spike in industrial injuries (Ashford & Caldart, 1996). Muntz (1932) refers to estimates from the National Safety Council (NSC) of over 18,000 fatal industrial injuries in 1928, 20,000 in 1929, and 19,000 in 1930. The NSC also reported approximately 2.5 million nonfatal accidents in 1930 (Muntz, 1932).

Industrial injuries were not the only safety and health-related issues of the time. Work related diseases, such as lung disease, heart and respiratory ailments, nerve disorders, radiation poisoning, exposure to inhalation hazards, and chemical exposure, also were taking their toll on workers (Ashford & Caldart, 1996). In the 1930s, during the Great Depression, public notice of health problems suffered by employees working in dusty environments was increased. The Hawk's Nest Tragedy (as cited in Goestch, 2005) was one of many cases that stimulated public awareness to occupational diseases. Mine workers were refused jobs when medical physicals revealed they had lung damage from breathing in high levels of silica (Goestch, 2005). The Great Depression resulted in lower workplace fatalities and injuries, but this was due to a lack of job availability (Ashford & Caldart, 1996; Gersuny, 1932). During World War II, there was a rapid growth of new industrial injuries because of the demand for wartime production and the millions of new workers entering the manufacturing economy (Ashford & Caldart, 1996).
Also in the 1930s, President Franklin D. Roosevelt began his New Deal program, which gave proponents of occupational safety and health the opportunity to advance safety and health standards as conditions for granting government contracts to private employers. These programs were dismantled during the late 1940s, as World War II came to an end and workers were left unprotected (Ashford & Caldart, 1996; Blosser, 1992). A variety of legislation was enacted to improve conditions for workers, such as the Walsh Henry Act of 1936, the Coal Mine Inspection and Investigation Act of 1942, and the Atomic Energy Act of 1954 (Blosser, 1992). Over time, safety awareness continued to grow and the federal government began to encourage the implementation and maintenance of a safe work environment (Goestch, 2005). During the 1950s a general push for workers’ safety and health began. Bills for uniform safety codes and mandatory standards for the safe use of hazardous materials in industry were introduced, but neither passed. However, the push for nationwide safety standards continued through the 1960s as concern for industrial injuries was raised (Blosser, 1992).

Legislation on worker safety and health was introduced in Congress in 1968, but was turned down. A Senate bill was introduced as the Occupational Safety and Health Act of 1969, proposing that the Department of Labor (DOL) be authorized to set standards, inspect workplaces, propose citations and fines for violations, and adjudicate employer challenges to those sanctions (Blosser, 1992; Donnelly, 1982). After amendments were made, the final compromise in December 1970 was to create a new agency within the DOL, the Occupational Safety and Health Administration (OSHA), to set and enforce standards; and a new independent panel, the Occupational Safety and Health Review Commission (OSHRC), to adjudicate challenges (Blosser, 1992; Goestch, 2005). Passage of the OSH Act of 1970
changed the basic institutional framework for addressing occupational health and safety problems in the U.S. (Ashford & Caldart, 1996). Other laws important to safety and health also were created, such as the Coal Mine Act of 1969, the National Environmental Policy Act, the Clean Air Act, the Federal Water Pollution Control Act, the Federal Mine and Safety Act of 1977, and the Emergency Planning Right-To-Know Act of 1986 (Ashford & Caldart, 1996; Blosser, 1992; Goestch, 2005).

**Current Safety Issues/Risks**

Despite the creation of a health and safety infrastructure, and other workplace safety and health-related laws, health and safety problems still persist. New concerns have been identified in emerging new eras of technology (Ashford & Caldart, 1996). New technologies introduce new occupational health and safety hazards (Parker, 2005). From the changes in the workplace due to emerging technological innovations, new workplace processes, and economic fluctuations, new and highly specialized occupations have emerged (Greene, 2005). The function of workplace safety is to evaluate, monitor, and mitigate hazards associated with new occupations (Greene, 2005). These new occupations are a potential threat to the safety and health of workers.

The materials that products are made from are more complex now. Metals and nonmetals used in technology bring their own potential hazards (Goestch, 2005). The emerging field of nanotechnology—the development of technologies based on the unique behavior of nanometer-scale structures, devices, and systems—currently is being used in industry today (Greene, 2005). According to NIOSH (as cited in Parker, 2005), the worldwide government investments in nanotechnology rose from $432 million annually in 1997 to $3 billion in 2003. Greene (2005) and Parker (2005) both referenced estimates from
NIOSH and the DOL that 2 million workers have been exposed to nanometer-diameter particles as research attempts to determine the hazard levels of exposure. Nanoparticles are very small, and smaller particles potentially are more hazardous than larger particles (Parker, 2005). The DOL also estimates (as cited in Greene, 2005) that in the next decade this growing field will require 2 million more workers.

Additionally, as industry processes change the safety concerns associated with these processes also change (Goestch, 2005). The National Safety Council (as cited in Roudebash, 2005) indicates that approximately 8% of all job deaths were caused by traumatic injuries involving being caught in, crushed by, or other hazardous contact with industrial machinery. Over the past 10 years the increase in automation, lasers, industrial robots, and other new technologies have introduced new safety and health problems in the workplace (Goestch, 2005, Roudebash, 2005).

Potential workplace safety risks and issues exist among industrial processes that do not involve new technology. The construction industry accounted for 20% of the gross domestic product from 1998 to 2002 in the U.S., and is the most costly in respect to worker safety and health (Wade & Davis, 2005). In 2002, the Bureau of Labor Statistics reported 5,524 fatalities for the year, with 1,121 of those occurring in the construction industry (Wade & Davis, 2005). Also, musculoskeletal disorders (MSDs) are a concern for workplace safety. Although technology has advanced industrial production techniques, manual material handling is still required on many jobs. In 2000, lower back injuries related to manual materials handling accounted for 467,235 lost workdays, and back sprains and strains account for 25.57% of the money spent in workers’ compensation each year (Townley, Hair, & Strong, 2005).
Whether it is new technology or older industrial processes, workplace safety is always a concern.

**National Association of Industrial Technology**

The National Association of Industrial Technology (NAIT) is the professional association responsible for promoting industrial technology in business, industry, education, and government; accrediting industrial technology programs in colleges, universities, and technical institutes; and certifying industrial technologists and recognizing their continued professional development (NAIT, 2006d). Industrial technology is a field of study designed to prepare technical- and/or management-oriented professionals for employment in business, industry, education, and government (NAIT, 2006d). Currently, 81 institutions are accredited by NAIT. There are 124 baccalaureate-level programs in 55 institutions and 135 associate-level programs in 29 institutions, with three universities accrediting both associate and baccalaureate level programs (NAIT, 2006a).

**History**

The field of industrial technology evolved from programs in industrial arts and vocational trade teacher programs (Strong et al., 1999). Post-World War II technology affected the growth of industrial productivity, and the demand for professional industrial personnel with higher education, technical skills, and leadership qualities increased (Strong et al., 1999). The success of the first four-year baccalaureate-level industrial technology program created a need for the profession to define industrial technology, develop standards for the curriculum, and apply the standards through an accreditation program (Strong et al., 1999). In 1965 and 1966, one meeting took place each year to set standards for the continued development of the industrial technology curriculum and promote the need for a formal
organization that could provide leadership educating people in technical management positions (NAIT, 1986; Strong et al., 1999). NAIT was formed at the third meeting, in 1967, to provide direction for the continuing development of the field of industrial technology, which prepares graduates for positions in industrial settings (NAIT, 1986; Strong et al., 1999). After being rejected in 1969, NAIT was approved for accreditation by the National Committee on Accrediting (NCA) from 1973 through 1982 (Strong et al., 1999). In 1989, NAIT received recognition from the U.S. Department of Education (USDE) for the accreditation of industrial technology programs. NAIT became unrecognized by USDE in 1994, when Congress changed the authorization to recognize accreditation agencies that received federal program support (Strong et al., 1999). NAIT currently is a member of the Association of Specialized and Professional Accreditors (ASPA), which operates in the U.S. to ensure that students in educational programs receive an education consistent with standards for entry into practice in their respective fields or disciplines (ASPA, 2006a, 2006b).

**Purpose**

As stated in NAIT’s constitution and bylaws, its purpose is to foster the improvement of industrial technology curricula in institutions of higher education. The Association shall serve the following objectives (NAIT, 2006f):

- To promote the establishment of curricula of Industrial Technology.
- To promote the establishment and maintenance of curricular standards designed to serve the best interests of industry and the profession.
- To provide opportunities for the study and discussion of all questions, issues, and problems related to curricula of Industrial Technology.
- To promote and sustain worthwhile research endeavors related to the curricula of Industrial Technology.
- To provide opportunities for collecting, developing, and disseminating information concerning Industrial Technology education among its members, industrial personnel, fellow educators, administrators, counselors, students, and laymen.
- To promote the goals and interests of the Association by cooperating with other national, regional, and local special interest organizations having related interests and goals.
- To develop and maintain a common understanding among its members, industrial personnel, fellow educators, and the general public of the unique and essential role of Industrial Technology education as a function of the total public educational system.
- To provide through an accreditation process for recognition of the attainment of appropriate standards for Industrial Technology programs (p. 1).

**Membership**

Membership is open to all individuals, firms, institutions, and organizations interested in promoting NAIT’s objectives. Currently, there are professional and student members at over 500 community colleges, universities, and companies throughout the United States (NAIT, 2006e). NAIT membership includes classifications of Professional, Retired, Student, and Organizational (NAIT, 2006e; Strong et al., 1999). NAIT is made up of Primary Divisions, Special Interest Divisions, and Focus Groups that contribute to the success of its programs and activities (NAIT, 2006c). There are four primary divisions in which membership is available: Community College and Technical Institute (CCTI), Industry, Student, and University. There are also five special interest divisions in which membership is optional: Electrical, Electronics and Computer Technology; Graphics; Manufacturing Systems; Safety; and Research (NAIT, 2006c). NAIT members can choose one primary division and designate two special interest divisions to participate in with their paid membership. Members also can join any of the four focus groups—Administration,
Construction, Distance Learning/Internet, and Management—depending on their interests (NAIT, 2006e). To apply for membership one must fill out an application and pay the membership fee associated with the classification.

**NAIT Certification Exam**

The primary purpose of the NAIT certification program is to provide recognition of the attainment of certain professional standards by industrial technologists. The authority and responsibility for certification through NAIT is established from its constitution, which gives the Board of Certification, an autonomous decision-making body, final authority for all certification decisions (NAIT, 2006b).

**History and Development of the NAIT Certification Exam**

The purpose of the NAIT Board of Certification, established in 1991, is to coordinate and conduct all of the certification activities of the association (Field & Rowe, 2001; NAIT, 2006b). Two thoughts provided the rationale to set up a program for certification by examination:

1. a group of professionals existed that were interested in certification, and
2. the examination results would prove beneficial to industrial technology baccalaureate-level programs (Field & Rowe, 2001).

The NAIT certification exam underwent the following four stages of initial development:

1. development of the exam specifications,
2. prototyping,
3. pre-testing, and
4. creating operational forms (Field & Rowe, 2001).
To develop the certification exam, the Delphi method was used to determine the subject areas on which the exam content should be based. This method identified eight exam content areas consistent with the course subject requirements for graduates of NAIT-accredited industrial technology programs (Field & Rowe, 2001). Copies of course listings and technical management core content areas were sent to all NAIT-accredited programs. The faculty, students, and advisory committees were asked to compare the courses offered in their programs to the listed content that was sent. A request was made to send all final exams, tests, and other questions that could be used on the certification exam, to give the NAIT Certification Board enough information to develop an examination meeting the accreditation guidelines (Field & Rowe, 2001). By the fall of 1993, discussion led to approval that the format of the exam should be three hours or less in length and open-book; cover the major concepts, theories, and problems related to the eight areas identified; and a panel of experts in each area convenes to review the potential exam content (Field & Rowe, 2001). Over the next two years the exam format changed to a closed-book exam with 200 multiple choice questions from six of the eight original content areas identified. In 1995, the exam was field tested on 60 examinees. Problem areas in the exam were detected from the field test, which resulted in the exam being reduced to four sections, 40 new questions added, and 80 questions deleted (Field & Rowe, 2001). The NAIT original certification exam was released in December 1998 (Field & Rowe, 2001; NAIT, 2006b).

Currently, the certification exam has undergone policy changes toward the development of a second generation certification exam. At the 2004 NAIT convention, the NAIT Board of Certification discussed changing the requirements for certification (NAIT, 2004). At the time graduates and faculty of NAIT-accredited schools were automatically
eligible for certification. The NAIT Board of Certification decided to change the policy to certifying individuals who took and passed the certification exam to add more value and validity to the exam (Monforton, 2005a). Also at the 2004 meeting, the NAIT Board of Certification discussed changing the criteria for passing the certification exam (NAIT, 2004). The decision was made to change the exam by requiring examinees to obtain a minimum score on the entire exam instead of on each of the four subsections (Monforton, 2005a).

The current NAIT certification exam contains 160 questions, 140 of which are from the initial certification exam and 20 replacement questions (Monforton, 2005b). The 20 replacement questions were added to cover new content areas to broaden the scope of the certification exam. This version of the NAIT certification exam was placed into use in the spring of 2005 (D.W. Field, personal communication, April 10, 2006). However, the replacement questions are not included when assessing examinees cumulative exam scores (Monforton, 2005b). The Board of Certification also has set goals for the second generation exam, which includes making the certification exam available online, having a larger question bank, and generating two specialty exams in the areas of Drafting/CAD and Manufacturing Technology (NAIT, 2005).

Eligibility

To be certified by NAIT one must have an industrial technology-related degree or an equivalent degree; teach or serve as an administrator in an industrial technology-related degree program; be employed professionally in a capacity related to the discipline of Industrial Technology; or have an academic advisor verify that the person is close to graduating with an A.S. or a B.S. degree. The candidate also must be a member of NAIT and take and pass the NAIT certification exam (NAIT, 2006b).
Currently there are two levels of NAIT certification: Certified Industrial Technologists (CIT) and Certified Senior Industrial Technologists (CSIT). The CIT certification is awarded for eight years and the CSIT is awarded for five years, if all renewal fees and membership dues are paid on time. The CIT certification is not renewable after eight years, but one can be recertified as a CSIT, if certain professional development criteria are met (NAIT, 2006b). During the initial certification period, 75 professional development units (PDUs) of continuing education activity must be completed and reported to NAIT to be eligible for recertification. After recertification as a CSIT, 75 PDUs must be completed and reported every five years to be eligible to be recertified as a CSIT (NAIT, 2006b).

**Delphi Method**

**History**

The Delphi method is a process of gathering and refining the opinions of experts to obtain consensus about some aspect of the present or future (Fischer, 1978). Delphi method also is used to obtain a structured communication process between groups of individuals that are dealing with a problem (Linstone & Turoff, 1975). Developed by the Rand Corporation in the early 1950s, this method was used first in 1953 by Dalkey and Helmer to forecast future developments for use in long-range planning by eliciting the opinion of experts through a series of questionnaires with controlled feedback (Linstone & Turoff, 1975; Fischer, 1978). During the early Rand experiments, Dalkey et al. (1972) found that the results of face-to-face group discussions were less accurate than the average of the groups’ individual opinions without discussion. He recognized that in face-to-face group discussion individuals were biased by the influence of dominant individuals, noise, and group pressure to conform. The Delphi method was developed to avoid these undesirable effects. The
person who dominated the group discussion, not necessarily the most knowledgeable, influenced others' opinions; most of the communication in the group dealt with individual interests and efforts to maintain the group, and some individuals conformed to the majority opinion of the more outspoken group members (Dalkey et al., 1972; Fischer, 1978).

When to use Delphi

Linstone and Turoff (1975) state the circumstance surrounding a group communication process is the best indicator of when the Delphi method is appropriate. They go on to say the Delphi method is needed when one or more of the following properties are present:

1. the problem can benefit from subjective judgments on a collective basis;
2. the individuals needing to address the issue do not have a history of adequate communication and may come from diverse backgrounds;
3. more individuals are needed than can interact effectively face-to-face;
4. the time and cost of frequent group meetings are infeasible;
5. the efficiency of face-to-face meetings can be increased by a group communication process;
6. disagreements among individuals are so severe that the communication process be mediated and/or anonymity assured; and
7. the heterogeneity of participants must be preserved to assure validity of the results.

Little’s study (as cited in Fischer, 1978) states that expert opinion must be used when there are several courses of action in the absence of an accepted body of theoretical knowledge.
Explanation of Delphi

The Delphi method was used first in defense research and was labeled as a forecasting procedure. Linstone and Turoff (1975) showed that the Delphi method could be applied in other areas when current data are not known or historical data are not available. It has been adapted subsequently for use in government, industry, academe, and many technologically-oriented corporations (Linstone & Turoff, 1975). Delphi procedures received a boost in general interest with the publication of Gordon and Helmer's study of forecasting technological events and the systematic use of expert opinion (Dalkey et al., 1972; Linstone & Turoff, 1975). Gordon and Helmer's study, together with a related philosophical paper, provided justification for the Delphi method and became the foundation for other individuals to experiment with the Delphi method in non-defense areas (Linstone & Turoff, 1975). Linstone and Turoff (1975) recognized the Delphi method existed in both conventional and real-time forms. In the conventional Delphi, a small monitor team develops a questionnaire to be given to a larger respondent group. After the questionnaire is returned the monitor team summarizes the results and develops a new questionnaire, based upon the results, from the respondent group. In the real-time Delphi, the small monitor team is replaced by a computer that has been programmed to compile the group results.

The Delphi method usually consists of two or more rounds characterized by anonymity, control of group response, and statistical group response (Dalkey et al., 1972; Linstone & Turoff, 1975). Anonymity is achieved by using questionnaires or other formal means of communication such as computers. Controlling the group's response is achieved by returning the summary of the group's opinions to the participants in a statistical group
response. Statistical response is a way to make sure all participants' opinions are represented in the final response (Dalkey et al., 1972; Fischer, 1978).

Each participant in the Delphi process receives a series of surveys, one per round. The same process for Delphi is used regardless of its various applications. The steps are (Fischer, 1978; Rowe, 2001):

1. Identify a panel of experts whose opinion would be valuable and explain the nature of the study.
2. Develop the survey (round one) of open ended questions to initiate the initial responses.
3. Obtain the responses from the participants, analyze the results, and prepare the next survey (round two) using the participants' responses.
4. Obtain the response to the survey (round two) from participants, analyze any new input by participants, and check if consensus has been reached.
5. If consensus has not been reached, repeat steps 3 and 4 using the participants' responses from each survey until consensus is reached.
6. When consensus has been reached, analyze the final input as a statement of group consensus and discontinue using the steps of the Delphi method.

Martino states (as cited in Rowe, 2001) that the procedures in the Delphi method can be modified by increasing or decreasing the number of rounds. Martino says further that when modifying the Delphi method one should maintain the three characteristics: (1) anonymity, (2) control of the group's response, and (3) statistical group response.
**Use in Other Disciplines**

This versatile method has been used in various disciplines to obtain group consensus. The Delphi method has been applied to other application areas, including: gathering current and historical data, examining the significance of historical events, evaluating budget allocations, exploring urban and regional planning options, planning university curriculum development, explaining the pros and cons of policy options, putting together the structure of a model, developing causal relationships in complex or social phenomena, distinguishing and clarifying real and perceived human motivations, and exposing priorities of personal values and social goals (Linstone & Turoff, 1975).

The following studies show how rankings have been used in the Delphi method to identify relevant topics and content to a discipline. Borko (Institute of Library Research) conducted a Delphi study (as cited in Fischer, 1978) to rate the importance of possible research projects for improving library information science and education. Borko grouped specific reports written by library science educators that identified problems in library science education and conducted a two-round study. His study asked participants to rank the items identified in the study by importance on a 100 point scale. From the ranking of the study Borko identified five groups based on priority rankings.

Philips, Anderson, and Ridl (2003) collaborated with five major care medical specialties to address the education of medical students about important issues related to women’s health. They gathered a ranking of topics to be used in developing a curriculum on Women’s Health Issues that defined objectives, tasks, skills, learning opportunities, and learning materials to educate medical students and resident physicians.
CHAPTER 3. METHODS AND MATERIALS

A Delphi method was proposed to determine if the safety portion of the NAIT certification exam is addressing the appropriate content. Participants were identified as the first step of the Delphi method. After identifying the participants, the first survey was created to determine the safety topics participants believe are important to technology students. The Round I survey then was sent to participants via email. After participants had provided feedback on the Round I survey and the information was analyzed, the Round II survey was created and emailed to participants. The Round II survey consisted of the safety topics listed from the Round I survey. The information from Round II was analyzed to establish if consensus has been reached. If consensus had not been reached, a Round III survey would be created and sent to participants via email. The Round III survey would address any new information added to the Round II survey by participants. Responses to the Round III survey would be analyzed to establish if consensus had been reached. If consensus had not been reached a new survey would be created from the new safety topics identified by participants and the process would repeat itself until consensus is reached.

Population and Sample

Martino suggests (as cited in Rowe, 2001) that participants for the Delphi method should be the most knowledgeable professionals in the field, who have been honored by professional organizations, published a number of papers, and/or held a professional office. Linstone and Turoff (1975) state the Delphi method can have as little as ten or more participants to complete its goal in obtaining consensus.

The participants selected for this study are all members of the Safety Division of NAIT. NAIT is a professional organization responsible for promoting industrial technology
in business, industry, education, and government (NAIT, 2006d). The Safety Division of NAIT is a special interest division that contributes to the overall success of the association’s programs and activities (NAIT, 2006c). Its mission is to carry out the purposes and objectives of NAIT as they apply to personnel employed in safety positions in education, industry, business, and government (NAIT, 2006c). Membership in the Safety Division of NAIT is not mandatory; one has to choose to serve NAIT in this manner. NAIT membership demonstrates a personal interest in the development of NAIT as an organization and voluntary membership in the safety division shows the participant’s personal interest in safety as it relates to NAIT.

Participants were informed about the study via email through the NAIT Safety Division list serve. The first survey, Round I, was attached to an email describing the intent and purpose of the study, the importance of participants’ feedback to this study, and the NAIT certification exam. Refer to Appendix A for a copy of the Round I survey and to Appendix B for a copy of the Round I survey letter. The Round II survey was attached to an email that reminded participants of the importance of their expertise to this study and thanked them for their participation. Refer to Appendix C for the Round II survey and to Appendix D for a copy of the Round II survey letter.

**Survey Development and Design**

The purpose of the Round I survey was to identify the safety topics that each participant believed to be important to all technology students and collect demographic information about each participant and their respective programs. The survey was created in Microsoft® Office Word 2003 using the forms template, which allows the field to expand as
a response is entered by each participant. Figure 3.1 contains the list of questions participants were asked on the Round I survey.

From the Round I survey each participant’s response to the safety topics important to all technology students were compiled together into a single list. The listed safety topics then were grouped into categories. The safety topics collected and categorized from the Round I results were used to construct the Round II survey, where these safety topics were listed in alphabetical order.

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**Figure 3.1: List of Round I Survey Questions**

What is your current academic position (check all that apply)?
- Assistant professor
- Associate professor
- Professor
- Lecturer/instructor
- Department chair
- Dean
- Other (please describe) ______________

In what areas are your primary teaching responsibilities?

What degrees and/or options are offered in your program?
Which of these degrees are NAIT accredited?

How many safety courses are required for your technology students?
What are the titles of these courses?

Please list and/or describe the core occupational safety content areas that you feel are important to all technology students in your program.

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Figure 3.1: List of Round I Survey Questions
The purpose of the Round II survey is to identify the safety topics that participants believe should be represented in the safety section of the NAIT certification exam. The Round II survey gave participants the opportunity to see the safety topics identified by participants from the Round I survey. Space was provided for participants to rank the safety topics they agreed should be represented on the NAIT certification exam and add any safety topics they felt were not represented in the Round I results.

The participants also were instructed to rank all safety topics on the survey by importance, including any safety topics that were added. For example, if one person felt only 25 of the safety topics were of importance, his/her rankings should be from 1 to 25.

Data Collection and Analysis

Before the Round I survey was distributed, the president of the Safety Division of NAIT was contacted, stating the purpose of this Delphi study and the importance of the division’s participation in this study. The president of the Safety Division was asked for an updated email list of all the current members, permission to distribute the survey to the Division, and permission to use his influence to show the importance of this study to the Divisions’ members. After gaining all permissions and a current email list, the Round I survey was distributed to the Safety Division in mid-April, 2005. Participants were asked to return the Round I survey within five days. After the first deadline had passed with little response the deadline was extended to early May, 2005.

The safety topics identified from the Round I survey were compiled into a single list. The listed safety topics then were analyzed and potentially combined into categories based on key terms found in each safety topic. For example, if the key term was “OSHA” then the
safety topics containing “OSHA” were examined and potentially combined into one category. The list of combined safety topics then was used to develop the Round II survey.

The Round II survey was emailed to the participant’s who responded to the Round I survey in early May, 2005. Participants were given a week to respond to the Round II survey. Individual email reminders were sent in mid-June to the Round I participants who had not responded to Round II. The email informed participants that the deadline to the Round II survey had been extended and reminded them of the importance of their participation to the outcome of the study. Participants indicated their desire to continue with this study by returning the Round II survey. Upon receiving and analyzing the Round II results, participants were contacted via email and asked to provide their credentials in the form of vitas in early August, 2005. See Appendix E for a copy of the letter asking participants to provide their credentials.

The Round II results were analyzed using Microsoft® Office Excel 2003. Some safety topics on the Round II survey were not ranked by participants because they did not agree that the safety topics should be represented on the NAIT certification exam. The participants’ individual rankings were placed next to the appropriate safety topic in the Round II survey and means were calculated to obtain the group’s mean rank opinion of each safety topic. The mean rank is the average of participants’ individual rankings based on the number of responses to each safety topic. The mean rank then was used to assign a priority order to each safety topic on the Round II survey. The priority order is the group’s rankings of each safety topic based on the number of participants’ responses, and is determined by the mean rank.
CHAPTER 4. RESULTS AND DISCUSSION

In this chapter the results from the Delphi rounds are discussed to identify the safety topics participants identified as important to the NAIT certification exam and to determine if changes in safety topics and curricula have occurred over time.

Description of Participant Sample

The participants for this study were the 53 members of the NAIT Safety Division. The participants in this study hold certifications with nationally known organizations, such as the Board of Certified Safety Professionals (BCSP), the National Association of Industrial Technology (NAIT), the Department of Labor, and the Occupational Health and Safety Administration. Aside from being active members of NAIT, participants also hold memberships in other professional organizations, such as the American Society of Safety Engineers (ASSE), the National Safety Council (NSC), and the American Society for Agricultural and Biological Engineers (ASABE). On average, each participant is involved in two or more professional organizations and holds two current certifications. Participants also have published and/or presented research in the areas of safety, health, and technology in peer-reviewed journals or books, or at professional conferences. Barnhart (1997) states that obtaining a certification in one’s field shows commitment and motivation to that profession, and those individuals who are certified are more involved in their profession and more aware of the constant changes in the profession.

Description of Survey Responses

Round I Survey

In the Round I survey, the participants were requested to list:

1. their primary teaching responsibilities,
2. the degrees, options, and/or minors offered in their programs, and whether the program was NAIT-accredited,

3. the required safety courses, and

4. the safety topics they believe are important to all technology students.

The Round I survey was emailed to the 53 members of the NAIT Safety Division. The response rate was 25%, for a total of 13 responses, 10 from academia and 3 from industry. Participants in educational positions teach in the following areas: occupational safety and health, fire safety, aviation safety, agricultural safety, manufacturing, industrial management, facility planning, industrial safety, manufacturing technology, environmental health, hazardous materials, and manufacturing technology. Industry participants have training experience in OSHA requirements and plant safety, and hold specialized positions in areas related to safety.

From the Round I survey, 35 degrees, options, and/or minors were listed as programs being offered at the institutions of participants who held educational positions. Degrees are programs in which credentials are assigned on a baccalaureate or masters-level. Options are programs that students choose to follow under a degree program, and minors are programs secondary to and separate from a degree program. Participants identified 24 degrees, 8 options, and 3 minors as programs offered at their institutions. Three of the 24 degree programs were masters-level programs. See Table 4.1 for the educational programs and accreditation status listed by category.
Of the 35 degrees, options, and/or minors, 14 programs held accreditations from NAIT, 8 were not NAIT-accredited, and 10 did not indicate if the programs were accredited by NAIT. Some colleges or universities offered more than one degree, option, and/or minor, in which one area of study was accredited and others were not. Also, of the 35 degrees, options, and/or minors, 14 degree programs required students to take 1 or more safety courses.

The Round I survey also contained a list of safety topics each participant believed was important to all technology students. The safety topics listed reflected some of the subject areas that participants currently teach and/or address in industry. When analyzing the Round I list of safety topics it was noticed that some were repeated by other participants'
responses. To obtain a combined list of safety topics that represented the group’s response to Round I, replication was removed and the safety topics were categorized.

First, the safety topics identified in the Round I survey were combined by grouping them into categories based on key terms found in each safety topic listed by participants. For example, if the key term was “management,” then all safety topics containing “management” were examined and potentially combined into that category. After the categories were formed based on key terms, the entire list of safety topics was analyzed to see if any other safety topics could be listed under the categories identified by this process. Some categories identified using this process was Hazard communications, Safety program management, and Construction safety. The Hazard communication category combined the following safety topics:

1. Hazard communication,
2. HAZMAT, and
3. Hazard communications regulation.

The Safety program management category combined these safety topics:

1. Overview of safety programs,
2. Safety and health countermeasure programs, and
3. Safety management/administration.

The Construction Safety category combined these safety topics:

1. Construction safety and
2. Construction safety fundamentals.

While analyzing the list of categories identified based on key terms, it was apparent there were safety topics listed that could be separated into its own separate category. To see
if other safety topics could be listed as a separate new category the entire list of safety topics was reanalyzed. Each time a new category was identified the entire list of safety topics was reanalyzed to determine if there were safety topics listed that could be found in that category. This resulted in some safety topics being listed under multiple categories. After each safety topic had been placed in the appropriate categories, the category was evaluated to determine if the title represented each list of safety topics. During this process safety topics were also added to categories identified by the first process. The final list of safety topics in the Hazard communications category was:

1. Hazard communication,
2. HAZMAT,
3. Hazard communications regulation, and

The final list of safety topics under the Safety program management category was:

1. Overview of safety programs,
2. Safety and health countermeasure programs,
3. Safety management/administration,
4. Overview of safety programs,
5. Shop safety,
6. Building safety, and
7. Overview of safety performance measures.

The final list of safety topics under the Construction safety category was:

1. Construction safety,
2. Construction safety fundamentals,
3. General safety and health concepts/terms,
4. Excavations,
5. Job site safety, and
6. Confined space.

As mentioned there were safety topics placed under multiple categories. Some examples of the safety topics are:

1. General safety and health concepts,
2. Development of safety policies and programs,
3. Machine guarding,
4. Confined space, and
5. Educational methods for safety.

To see the complete list of safety topics and categories from Round I, refer to Appendix F.

For the list of combined categories from the Round I survey, see Table 4.2.

**Round II Survey**

Items in the Round II survey were the participants’ opinions from the Round I survey. Applying the Delphi method in this portion of the study called for the data from the Round I survey to be gathered and analyzed, and the feedback presented to the participants. After analyzing the listed safety topics from the Round I survey, 30 safety topics were identified. The safety topics then were listed in alphabetical order in the Round II survey and emailed to participants. The participants then acknowledged and ranked the safety topics that they felt should be represented on the NAIT certification exam. They also were given the opportunity to add any safety topic(s) they believed should be included but were not represented on the Round II survey.
Table 4.2. List of combined categories from Round I Survey

<table>
<thead>
<tr>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accident investigation</td>
</tr>
<tr>
<td>Causes for injuries and/or incidents</td>
</tr>
<tr>
<td>Construction safety</td>
</tr>
<tr>
<td>Development of safety policies and programs</td>
</tr>
<tr>
<td>Emergency action plans</td>
</tr>
<tr>
<td>Emergency response</td>
</tr>
<tr>
<td>Employee involvement in safety programs</td>
</tr>
<tr>
<td>Engineering controls for hazards</td>
</tr>
<tr>
<td>Ergonomics</td>
</tr>
<tr>
<td>Fire safety</td>
</tr>
<tr>
<td>Hazard communications</td>
</tr>
<tr>
<td>Hazard identification, analysis, and assessment</td>
</tr>
<tr>
<td>Hazardous materials</td>
</tr>
<tr>
<td>Industrial hygiene</td>
</tr>
<tr>
<td>Injury prevention</td>
</tr>
<tr>
<td>Job safety analysis</td>
</tr>
<tr>
<td>Lifting techniques/back safety</td>
</tr>
<tr>
<td>Lockout/tag out</td>
</tr>
<tr>
<td>Machine guarding</td>
</tr>
<tr>
<td>Noise and vibration</td>
</tr>
<tr>
<td>OSHA rules and regulations</td>
</tr>
<tr>
<td>Personal safety</td>
</tr>
<tr>
<td>Process safety management</td>
</tr>
<tr>
<td>Record keeping</td>
</tr>
<tr>
<td>Safety attitudes</td>
</tr>
<tr>
<td>Safety inspection/audits</td>
</tr>
<tr>
<td>Safety program management</td>
</tr>
<tr>
<td>Safety training</td>
</tr>
<tr>
<td>Selection of PPE</td>
</tr>
<tr>
<td>Workers’ compensation</td>
</tr>
</tbody>
</table>
The Round II survey was sent to the 13 participants who had responded to the Round I survey. Ten participants, a 77% rate of return, responded to the Round II survey. Two participants ranked all of the safety topics, indicating they believed all of the items should be represented in the safety portion of the NAIT certification exam. The other eight participants agreed that one or more of the safety topics on the Round II survey were not important enough to be represented on the safety portion of the NAIT certification exam. One of these participants ranked some of the safety topics as tied, indicating they were seen as equal to one another. No safety topics were added to the Round II survey, indicating that participants believed all relevant safety topics were addressed in the original list.

**Analysis of Consensus**

From the Round II survey, participants were given the opportunity to add any safety topics they believed should be on the NAIT certification exam but were not represented on the survey, and remove any topics they believed should not be represented on the NAIT certification exam by not ranking them. After analyzing the responses of the Round II survey, all safety topics identified were assigned a ranking by participants in the study. Since all safety topics were ranked by two or more participants they were seen as important and were not removed from the list. It was concluded that participants had reached consensus that the safety topics on the Round II survey all were important enough to be represented on the NAIT certification exam. The 30 safety topics listed in the Round II survey were identified as important to the NAIT certification exam by participants. The list was compared to the safety topics currently being addressed on the NAIT certification exam to determine if the appropriate safety topics are being addressed. It was determined that the
safety topics on the current NAIT certification exam corresponds with the 30 safety topics identified in this study, indicating that the NAIT certification exam is addressing appropriate safety topics. See Table 4.3 for the list of safety topics identified in this study and the list of safety topics currently being addressed on the NAIT certification exam. See Appendix F for a complete list of safety topics and combined categories.

Some safety topics identified in this study are identical to the safety topics on the certification exam, such as Noise and vibration, Safety attitudes, Industrial hygiene, and Personal safety. Other safety topics can be categorized similar to those topics currently being addressed on the certification exam, for example, Safety program management was identified in this study and Developing safety policies and programs is a topic currently being addressed. Injury prevention in this study, corresponds to the Accident prevention topic on the current exam. This change represents an update in terminology. Similarities like these exist between the content on the NAIT certification exam and the safety topics identified by this study. There also were safety topics on the NAIT certification exam that were not listed by participants in this study, such as electrical hazards and appraising safety practices; however, these safety topics are embedded in the safety topics identified by this study.
<table>
<thead>
<tr>
<th>Topics Identified by this study</th>
<th>NAIT Certification exam topics</th>
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<td>Accident investigation</td>
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<td>Causes for injuries and/or incidents</td>
<td>Accident prevention</td>
</tr>
<tr>
<td>Construction safety</td>
<td>Appraising safety practices</td>
</tr>
<tr>
<td>Development of safety policies and programs</td>
<td>Developing safety policies and programs</td>
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<td>Emergency action plans</td>
<td>Electrical hazards</td>
</tr>
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<td>Emergency response</td>
<td>Employee safety training</td>
</tr>
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<td>Employee involvement in safety programs</td>
<td>EPA</td>
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<td>Hazardous materials</td>
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<td>Hazardous waste management</td>
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<td>Industrial hazards and their prevention</td>
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<td>Hazard identification, analysis and assessment</td>
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<td>Lifting techniques/back safety</td>
<td>OSHA</td>
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<td>Personal protection</td>
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<td>OSHA rules and regulations</td>
<td>Process hazards management</td>
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<td>Personal safety</td>
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<td>Vibration and noise</td>
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<td>Selection of PPE</td>
<td>Work hazards</td>
</tr>
<tr>
<td>Workers compensation</td>
<td>Workman’s compensation</td>
</tr>
</tbody>
</table>
Analysis of Participants Rankings

The participants’ responses were analyzed using Microsoft© Excel 2003. Each participant’s response to the Round II survey was placed next to each safety topic, the mean rank from each safety topic was calculated, and a priority order was assigned to that safety topic based on the mean rank response.

To determine how the group ranked each safety topic, the mean ranks of each safety topic were calculated. Each participant’s individual rankings were placed in Excel next to the appropriate safety topic from the Round II survey. The participants’ individual rankings then were averaged to obtain the group’s opinion of each safety topic and identified as the mean rank. The mean rank, or group’s opinion, was used to assign a priority order to each safety topic and the numbers of participants’ responses were placed next to it. Unranked safety topics in the Round II survey that were not assigned an individual ranking by participants were not included in calculating the mean rank of each safety topic because participants felt these topics were not important enough to be included on the NAIT certification exam.

Participants’ opinions on the safety topics identified in Round II varied. Participants’ opinions varied on the inclusion of safety topics, as well as, the importance of safety topics. Most participants left one or more safety topics unranked, which indicated that they felt the safety topic should not be included on the NAIT certification exam. However, no topics were unranked by all participants indicating that the topic should be excluded from the exam. Similarly, participants did not rank all safety topics which made determining the importance of each safety topic difficult. The groups’ opinion on the importance of all safety topics
could not be established for this reason. However, there were five safety topics ranked by all participants, indicating the group mutually agreed the following safety topics are important:

1. OSHA rules and regulations,
2. Hazard communications,
3. Lockout/tag out,
4. Ergonomics, and
5. Fire safety.

The participants' individual rankings for the five safety topics ranked by all participants show higher individual rankings assigned to the safety topics OSHA rules and regulations and lower individual rankings assigned to the other four safety topics, Hazard communications, Lockout/tag out, Ergonomics, and Fire safety. See Table 4.4 for the analysis of participants' responses to the Round II survey.

Because participants did not assign individual rankings to all safety topics in Round II, safety topics were placed in order of importance based on the number of participants' responses. To determine the importance of safety topics to the participants who ranked them, the mean ranks were used to place each safety topic in priority order. The numbers of participants' responses were used to group the safety topics together. Then the mean rank was used to assign a priority order to the group of safety topics. The safety topics then were placed in priority order by number of responses. Although the safety topics are placed in priority order, consensus on order of importance among all participants in the study was not reached concerning the priority order. See Table 4.5 for all safety topics listed in priority order by number of responses.
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<th>A3</th>
<th>A4</th>
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<th>A8</th>
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<th>I2</th>
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</table>

1 Participants in academia  
2 Participants in industry  
3 Average of participants' individual rankings by number of participants response  
4 Groups' rankings of safety topics by number of participants responses  
5 Number of responses to each safety topic
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<tr>
<th>Priority Order</th>
<th>Mean Rank</th>
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<td>Fire safety</td>
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<td>Process safety management</td>
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</table>

*a Group’s rankings of safety topics by number of participants responses

*b Average of participant’s individual rankings based on number of participant’s responses

*c Number of responses to each safety topic
CHAPTER 5. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to determine if the safety portion of the NAIT certification exam is addressing the appropriate content and make recommendations to the NAIT Board of Certification. The Delphi method was used in this study to identify the current safety topics important to all technology students. Ten participants identified 30 safety topics as being important enough to be represented in the safety portion of the NAIT certification exam. Participants were asked to rank safety topics by importance. However, all participants had assigned rankings to five safety topics indicating they agreed these five safety topics were important. These are the safety topics listed in priority order:

1. OSHA rules and regulations;
2. Hazard communications;
3. Lockout/tag out;
4. Ergonomics; and
5. Fire safety.

Although the five listed safety topics were ranked by all participants in priority order, they did not receive the highest rankings by the group. Safety topics that were left unranked by participants were not included in calculating the mean rank for the safety topics. This allowed safety topics with lower rankings and fewer responses to obtain lower mean ranks. The five safety topics assigned the lowest mean ranks are:

1. Causes of injuries and/or incidents;
2. Hazard identification, analysis, and assessment;
3. Engineering controls for hazards;
4. Employee involvement in safety programs; and
5. Injury prevention.

Though the mean ranks of these safety topics would suggest they are important, all participants did not rank them. By not ranking safety topics participants were indicating the safety topic is not important and should not be included on the NAIT certification exam. Eight participants did not assign rankings to one or more safety topics and consensus on priority order for all safety topics was not reached.

**Conclusions**

This study analyzed the safety topics of the NAIT certification exam and offers some insight into the significance of safety topics at the forefront of industry and academia. The findings of this study have determined that the 30 safety topics identified by this study are represented currently on the NAIT certification exam. These topics represent the current safety topics being addressed in academia and industry. This study has determined that the safety portion of the NAIT certification exam is addressing the appropriate content.

The following recommendations are made to the NAIT Certification Board based on the findings of this study:

1. update the terminology used on the safety portion in the current NAIT certification exam to reflect changes in the profession; and
2. examine the importance of the safety topics used on the certification exam.

**Recommendations for Future Research**

The NAIT Board of Certification should consider conducting more in-depth research on the importance of safety topics on the second generation exam. Another Delphi method can be used to determine the priority order of safety topics to be included on the NAIT certification
Identifying the priority order of safety topics would help NAIT identify those safety topics that are most important to the discipline. Research in this area would help NAIT determine questions to add to and/or remove from the certification exam. Research in this area would assist in evaluating the safety questions on the current exam and developing new questions for the next generation exam.

NAIT is in the development stages of the second generation exam (D. W. Field, personal communication, April 10, 2006), so this would be an appropriate time to conduct more extensive research to identify if the content within the safety topics has changed. This study is a beginning point for further research on the safety portion of the certification exam. Because it has been determined that the safety topics represented on the NAIT certification exam are both current and relevant, research can be conducted to define further the content of each safety topic identified in this study. Each safety topic identified in this study is comprised of other subtopics. Identifying the subtopics that are being addressed in business and industry would assist NAIT in further identifying safety content that is important. This would allow NAIT to ask more safety content related questions and develop more safety questions relevant to the certification exam. From this research the certification exam could achieve its goal of increasing the certification question bank.

NAIT also should look to other professional organizations with similar interests to participate in current research to develop new exam questions for the second generation exam or specialized certification exams. Students who graduate from industrial technology programs are employed in various technological careers, and seeking input from other technology-oriented professions could help NAIT identify other topics that may be of interest to its future examinees.
APPENDIX A: ROUND I SURVEY

Delphi Study: A Critical Evaluation of the Content Area Coverage for Safety in the NAIT

Please place all of your input to the questions below inside of the text boxes. Use as much space as needed to answer all the questions. Remember to save this as “Delphi.doc” and return to chhill@iastate.edu. Thank you for your participation.

1. What is your current academic position (check all that apply)?
   - Assistant professor
   - Associate professor
   - Professor
   - Lecturer/instructor
   - Department chair
   - Dean
   - Other (please describe) ________________

2. In what areas are your primary teaching responsibilities?

3. What degrees and/or options are offered in your program? Which of these degrees are NAIT accredited?


4. How many safety courses are required for your technology students? What are the titles of these courses?

5. Please list and/or describe the core occupational safety content areas that you feel are important to all technology students in your program:
APPENDIX B: ROUND I SURVEY LETTER

Introduction to Study

My name is Chandra Hill-Lott. I am an Industrial Technology M.S. student at Iowa State University. Under the direction of Dr. Steven Freeman (past-president of the NAIT Safety Division) and Dr. Dennis Field (chair of the NAIT Certification Board), I am conducting a Delphi study to (1) identify core content and subject areas for the safety section of the NAIT Certification Exam and (2) recommend an exam blueprint for safety topics for the next generation of NAIT certification exams. As a member of the NAIT Safety Division you have been included in this study because of your safety expertise and your interest in NAIT. Your feedback is important to the continued validity of the NAIT Certification Exam.

The current certification exam was initially developed during the early to mid-1990s. It is an ongoing process to ensure that the NAIT Certification Exam covers appropriate, current and relevant subject matter content. Curricula focus and content coverage expectations change over time and what is taught must be periodically reviewed and made available to ensure that the needs of industry are met.

A Delphi study was conceived as a way to obtain the opinion of experts without necessarily bringing them together face to face. All responses to this study are confidential. Please understand that you are under no obligation to participate in this study. Your participation in this study is voluntary and you may quit at any time.

This study is directed toward current members of the Safety Division of NAIT and will be conducted via email. The first round of this Delphi study is attached to this email message. There will be up to three additional rounds of this study based on the responses of the previous rounds. We hope that you choose participate in this study because your expertise is needed in to ensure that appropriate safety related content is part of the NAIT Certification Exam.

Please take a moment to give us your input. After completing the attached form, save the file as "Delphi.doc" and return it to chhill@iastate.edu. Please return this survey by April 20, 2005.

If you have any questions and/or concerns please contact Dr. Steven Freeman (sfreeman@iastate.edu or 515-294-9541), Dr. Dennis Field (Dennis.Field@eku.edu or 859-527-7856) or myself (chhill@iastate.edu). Thank you for you participation.

Chandra Hill-Lott, Graduate Assistant
Steven Freeman, Past-President, NAIT Safety Division
Dennis Field, Chair, NAIT Board of Certification
Mandara Savage, President, NAIT Safety Division
APPENDIX C: ROUND II SURVEY

Delphi Study: A Critical Evaluation of the Content Area Coverage for Safety in the NAIT

Round 2

Below are the results (in alphabetical order) that were given to us during the first round of this study. These are the safety issues that we were told were important for all technology students and thus should be represented in the safety section of the NAIT Certification Exam. For this round we are asking you to do two things, (1) if you agree that the item should be represented on the Exam indicated that by putting “yes” or “Y” in the second column. (2) The items that you agree should be represented on the Exam indicate a priority order in column three. Example: If you end up with 30 items that should be on the Exam, rank those items from 1-30 by importance. If there are additional topics that you think should be included write them in the space(s) provided at the bottom of the table. Remember to save this as “Delphi2.doc” and return to chhill@iastate.edu. Thank you for your participation.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Agree (Y/N)</th>
<th>Rank</th>
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<tbody>
<tr>
<td>Accident investigation</td>
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<tr>
<td>Causes for injuries and/or incidents</td>
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<td>Construction safety</td>
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<tr>
<td>Development of safety policies and programs</td>
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<td>Emergency action plans</td>
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<td>Emergency response</td>
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<td>Employee involvement in safety programs</td>
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<td>Engineering controls for hazards</td>
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<td>Ergonomics</td>
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<td>Fire safety</td>
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<td>Hazard communications</td>
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<td>Hazard identification, analysis and assessment</td>
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<td>Hazardous materials</td>
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<td>Industrial hygiene</td>
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<td>Injury prevention</td>
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<td>Lifting techniques/back safety</td>
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<td>Lockout/tag out</td>
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<td>Job safety analysis</td>
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<td>Machine guarding</td>
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<td>Noise and vibration</td>
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<td>OSHA rules and regulations</td>
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<td>Personal safety</td>
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<td>Process safety management</td>
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<td>Record keeping</td>
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<td>Safety inspections/audits</td>
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<td>Safety program management</td>
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<td>Safety training</td>
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<td>Selection of PPE</td>
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<td>Workers compensation</td>
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<td>Safety attitudes</td>
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Please place any additional topics not seen in the above table in the space provided below. Use as much space as needed.
APPENDIX D: ROUND II SURVEY LETTER

Introduction to Round II of Study

Again, my name is Chandra Hill-Lott. I am an Industrial Technology M.S. student at Iowa State University. Under the direction of Dr. Steven Freeman (past-president of the NAIT Safety Division) and Dr. Dennis Field (chair of the NAIT Certification Board), I am conducting a Delphi study to (1) identify core content and subject areas for the safety section (25%) of the NAIT Certification Exam and (2) recommend an exam blueprint for safety topics for the next generation of NAIT certification exams.

We would like to thank you for your participation in the first round of this study. This email contains the second round of this study. I hope that you would continue to participate in this study because your expertise is needed to ensure that appropriate safety related content is part of the NAIT Certification Exam.

Please take a moment to give us your input. After completing the attached form, save the file as "Delphi2.doc" and return it to chhill@iastate.edu. Please return this survey by May 17, 2005.

If you have any questions and/or concerns please contact Dr. Steven Freeman (sfreeman@iastate.edu or 515-294-9541), Dr. Dennis Field (Dennis.Field@eku.edu or 859-527-7856) or myself (chhill@iastate.edu). Thank you for your participation.

Chandra Hill-Lott, Graduate Assistant
Steven Freeman, Past-President, NAIT Safety Division
Dennis Field, Chair, NAIT Board of Certification
Mandara Savage, President, NAIT Safety Division
APPENDIX E: REQUEST FOR CREDENTIALS

Request for Vitas

I want to thank you for your continued support in this study concerning the NAIT Certification Exam. While I continue to work on this study I do need some additional information from you. At this time I will need a vita or curriculum vitae. This information will be used to verify your expertise and knowledge in the area of safety for this study. In your response to this email, please attach the file containing your vita or vitae. This information will not be shared and no identifying details will be published. Information from your vita will only be released in a summary format combined with the other respondents so that no individual's information can be identified. Thank you.

Chandra Hill-Lott
Graduate Assistant
Iowa State University
Ag & Biosystems Engineering
Industrial Education & Technology
219E I ED II
AMES, IA 50011-3130
515-294-1123 (fax)
# APPENDIX F: LIST OF COMBINED CATEGORIES FROM ROUND I

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<td>Overview of safety performance measures</td>
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<td>Accident investigation</td>
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<td>Inspections/audits/accident investigation</td>
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<td>Injury prevention</td>
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<td>Injury investigation &amp; reporting</td>
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<td>Noise and Vibration</td>
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Lockout/ tag out
Hazard communications
Engineering controls for hazards
Safety program management
Safety management/ administration
Safety & health countermeasure programs
Overview of safety performance measures
Overview of safety programs
Job safety analysis programs
Specific training to causes
Process safety management
Employee involvement in programs
Risk assessment as it relates to employee safety
Safety training
Educational methods for safety
General safety & health concepts/terms
Inspections/audits/accident investigation
Injury investigation & reporting
Safety inspections/audits
Record keeping
How to develop checklist
OSHA rules and regulations
OSHA standards applications to the workplace
Overview of safety and health regulations
Emergency response
Emergency action plans
Selection of PPE
Machine guarding
Fire safety
Lifting safety
Safety attitudes
Confined space

First responder fundamentals
Emergency response

Safety attitudes
Employee involvement in programs
Risk assessment as it relates to employee safety
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<td>Problem solving - hazard control process</td>
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Job safety analysis and programs
Specific training to causes
Overview of safety performance measures
Risk analysis and management
Safety inspections/ audits
Risk assessment as it relates to employee safety
Employee involvement in programs
How to develop a checklist

Lifting safety
General safety & health concepts/terms

Lockout/ tag out
Development of safety policies and programs
Machine guarding
OSHA standards application to the workplace
OSHA rules and regulations
General safety & health concepts/terms

Safety inspections/ audits
Confined space
Job site safety
Machine guarding
Noise and Vibration
Selection of PPE

Injury investigation & reporting
Inspections/ audits/ accident investigations
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Safety and health countermeasure programs
Safety program management
Hazard identification and assessment
Hazard identification
Hazard analysis

Process safety management
Overview of safety programs
Shop safety
Building safety
Safety and health countermeasure programs
Safety program management
Safety management/administration
Overview of safety performance measures

Machine guarding
OSHA standards application to the workplace
OSHA rules and regulations
Safety inspections/audits
General safety & health concepts/terms
Engineering controls for hazards
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Causes for injuries and/or incidents
Problem solving - hazard control process
Shop safety
Hazard analysis
Hazard identification and assessment

Safety Attitudes
Development of safety policies and programs
Personal safety
General safety & health concepts/terms
Safety training
Educational methods for safety
Employee involvement in safety programs
Safety management/administration
Safety programs management

Selection of PPE
Noise measurement and PPE

Workers Compensation Law
Overview of workers compensation
General safety & health concepts/terms

Safety Program Management
Machine guarding
Safety Attitudes
Selection of PPE
Workers Compensation
Safety of others
Safety training
Educational methods for safety
General safety & health concepts/terms
Incipient fire extinguisher training
Meetings
Job safety analysis programs
Specific training to causes

Safety management/administration
Safety program management
Inspections/audits/accident investigation
Injury investigation and reporting
Safety and health countermeasure programs
Accident investigation
Job safety analysis
Job safety analysis programs
Injury prevention
Development of safety policies and programs
Safety inspections/audits
Industrial hygiene

Record keeping
How to develop a checklist
Development of safety policies and programs
Emergency action plans
Safety and health laws
Legal issues
Overview of safety & health regulations
OSHA rules and regulations
Safety inspection/audits
Job safety analysis
Safety management/administration
Safety program management
Hazard communications

Safety Training
Accident Investigation
Record Keeping
Noise and Vibration
Noise measurement and PPE
General safety & health concepts/terms

Hazardous materials management
Handling of dangerous chemicals
Chemical safety
Materials safety
General safety & health concepts/terms

OSHA rules and regulations
Safety legislations/ regulations
OSHA standards applications to the workplace
Overview of safety & health regulations
Legal issues
Safety and health laws
Confined space
Development of safety policies and programs
Machine guarding
Selection of PPE
Emergency action plans

Emergency response
Overview of workers compensation
Workers compensation law
Record keeping
Safety inspections/ audits
Inspections/audits/ accident investigation
Fire safety
Safety training
Process safety management
Safety program management
Lockout/ tag out
Construction fundamentals
Hazard communications signs
Hazard communications
Construction safety
HAZMAT
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Hamm, M. S. (1996). What are the building blocks of good certification and accreditation programs? In M. A. Pare (Ed.), *Certification and accreditation directory: A descriptive guide to national voluntary certification and accreditation programs for professional institutions* (pp. xi-xiv). Detroit, Michigan: Gale Research.


